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The construction and evaluation of an inventory test in arithmetic for grade six

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Thesis

The Construction and Evaluation of an Inventory Test in Arithmetic for Grade Six

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INTRODUCTION

THE PURPOSE

The purpose of this study was to construct and evaluate an inventory test in arithmetic to be used at the beginning of the sixth grade.

JUSTIFICATION

There is a wide range in achievement in any classroom and in any area. Therefore, in order that a teacher may know, as early as possible, how to provide for the children within the group, an inventory test in arithmetic is a necessary teaching tool. According to the Alabama Course of Study:

> Teacher-made tests should be given during the first few days of the school year and other tests of increasing difficulty should be given during the year. It is well to devote the arithmetic period of several days to administer it.[1]

Brownell,[2] Wheat,[3] and Woody[4] have expressed a similar

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[1] Alabama Course of Study, Grades 1 - 12, Bulletin No. 8, (Montgomery, Alabama, 1954) p. 188

[2] William A. Brownell, "The Evaluation of Learning in Arithmetic," Sixteenth Yearbook of the National Council of Teachers of Mathematics, (New York: Bureau of Publications, Teachers College, Columbia University, 1941) p. 233

[3] Harry C. Wheat, "The Psychology and Teaching of Arithmetic," (Boston: D. C. Heath and Company, 1937) p. 529

[4] Clifford Woody, "The Arithmetical Backgrounds of Young Children," Journal of Educational Research, (26: October 1931) p. 201

opinion.

In addition to "indicating individual strengths and weaknesses,"[1] an inventory test may serve as a guide in the planning and organizing of an enriched program for those students who have achieved the requirements for that grade.

[1]Louis Beattie, "Standardized Tests in Arithmetic," Educational Method, (40: November 1939) p. 177

CHAPTER ONE

REVIEW OF LITERATURE AND RESEARCH

Greene, Jorgensen, and Gerberich remarked:

> Although standardized instruments for measuring achievement of school children have come into wide use, the examination constructed by the teacher still remains the most frequently used means of measuring the achievement of pupils.[1]

Nevertheless, it seemed worth while to the writer to construct an inventory test to check arithmetic work presumably covered at this point in the student's career. Especially at the beginning of the school year, elementary teachers are far too busy, it seems, to give adequate thought and time to preparing such an instrument to get their arithmetic program moving.

Today schools are trying more than ever before to prepare a generation which will be equipped with the tools necessary to face the responsibilities that will be entrusted to it when it has reached adulthood. Besides promoting good spellers and readers, our schools have a serious obligation to develop skilled mathematicians; i.e., boys and girls who can understand and manipulate numbers intelligently and efficiently. McSwain and Cooke have reported that "the expansion in technology, research, and

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[1]Harry A. Greene, Albert N. Jorgensen, and J. Raymond Gerberich, "Measurement and Evaluation in the Elementary School," (New York: Longmans, Green and Company, 1953) p. 161

business have greatly increased the value of mathematics in our society."[1] Dicky also commented upon the social value and significance of mathematics.[2] It must be accepted that mathematics as a tool is as important as any other material of the curriculum and that the basic facts and processes must be taught efficiently and sufficiently in the elementary grades. As Wilson and others pointed out:

> Ninety percent of adult figuring is contained in the four fundamental processes. Moreover, since these number facts are the basis for all calculations, they must be mastered thoroughly before additional instruction is given.[3]

If the modern school is expected to meet and conquer such a challenge as this, it should be clearly stated what is meant by instruction. Anderson and others define instruction as "a process of guiding and directing the experiences of children to the end that they learn."[4] It

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[1]Elridge F. McSwain and Ralph J. Cooke, "Understanding and Teaching Arithmetic in the Elementary School," (New York: Henry Holt and Company, 1958) p. 317

[2]John W. Dicky, "Readiness for Arithmetic," Elementary School Journal, (April 1940) p. 598

[3]Guy M. Wilson, Mildred B. Stone, and Charles C. Dalrymple, "Teaching the New Arithmetic," (New York: McGraw-Hill Company, Inc., 1939) p. 383

[4]G. Lester Anderson, Gertrude Whipple, and Robert Gilchrist, "The Psychology of Learning and Teaching Procedure," Forty-Ninth Yearbook of the National Society for the Study of Education, Part 1, (Chicago: University of Chicago Press, 1950) p. 337

will be agreed that to guide and direct children's experiences properly and effectively is not an easy or simple task. However, it is not an impossible duty for those concerned with education. John L. Clark writes:

> We must realize that learning is thinking. Successful thinking offers the best assurance of independence in meeting new situations. Be particularly interested in the learner's growth in maturity as well as in the correctness of his answers. Be as much concerned with his thinking as with his answers.[1]

It must be admitted that the arithmetic program is one of the areas in the school curriculum which definitely can be used to help the students develop self-reliance and confidence. Through education, especially through the arithmetic work, youngsters can learn how to cope with situations which may confront them later in life. Thus, one of the aims of education will have been mastered. As Dicky pointed out:

> A more recent definition of middle-grade arithmetic is in terms of concepts to be learned, skills to be mastered, and problem-solving ability to be acquired. This definition seems more functional. The focus of attention is primarily upon the learner. This definition places

[1] John L. Clark, "The Intangibles of Arithmetic Learning," The Arithmetic Teacher, (March 1956) p. 58

> major emphasis upon the process, and somewhat less emphasis upon the product learned. The teacher must "see both sides of the coin," the products and the processes. Our culture demands competency as well as interest in the personality of the pupil.[1]

Sharing this point of view are Buswell and others:

> Arithmetic is a series of related meanings, principles, and generalizations. And to the degree that we approach the teaching and testing of arithmetic with that point of view, to that same degree we raise the subject from the level of a series of arbitrary associations to the level of the higher mental processes.[2]

In view of the preceding statements, it must be concluded that the school's responsibility in regard to the teaching of arithmetic is definitely challenging as well as broad in scope, for as pointed out by Moser, "each child must promote from one level to another with success, ease, and proficiency."[3] In spite of the fact that the teachers are trying wholeheartedly to prepare skilled mathematicians,

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[1] John W. Dicky, "Comments on Middle-Grade Arithmetic," The Arithmetic Teacher, (February 1958) p. 37

[2] Gilbert T. Buswell, Maurice L. Hartung, and Vincent J. Glennon, Editors, "Testing Meanings in Arithmetic," Conference on Arithmetic, (Chicago: University of Chicago Press, 1949) p. 67

[3] Harold E. Moser, "Levels of Learning, Planning in Depth," The Arithmetic Teacher, (December 1956) p. 222

it seems, unfortunately, that there is yet much work in sight; for, as reported by Grossnickle[1] in a study of 288 firms representing 15 different industries in New York City, 55 percent of the firms complained that students do not demonstrate sufficient basic training in arithmetic. Wheat reports:

> It has been proved that more students fail in arithmetic than in any other subject in the elementary curriculum. Therefore, it is important that the children's arithmetic practices be checked early. Failures in arithmetic are cumulative. Each succeeding grade witnesses a larger number of failures than the grade preceding. The partial failure of a pupil in the primary grades usually turns out to be a complete failure in the intermediate grades.[2]

Moreover, Brueckner contends:

> Investigations of causes of pupil failure and retardation in the elementary school show that arithmetic is a subject that is extremely difficult for many students. Above the second grade, inferior work in arithmetic has caused more non-promotions than any other subject in the curriculum.[3]

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[1]Foster E. Grossnickle, "Dilemmas Confronting the Teacher of Arithmetic," The Arithmetic Teacher, (February 1954) p. 14

[2]Wheat, op. cit., p. 524

[3]Leo J. Brueckner, "Diagnosis in Arithmetic," Thirty-Fourth Yearbook of the National Society for the Study of Education, (Bloomington, Ill., Public School Publishing Company, 1935) p. 269

Of course, such reports led investigators to search for the reasons why students were failing and being retained because of arithmetic. According to Fernald, failures in arithmetic are due to "(1) inadequate number concepts, (2) insufficient skill in the fundamentals, and (3) inability to solve problems."[1] The writer also found a similar report entitled "Reasons Why Arithmetic Is A Disliked Subject" investigated by Brown. The reasons found and reported were "(1) lack of understanding, (2) dissociation of mathematics from life situations, (3) pages of word problems, and (4) fear of making mistakes."[2]

It was stated in the preceding reports that partial and complete failures in arithmetic are caused by "lack of understanding." In view of this information, investigators wanted to know what seemed particularly troublesome for the students. In a study conducted by Buswell and John, it was found that "errors in the combinations headed the list for each of the four operations."[3] Undoubtedly, such a weakness is traceable to what Wilson, Stone, and Dalrymple

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[1]Grace M. Fernald, "Remedial Techniques in Basic School Subjects," (New York: McGraw-Hill Book Company, 1943) p. 217

[2]Francis R. Brown, "Arithmetic - Friend or Foe," The Arithmetic Teacher, (February 1957) p. 8

[3]Gilbert T. Buswell and Lenore L. John, "Diagnostic Studies in Arithmetic," Supplementary Educational Monograph, No. 30, (Chicago: University of Chicago Press, 1926) p. 136

have observed.

> One of the greatest weaknesses of the work in arithmetic is the failure constantly to follow up on processes after they have been taught.[1]

Sharing a similar point of view are Clark and Eads.[2]

On the other hand, Rappaport contends:

> ...administrators, supervisors, and teachers should have a clear understanding of the basic meanings in arithmetic, and that these should be clearly stated in courses of study, curriculum guides, and outlines, that teachers should motivate, stimulate, and create a learning atmosphere in which pupils discover for themselves the meanings in arithmetic, that children need much practice to do accurate work but this should come AFTER meanings have been developed and not before - in other words, MEANINGFUL PRACTICE instead of meaningless drill.[3]

Moreover, as revealed by Hamilton:

> We have long known that a basic goal in a good program in arithmetic is to help children develop the ability to do quantitative thinking. Such a program gives attention to meaning and understanding and teaches arithmetic as a closely knit system of ideas, principles, and processes. It gives

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[1] Wilson, Stone, and Dalrymple, op. cit., p. 384

[2] John R. Clark and Laura K. Eads, "Guiding Arithmetic Learning," (Yonkers-on-Hudson, New York, World Book Company, 1954) p. 252

[3] David Rappaport, "Understanding Meanings in Arithmetic," The Arithmetic Teacher, (March 1958) p. 99

> close attention to the number system and to relationships inherent in the system. This by necessity, means a continuous and systematically organized course at all grade levels.[1]

In view of what has been investigated and reported, it seems apparent that "lack of understanding" is primarily due to MEANINGLESS drills. To quote Wilson once again:

> Mental discipline as an excuse for mastery of tasks poorly understood has been studied experimentally, and found wanting. The child does better thinking, concentrates better, and develops better attitudes when he sees the value of what he is doing.[2]

A result that has also frequently emerged from meaningless drills is stated by Van Engen.

> Little is known about the damage that has been done to the emotional stability of children because arithmetic teaching has been mistakenly preoccupied with the rapid attainment of the ends of learning.[3]

How is mastery going to be achieved? According to Anderson and Gates:

> Attaining mastery and efficiency is essentially a matter of reducing the probability of incorrect responses, or, conversely, of increasing the

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[1]Jean F. Hamilton, "Remedial Arithmetic in the Regular Classroom," School Science and Mathematics, (March 1956) p. 202

[2]Guy M. Wilson, "Toward Perfect Scores in Arithmetic Fundamentals," The Arithmetic Teacher, (December 1954) p. 16

[3]H. Van Engen, "Teaching the Mathematical Skills in the Elementary School," Progressive Education, (October 1951) p. 18

> probability that in a given situation where a given learned response should be forthcoming that this learned response will be the one elicited.[1]

Risden maintains a similar opinion:

> What is wrong with school arithmetic, is too little understanding, too little use of the higher mental processes, too much finding answers, not enough finding "how much" and "how many," too much repetition of someone else's generalization and not enough opportunity to experience, to abstract and to generalize for oneself.[2]

Because of the fact that many loopholes and weaknesses were found in arithmetic programs, committees were organized to find "ways and means" which would improve the teaching and learning processes. The studies were numerous and the findings were reported in periodicals and other professional magazines. An approach suggested is one submitted by Spear. The plan recommends the following steps:

> (1) Let us build an extensive mathematical vocabulary at each grade level.
> (2) Let us teach our students to estimate measurement with a high degree of accuracy.
> (3) Let us present something new and challenging in mathematics everyday.
> (4) Let us teach our students to solve problems with and without such mediums as chalk and pencil.

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[1] Lester Anderson and Arthur I. Gates, "The General Nature of Learning," Forty-Ninth Yearbook of the National Society for the Study of Education, Part 1, (Chicago: University of Chicago Press, 1950) p. 19

[2] Gladys Risden, "What is Wrong with School Arithmetic?" Mathematics Teacher, (October 1953) p. 410

> (5) Let us help our students to develop their maximum degree of accuracy by grading meticulously each lesson which they prepare.[1]

The above plan is closely akin to what Hildreth maintains:

> In schools where these psychological learning principles are adhered to the teaching of arithmetic, the results are bearing fruit. Children are more interested in the work, they can do problem-solving earlier and with better results than ever before, they can use arithmetic with fuller understanding.[2]

In spite of the fact that sound psychological principles are used in the teaching of arithmetic, the teacher's attitude and interest in the subject highly determine what learning will take place, for it is known that students respond in conjunction to the teacher's point of view. As stated by Rappaport:

> The role of the teacher has become one of motivating and stimulating the child to discover the meanings in arithmetic. Instead of requiring the child to follow set patterns the teacher provides a learning situation in which the child gains insight and understanding.[3]

Many other sources consulted share a similar point of

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[1]Margaret Spear, "Five Ways to Improve Arithmetic Instruction," The Arithmetic Teacher, (February 1956) p. 30

[2]Gertrude Hildreth, "Principles of Learning Applied to Arithmetic," The Arithmetic Teacher, (October 1954) p. 5

[3]Rappaport, op. cit., p. 96

view. Spencer and Brydegaard,[1] Weaver,[2] Hildreth,[3] and Seeger[4] are in agreement with Rappaport's opinion.

Although teachers may maintain a wholesome attitude and interest for the improvement and teaching of the arithmetic program, there is still the matter of the pupil's ability to grasp the concepts to be considered. As pointed out by Grover:

> The necessary adjustment is particularly difficult in the teaching of arithmetic. It is believed by some psychologists that facility with numerical relationships is a special ability and that satisfactory progress in mathematics is not only dependent upon general intelligence and previous preparation, but upon this SPECIAL ABILITY as well.[5]

Moreover, as reported by Hamilton:

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[1] Peter L. Spencer and Marguerite Brydegaard, "Building Mathematical Concepts in the Elementary School," (New York: Henry Holt and Company, 1952) p. 43

[2] J. Fred Weaver, "Some Areas of Misunderstanding About Meaning in Arithmetic," Elementary School Journal, (September 1950) p. 36

[3] Hildreth, op. cit., p. 2

[4] Raymond Seeger, "Teaching the Three A's in Elementary Mathematics," The Arithmetic Teacher, (February 1957) p. 25

[5] C. C. Grover, "The Rate of Progress of Pupils in Arithmetic in the Elementary School," Mathematics Teacher, (January 1951) p. 7

> About 80% of the children in need of remedial instruction in our regular classrooms are children of normal or above normal intelligence. Many of them are gifted children who are working just at grade level but far below their innate capacity.[1]

From the preceding remarks, it will be agreed that Wheat's conclusion is justifiable.

> So much depends upon continuous travel over the main road that the pupil must usually be taken back to the point of original departure before he can be set moving again in the right direction.[2]

Brownell maintains that a sound arithmetic program is "primarily concerned with its contributions to intelligent and successful living in social, economic, and cultural situations."[3] Junge points out that one of the problems involved in this program is "recognition of individual differences, which is not an easy matter."[4] Hamilton states:

> A teacher who recognizes the fact that pupils in her classroom need remedial help should be COMPLIMENTED, because, to help a child overcome a deficiency,

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[1] Hamilton, op. cit., p. 198

[2] Wheat, op. cit., p. 524

[3] William A. Brownell, "Meaning and Skill - Maintaining the Balance," The Arithmetic Teacher, (October 1956) p. 134

[4] Charlotte Junge, "The Gifted Ones - How Shall We Know Them," The Arithmetic Teacher, (October 1957) p. 144

> it must first be recognized as a deficiency.[1]

In view of this fact, it seems that Esther Swenson's comment concerning children cannot be overemphasized:

> Children are different in their present status and rates of progress in learning arithmetic, just as they are different in height and weight and finger-prints.[2]

Buckingham states:

> Meet the child where he is. Don't meet him where you think he is. Know where he is. Don't meet him where he ought to be or where his mother says he is.[3]

Also stated by Hildreth:

> Where one repetition of a fact will suffice Child A, Child B will require a dozen repetitions and still be shaky on the fact or process. The facts about learning individual differences invalidate all learning programs that require the same performance standards of all at stated intervals.[4]

Hill maintains that "it is very difficult for students to learn arithmetic as numbers have so many meanings -

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[1]Hamilton, op. cit., p. 199

[2]Esther J. Swenson, "Rate of Progress in Learning Arithmetic," Mathematics Teacher, (February 1955) p. 70

[3]Burdette R. Buckingham, "When to Begin Teaching Arithmetic," Childhood Education, (May 1935) p. 341

[4]Hildreth, op. cit., p. 4

depending upon place value."[1] Brueckner and Grossnickle[2] report a similar conclusion. Grover states:

> The doctrine of individual differences is now generally accepted by educators and its implications are considered in the development of instructional programs in most schools. This doctrine assumes that there is a wide variation in ability, needs and interests among pupils; that these differences become greater as pupils progress through the grades, and that such differences in ability and interests necessarily result in wide variations in achievement in the various school subjects.[3]

It is accepted by educators that students are individuals, not only in personality but in ability to learn and progress. So, according to Jackson, "the first step in assisting the pupils is to diagnose tests to discover the types of examples and computational skills the child has difficulty doing."[4]

Weaver states:

> Diagnosis is not an end in itself. Rather, it is a means to more effective differentiated instruction. Only when we have diagnosed the difficulties and

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[1] Jane M. Hill, "Meaning in Arithmetic," The Arithmetic Teacher, (November 1957) p. 224

[2] Leo J. Brueckner and Foster E. Grossnickle, "Making Arithmetic Meaningful," (Philadelphia: The John C. Winston Company, 1953) p. 453

[3] Grover, op. cit., p. 7

[4] Humphrey Jackson, "Techniques for Drill in Arithmetic Fundamentals," Mathematics Teacher, (January 1956) p. 47

> determined the needs of children, quantitatively can we provide the kind of instruction designed to remedy those difficulties and meet those needs.[1]

Moreover, Buswell and John contend that:

> ...even though some time is required for the process of diagnosis, a greater amount of time can be saved in the teaching process since the teacher does not need to spend time in building up good habits of work which the pupil already possesses and she can avoid waste of time by focusing her teaching on the specific habits which need to be changed.[2]

To quote Weaver once again:

> Diagnosis is far more than a matter of showing the existence, if any, of quantitative trouble or difficulty. More importantly, it seeks to determine the specific place and nature of the cause, or reason for, an observed difficulty.[3]

Among other sources found to maintain a similar point of view were Hamilton,[4] Morton,[5] and Brownell.[6]

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[1] J. Fred Weaver, "Differentiated Instruction in Arithmetic: An Overview and A Promising Trend," Education, (January 1954) p. 303

[2] Buswell and John, op. cit., p. 132

[3] Ibid., p. 303

[4] Hamilton, op. cit., p. 205

[5] Robert L. Morton, "Teaching Children Arithmetic," (New York: Silver Burdett Company, 1953) p. 538

[6] William A. Brownell, "The Measurement of Understanding," Forty-Fifth Yearbook of the National Society for the Study of Education, Part 1, (Chicago: University of Chicago Press, 1946) p. 148

Thus, by locating the difficulties in the classroom and in the individuals, one of the best teaching aids has been attained. This point of view is also shared by Hickerson:

> Determining what children's abilities, knowledge, understandings, and attitudes are at the beginning of the school year should be just one part of the total evaluation program. In guiding children's learning experiences at any time during the year, the teacher should know (1) where the children were, (2) where they are, and (3) where they are going.[1]

It seems that under those conditions "the many uses of arithmetic will more easily fuse into the other school subjects," as expressed by Curtin.[2]

Then to accomplish one of the goals of the modern school as revealed by Spitzer, that is, "to locate the strengths and weaknesses of the pupils and to organize instruction so that all the aims of the arithmetic program can be taught,"[3] a testing program is undoubtedly indispensable. A testing program to locate the strengths and weaknesses in the students at the beginning of the school

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[1] J. Allen Hickerson, "Guiding Children's Arithmetic Experiences," (New York: Prentice, Hall Inc., 1952) p. 46

[2] James Curtin, "Arithmetic in the Total School Program," The Arithmetic Teacher, (December 1957) p. 235

[3] Herbert F. Spitzer, "The Teaching of Arithmetic," (Boston: Houghton Mifflin Company, 1954) p. 352

year is also advocated by Brueckner,[1] Wrightstone,[2] and the Alabama Course of Study.[3]

Brueckner and Grossnickle say that "an inventory test reveals the weak spots in the individuals, and those who have similar weaknesses can be grouped for instructional purposes."[4] Morton writes that tests furnish valuable information in that "(1) both the teacher and pupil know what the pupil knows and can do, (2) the information may result in significant changes in later teaching plans, and (3) the data tells whether the pupil is weak or strong and where weaknesses are."[5] Brownell,[6] Buckingham,[7] Burton,[8]

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[1] Brueckner, op. cit., p. 283

[2] J. Wayne Wrightstone, "Evaluating Achievement," Childhood Education, (February 1948) p. 253

[3] Alabama Course of Study, Grades 1 - 12, op. cit., p. 175

[4] Leo J. Brueckner and Foster E. Grossnickle, "How To Make Arithmetic Meaningful," (Philadelphia: The John C. Winston Company, 1947) p. 402

[5] Robert L. Morton, "Teaching Arithmetic in the Elementary School," (New York: Silver Burdett Company, 1939) p. 497

[6] Brownell, "The Evaluation of Learning in Arithmetic," op. cit., p. 225

[7] Buckingham, op. cit., p. 341

[8] William H. Burton, "The Guidance of Learning Activities," (New York: Appleton-Century-Crofts, Inc., 1944) p. 598

Barr and others[1] are in agreement that a sound evaluation program is of utmost importance in directing and guiding the students. The necessity for testing is therefore, the basis for sound teaching. Standard tests are extremely valuable. However, they do not always serve the purpose. Hickerson maintains this point of view:

> One of the major faults of standard tests is that the children who take them are confronted with computations that both test-makers and teachers know in advance are too difficult, no child is expected to get every item correct. Every child is expected to get some answers wrong and not to be able to do other computations at all.[2]

The teacher of the incoming sixth-graders, according to Spitzer, "must know what arithmetic concepts and skills the students have retained during the summer and what must be reviewed prior to introducing the work for the year."[3] According to Burton,[4] the modern school must attempt to have each child achieve up to the limits of his capacity. An inventory test should help to achieve these aims.

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[1] A. S. Barr, William H. Burton, and Leo J. Brueckner, "Supervision; Democratic Leadership in the Improvement of Learning," (New York: Appleton-Century-Crofts, Inc., 1947) p. 513

[2] Hickerson, op. cit., p. 41

[3] Spitzer, op. cit., p. 367

[4] Burton, op. cit., p. 588

Brownell defines an inventory test as an "evaluation most practicably undertaken (1) through testing programs in textbooks and manuals, (2) through prepared tests constructed according to the local course of study, and (3) through observations."[1] Greene, Jorgensen, and Gerberich describe an inventory test as "an instrument for use prior to instruction, as an aid to the teacher in keying his instruction to the background learnings, and levels of advancement of his pupils."[2] A similar opinion is maintained by Stokes:

> The informal test made by the teacher is better. She builds a test based on the materials she has taught. She tests for evidence in the achievement of outcomes she had in mind, when she designed a program of study for her children.[3]

Thus, it is for these reasons that the writer undertook the task of constructing and evaluating an inventory test to be used at the beginning of the sixth grade. It is intended to reveal the existing strengths and weaknesses as well as to help all those devoted to teaching in better planning and organizing an enriched sixth grade program.

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[1] Brownell, op. cit., p. 245

[2] Greene, Jorgensen, and Gerberich, op. cit., p. 47

[3] C. Newton Stokes, "Teaching the Meanings of Arithmetic," (New York: Appleton-Century-Crofts, Inc., 1951) p. 250

Such an instrument seemed of utmost value toward the improvement of education.

CHAPTER TWO

PLAN OF STUDY

The purpose of this study was to construct and evaluate an inventory test in arithmetic to be used at the beginning of the sixth grade.

In order to conduct this study it was necessary: (1) to prepare a guide to evaluate content materials, (2) to analyze curriculum guides, textbooks, and workbooks for content, (3) to prepare specific objectives to be met in the test, (4) to construct the instrument, (5) to obtain a population, and (6) to administer the instrument and evaluate it statistically.

THE GUIDE

A brief guide was prepared to be used to evaluate the curriculum guides, textbooks, and workbooks for content materials. Several outlines commercially prepared were selected, as such outlines closely follow the content presented in textbooks. This guide was necessary in order to avoid omitting any major phase of the problem, and to simplify the evaluation process. A copy of the guide that was constructed and used follows.

GUIDE

I. Number system

a - Reading numbers

b - Writing numbers

c - Meaning and place value of numbers and zero

II. Whole numbers

a - Addition

b - Subtraction

c - Multiplication

d - Division

III. Fractions

a - Common

b - Decimal

IV. Graph work

V. Measurement

VI. Roman numerals

VII. Vocabulary and terms

VIII. Problem solving

ANALYSIS OF PUBLISHED MATERIALS

Following the preparation of this guide, an examination and evaluation of curriculum guides, textbooks, and workbooks for content materials was undertaken. It was necessary to know precisely the amount of material which had been presented up to this point, for the instrument was being prepared to be used with children at the sixth grade level in any community. Following is the list of curriculum guides, textbooks, and workbooks examined in selecting the material for the test content.

COURSES OF STUDY:

"Arithmetic Curriculum for Elementary Grades," Sanford Public Schools, (Sanford, Maine, 1955)

"Arithmetic for Grades Four - Six," Newton Public Schools, (Newton, Massachusetts, 1950)

"Arithmetic for Kindergarten - Grade Three," Newton Public Schools, (Newton, Massachusetts, 1950)

"Arithmetic Guide for Kindergarten - Grade Eight," Palo Alto Unified School District, (Palo Alto, California, 1957)

"Course of Study, Grades One - Twelve," Approved by the State Board of Education, (Montgomery, Alabama, 1954)

"Curriculum Guide for Arithmetic," Springfield Public Schools, (Springfield, Missouri, 1954)

"Guide to Teaching Arithmetic, Kindergarten - Grade Seven," Minneapolis Public Schools, (Minneapolis, Minnesota, 1955)

"New Intermediate Manual," Cincinnati Public Schools, (Cincinnati, Ohio, 1957)

"New Primary Manual," Cincinnati Public Schools, (Cincinnati, Ohio, 1957)

"Teaching Guide, Kindergarten - Grade Nine," San Francisco Public Schools, (San Francisco, California, 1951)

TEXTBOOKS:

John R. Clark, Charlotte W. Junge, and Harold E. Moser, "Growth in Arithmetic, Book Five," (New York: World Book Company, 1956) 310 p.

_____, et al., "Growth in Arithmetic, Book Four," (New York: World Book Company, 1956) 310 p.

_____, et al., "Growth in Arithmetic, Book Three," (New York: World Book Company, 1956) 310 p.

Thomas J. Durell, Adeline P. Hagaman, and James H. Smith, "Arithmetic For Today, Grade Five," (Columbus: Charles E. Merrill Books, 1953) 313 p.

_____, et al., "Arithmetic For Today, Grade Four," (Columbus: Charles E. Merrill Books, 1953) 313 p.

Robert L. Morton, Merle Gray, Elizabeth Springstun, William L. Schaff, and Myron K. Rosskopf, "Making Sure of Arithmetic, Book Five," (New York: Silver Burdett Company, 1958) 398 p.

_____, et al., "Making Sure of Arithmetic, Book Four," (New York: Silver Burdett Company, 1958) 396 p.

_____, et al., "Making Sure of Arithmetic, Book Three," (New York: Silver Burdett Company, 1958) 396 p.

Jesse Osborn, Herbert F. Spitzer, and Adeline Riefling, "Exploring Arithmetic, Book Five," (St. Louis: Webster Publishing Company, 1957) 348 p.

_____, et al., "Exploring Arithmetic, Book Four," (St. Louis: Webster Publishing Company, 1957) 346 p.

_____, et al., "Exploring Arithmetic, Book Three," (St. Louis: Webster Publishing Company, 1956) 323 p.

David H. Patton and William E. Young, "How Numbers Work," (Syracuse: Iroquois Publishing Company, 1957) 367 p.

_____, et al., "Learning to Use Numbers," (Syracuse: Iroquois Publishing Company, 1957) 366 p.

_____, et al., "Meet the Number Family," (Syracuse: Iroquois Publishing Company, 1957) 340 p.

J. W. Studebaker, W. C. Findley, and F. B. Knight, "Number Stories, Book One," (Chicago: Scott, Foresman and Company, 1946) 157 p.

_____, et al., "Number Stories, Book Two," (Chicago: Scott, Foresman and Company, 1947) 251 p.

Harry C. Wheat, Geraldine Kauggman, and Earl R. Douglas, "Row-Peterson Arithmetic, Book Five," (Evanston: Row-Peterson and Company, 1957) 332 p.

_____, et al., "Row-Peterson Arithmetic, Book Four," (Evanston: Row-Peterson and Company, 1957) 316 p.

_____, et al., "Row-Peterson Arithmetic, Book One," (Evanston: Row-Peterson and Company, 1957) 210 p.

_____, et al., "Row-Peterson Arithmetic, Book Two," (Evanston: Row-Peterson and Company, 1957) 278 p.

WORKBOOKS:

C. Newton Stokes, Belle Adams, and Esther R. Unkel, "Arithmetic in My World, Book Five," (Boston: Allyn and Bacon, Inc., 1958) 128 p.

_____, et al., "Arithmetic in My World, Book Four," (Boston: Allyn and Bacon, Inc., 1958) 128 p.

_____, et al., "Arithmetic in My World, Book One." (Boston: Allyn and Bacon, Inc., 1958) 96 p.

_____, et al., "Arithmetic in My World, Book Three," (Boston: Allyn and Bacon, Inc., 1958) 128 p.

_____, et al., "Arithmetic in My World, Book Two," (Boston: Allyn and Bacon, Inc., 1958) 96 p.

ESTABLISHING THE AIMS

A careful and thorough survey of curriculum guides, textbooks, and workbooks to determine what material covered by all students was then undertaken. Marked differences, especially in the curriculum guides, were observed. Some material presented in the third grade in one school district is postponed until the fourth in another. Following, in outline form, is the list of facts and processes which were found to be common in all guides and so were included in the test.

1. Number system

   a - Reading and interpreting numbers up to a million

   b - Writing numbers up to a million, including the use of zero

11. Whole numbers

   Addition

   a - The addition facts

   b - Addition involving bridging and carrying

   c - Adding six addends of three figures

   d - Adding five addends of four figures

   e - Adding four addends of five figures

   f - Use of dollars and cents

   g - Terms: addends, sum

   h - Addition computation in problem solving

Subtraction

a - The subtraction facts

b - Subtracting four, five, and six place numbers with and without zeros

c - Subtracting in which borrowing and regrouping are required

d - Use of dollars and cents

e - Terms: difference or remainder, minuend

f - Subtraction computation in problem solving

Multiplication

a - The multiplication facts

b - Multiplying three and four number multiplicands by a three figure multiplier

c - Use of zero in both multiplicand and multiplier

d - Use of dollars and cents

e - Terms: multiplicand, multiplier, product

f - Multiplication computation in problem solving

Division

a - The division facts

b - Dividing four and five number dividends by a two figure divisor

c - Use of the apparent and non-apparent methods

d - Zero in the quotient

e - Three place quotient

f - Remainder in the answer

g - Use of dollars and cents

h - Terms: dividend, divisor, quotient

i - Division computation in problem solving

III. Common fractions

a - Fractional part of a group

b - Comparing fractions

c - Recognizing part of a group

d - Terms: numerator, denominator, proper fraction, improper fraction, mixed number, common fraction, terms of a fraction, lowest terms

e - Computation of fraction in problem solving

Addition

a - Adding like and unlike and unrelated fractions and mixed numbers

b - Sums which are in lowest terms

c - Sums which are equal to a whole number

d - Sums which are improper and must be changed to a mixed number and lowest terms

Subtraction

a - Subtracting like and unlike and unrelated fractions and mixed numbers

b - Subtracting a mixed number from a whole number

c - Differences which are improper and must be changed to a mixed number

d - Differences which are not in lowest terms

IV. Decimal fractions

a - Adding and subtracting tenths and hundredths and as part of a mixed decimal

V. Problem solving

a - One, two, and three step problems

b - Everyday situations involving addition, subtraction, multiplication, division, averages, time, weights, measures, and common fractions

VI. Graphs

a - Reading and interpreting a line and a bar graph

b - Using a table to determine averages

VII. Measurement

Linear

a - Inch

b - Foot

c - Yard

d - Mile

e - Perimeter

f - Area

Liquid

a - Pint

b - Quart

c - Gallon

Dry

a - Dozen

b - Peck

c - Pound

d - Ton

Time

a - Second

b - Minute

c - Hour

d - Day

e - Year

f - Century

VIII. Other terms: square, rectangle, triangle, and square measure

CONSTRUCTION OF TEST

The test items were constructed on the basis of the findings of the analysis just described. The plan was to develop an instrument which would reveal strengths and weaknesses and which could be easily administered and quickly corrected. In order to simplify the correcting, as many items as possible were set up objectively and all items had only one possible answer.

Before selecting the items included in the instrument, an initial test in the form of a power test was prepared. This test included all the concepts which had been introduced up to grade six. For example, the test had in the addition of whole numbers items of two addends, one in

which there was no bridging and another item involving bridging. There were also items of two, three, four, five, and six addends of two figures. This procedure was carried in all phases being checked. There were, in all, 487 items in the initial test. Therefore, in order to shorten the test, the writer did not include items covering each fact and process separately but items including several concepts; e.g., adding by bridging and carrying, subtracting fractions not changed to a mixed number or lowest terms. In this way, it was possible to have only 289 items in the test. This was considered a fair number to arrive at the purpose for which the instrument was being constructed. Roman numerals were excluded entirely as they seem to have very little social significance at the present time. Furthermore, each test section is set up in the forms of a power test; i.e., each item is of increasing difficulty. Thus, it was felt that the teacher could more accurately gauge the ability of the students.

DESCRIPTION OF TEST

Section A:

The first 180 items refer to the basic facts in addition, subtraction, multiplication, and division. It was felt that an inventory test given at the beginning of the school year should determine how well the facts are known. It is useless to present any further material unless the

facts have been relatively well mastered. Many writers in the field of arithmetic believe that a large percentage of failures in intermediate arithmetic are due to insufficient mastery of the basic facts.

Section B:

This part was divided into three categories: (1) Vocabulary, (2) Fundamental Knowledge, and (3) Bar Graphs.

Items 181-204, Vocabulary, were set up matching terms with definitions or statements. The vocabulary work was subdivided into three areas, the first are terms used in reference to whole number processes, next are terms used in the work of common fractions, and the last terms are in relation to measurement. Extra items in the matching questions eliminated all possibility of guessing.

Four questions, items 205-208, checked fundamental knowledge, the first two dealing with the understanding and interpretation of the number system, the last two requiring reading and writing of whole numbers to a million.

The last part of Section B includes questions requiring the reading and interpretation of bar graphs. The graphs compare favorably with those found in a regular arithmetic textbook. Item 211, "On Wednesday Sam did how many examples incorrectly?" was not meant to be a tricky question nor to be a check on reading power. It was prepared to determine how observant students taking the test were, for the answer

requires simply the addition of blank squares.

Section C:

This section has twenty-five items, the first twenty of which deal with material on time, weight, and measure and demand a "Yes" or "No" answer.

The second part involves finding the average of five different subject areas, from information tabulated in the form of a table.

Section D:

The line graph, a temperature record, was constructed to resemble those ordinarily found in a textbook. Three questions seemed sufficient to cover knowledge of this type.

The second part of this section has twelve examples, three for each of the four processes, addition, subtraction, multiplication, and division. Two of the subtraction examples contain zeros in the minuend only; the third has zeros in both minuend and subtrahand. The first of the multiplication examples has a zero in the multiplicand only, but the second has zeros in both the multiplicand and the multiplier. The third example involves the use of dollars and cents. All the division examples have a two figure divisor, and all require a three figure quotient. There were no three figure divisor example included, as this skill is ordinarily not introduced before grade six.

It will be noted that the twelve examples concerning

the four fundamental processes were constructed to check the maximum computational skill of beginning sixth graders. It was felt that if those items could be completed correctly, little review work would be needed. Then, too, the teacher could more easily divide the group for instructional purposes.

Section E:

The items in this section refer to work in the area of common and decimal fractions. The first five items are concerned with basic understandings of common fractions. It is believed that any student interpreting item 259 correctly must have a sound conception of common fractions.

The six addition and subtraction examples are either like, unlike, and unrelated. There were no items set up separately to be reduced (changed) to lowest terms, nor were there any improper fractions to be changed to a whole or mixed number. It was felt that these skills could be checked just as well in either the addition or the subtraction examples. Therefore, as in the examples related to the four fundamental processes, the items in this section were constructed to be a check on several concepts.

The work in the area of decimal fractions is also a check on what has presumably been learned by the students up to this point. However, as the bulk of decimal fraction work is presented in the sixth grade only, it was felt that

a simple review was all that was needed at this time.

Section F:

The last part of the instrument is a check to find out how well the students can solve twelve common problems. These were constructed to make use of the four fundamental processes, common fractions, time, and measurement and to include one, two, and three step solutions. As problem solving frequently presents a challenge to most students, it was felt that more emphasis should be placed on the one step procedure. For that reason, seven one-step problems were included. In this way a teacher is in a better position to evaluate the ability of the group. The complete test follows.

INVENTORY TEST

Section A

Addition:

1. $\begin{array}{r} 6 \\ +\,8 \end{array}$ 2. $\begin{array}{r} 9 \\ +\,6 \end{array}$ 3. $\begin{array}{r} 3 \\ +\,6 \end{array}$ 4. $\begin{array}{r} 7 \\ +\,2 \end{array}$ 5. $\begin{array}{r} 1 \\ +\,3 \end{array}$ 6. $\begin{array}{r} 4 \\ +\,5 \end{array}$ 7. $\begin{array}{r} 6 \\ +\,6 \end{array}$ 8. $\begin{array}{r} 8 \\ +\,9 \end{array}$

9. $\begin{array}{r} 7 \\ +\,3 \end{array}$ 10. $\begin{array}{r} 4 \\ +\,1 \end{array}$ 11. $\begin{array}{r} 7 \\ +\,8 \end{array}$ 12. $\begin{array}{r} 6 \\ +\,5 \end{array}$ 13. $\begin{array}{r} 5 \\ +\,1 \end{array}$ 14. $\begin{array}{r} 7 \\ +\,5 \end{array}$ 15. $\begin{array}{r} 5 \\ +\,2 \end{array}$

16. $\begin{array}{r} 4 \\ +\,3 \end{array}$ 17. $\begin{array}{r} 5 \\ +\,5 \end{array}$ 18. $\begin{array}{r} 6 \\ +\,7 \end{array}$ 19. $\begin{array}{r} 7 \\ +\,1 \end{array}$ 20. $\begin{array}{r} 5 \\ +\,8 \end{array}$ 21. $\begin{array}{r} 6 \\ +\,4 \end{array}$ 22. $\begin{array}{r} 2 \\ +\,2 \end{array}$

23. $\begin{array}{r} 4 \\ +\,7 \end{array}$ 24. $\begin{array}{r} 7 \\ +\,9 \end{array}$ 25. $\begin{array}{r} 1 \\ +\,1 \end{array}$ 26. $\begin{array}{r} 2 \\ +\,4 \end{array}$ 27. $\begin{array}{r} 3 \\ +\,8 \end{array}$ 28. $\begin{array}{r} 3 \\ +\,3 \end{array}$ 29. $\begin{array}{r} 6 \\ +\,1 \end{array}$

30. $\begin{array}{r} 9 \\ +\,9 \end{array}$ 31. $\begin{array}{r} 8 \\ +\,4 \end{array}$ 32. $\begin{array}{r} 5 \\ +\,3 \end{array}$ 33. $\begin{array}{r} 9 \\ +\,2 \end{array}$ 34. $\begin{array}{r} 1 \\ +\,9 \end{array}$ 35. $\begin{array}{r} 7 \\ +\,7 \end{array}$ 36. $\begin{array}{r} 4 \\ +\,4 \end{array}$

37. $\begin{array}{r} 3 \\ +\,2 \end{array}$ 38. $\begin{array}{r} 2 \\ +\,8 \end{array}$ 39. $\begin{array}{r} 9 \\ +\,3 \end{array}$ 40. $\begin{array}{r} 8 \\ +\,8 \end{array}$ 41. $\begin{array}{r} 4 \\ +\,9 \end{array}$ 42. $\begin{array}{r} 2 \\ +\,1 \end{array}$ 43. $\begin{array}{r} 1 \\ +\,8 \end{array}$

44. $\begin{array}{r} 6 \\ +\,2 \end{array}$ 45. $\begin{array}{r} 5 \\ +\,9 \end{array}$

Subtraction:

46. $\begin{array}{r} 4 \\ -\,1 \end{array}$ 47. $\begin{array}{r} 9 \\ -\,3 \end{array}$ 48. $\begin{array}{r} 8 \\ -\,5 \end{array}$ 49. $\begin{array}{r} 5 \\ -\,4 \end{array}$ 50. $\begin{array}{r} 2 \\ -\,1 \end{array}$ 51. $\begin{array}{r} 10 \\ -\,3 \end{array}$ 52. $\begin{array}{r} 7 \\ -\,4 \end{array}$

53. $\begin{array}{r} 9 \\ -\,2 \end{array}$ 54. $\begin{array}{r} 6 \\ -\,5 \end{array}$ 55. $\begin{array}{r} 8 \\ -\,7 \end{array}$ 56. $\begin{array}{r} 5 \\ -\,2 \end{array}$ 57. $\begin{array}{r} 4 \\ -\,3 \end{array}$ 58. $\begin{array}{r} 9 \\ -\,1 \end{array}$ 59. $\begin{array}{r} 6 \\ -\,2 \end{array}$

60. $\begin{array}{r} 7 \\ -\,6 \end{array}$ 61. $\begin{array}{r} 5 \\ -\,3 \end{array}$ 62. $\begin{array}{r} 10 \\ -\,5 \end{array}$ 63. $\begin{array}{r} 8 \\ -\,1 \end{array}$ 64. $\begin{array}{r} 9 \\ -\,7 \end{array}$ 65. $\begin{array}{r} 6 \\ -\,4 \end{array}$ 66. $\begin{array}{r} 3 \\ -\,2 \end{array}$

67. $\begin{array}{r} 5 \\ -\,1 \end{array}$ 68. $\begin{array}{r} 9 \\ -\,5 \end{array}$ 69. $\begin{array}{r} 3 \\ -\,1 \end{array}$ 70. $\begin{array}{r} 6 \\ -\,3 \end{array}$ 71. $\begin{array}{r} 9 \\ -\,4 \end{array}$ 72. $\begin{array}{r} 10 \\ -\,6 \end{array}$ 73. $\begin{array}{r} 7 \\ -\,1 \end{array}$

74. $\begin{array}{r} 10 \\ -\,4 \end{array}$ 75. $\begin{array}{r} 8 \\ -\,3 \end{array}$ 76. $\begin{array}{r} 9 \\ -\,6 \end{array}$ 77. $\begin{array}{r} 10 \\ -\,1 \end{array}$ 78. $\begin{array}{r} 9 \\ -\,8 \end{array}$ 79. $\begin{array}{r} 4 \\ -\,2 \end{array}$ 80. $\begin{array}{r} 10 \\ -\,2 \end{array}$

81. $\begin{array}{r} 6 \\ -\,1 \end{array}$ 82. $\begin{array}{r} 7 \\ -\,2 \end{array}$ 83. $\begin{array}{r} 10 \\ -\,7 \end{array}$ 84. $\begin{array}{r} 8 \\ -\,4 \end{array}$ 85. $\begin{array}{r} 7 \\ -\,5 \end{array}$ 86. $\begin{array}{r} 10 \\ -\,8 \end{array}$ 87. $\begin{array}{r} 8 \\ -\,2 \end{array}$

88. $\begin{array}{r} 7 \\ -\,3 \end{array}$ 89. $\begin{array}{r} 8 \\ -\,6 \end{array}$ 90. $\begin{array}{r} 10 \\ -\,9 \end{array}$

Multiplication:

91. $\begin{array}{r} 7 \\ \times\ 3 \\ \hline \end{array}$ 92. $\begin{array}{r} 6 \\ \times\ 9 \\ \hline \end{array}$ 93. $\begin{array}{r} 3 \\ \times\ 6 \\ \hline \end{array}$ 94. $\begin{array}{r} 1 \\ \times\ 4 \\ \hline \end{array}$ 95. $\begin{array}{r} 5 \\ \times\ 5 \\ \hline \end{array}$ 96. $\begin{array}{r} 6 \\ \times\ 4 \\ \hline \end{array}$ 97. $\begin{array}{r} 8 \\ \times\ 9 \\ \hline \end{array}$

98. $\begin{array}{r} 3 \\ \times\ 4 \\ \hline \end{array}$ 99. $\begin{array}{r} 1 \\ \times\ 2 \\ \hline \end{array}$ 100. $\begin{array}{r} 9 \\ \times\ 9 \\ \hline \end{array}$ 101. $\begin{array}{r} 4 \\ \times\ 7 \\ \hline \end{array}$ 102. $\begin{array}{r} 1 \\ \times\ 8 \\ \hline \end{array}$ 103. $\begin{array}{r} 7 \\ \times\ 7 \\ \hline \end{array}$

104. $\begin{array}{r} 4 \\ \times\ 5 \\ \hline \end{array}$ 105. $\begin{array}{r} 3 \\ \times\ 3 \\ \hline \end{array}$ 106. $\begin{array}{r} 9 \\ \times\ 2 \\ \hline \end{array}$ 107. $\begin{array}{r} 3 \\ \times\ 8 \\ \hline \end{array}$ 108. $\begin{array}{r} 6 \\ \times\ 6 \\ \hline \end{array}$ 109. $\begin{array}{r} 6 \\ \times\ 1 \\ \hline \end{array}$

110. $\begin{array}{r} 3 \\ \times\ 5 \\ \hline \end{array}$ 111. $\begin{array}{r} 2 \\ \times\ 2 \\ \hline \end{array}$ 112. $\begin{array}{r} 7 \\ \times\ 6 \\ \hline \end{array}$ 113. $\begin{array}{r} 6 \\ \times\ 5 \\ \hline \end{array}$ 114. $\begin{array}{r} 6 \\ \times\ 2 \\ \hline \end{array}$ 115. $\begin{array}{r} 1 \\ \times\ 9 \\ \hline \end{array}$

116. $\begin{array}{r} 4 \\ \times\ 2 \\ \hline \end{array}$ 117. $\begin{array}{r} 7 \\ \times\ 8 \\ \hline \end{array}$ 118. $\begin{array}{r} 8 \\ \times\ 5 \\ \hline \end{array}$ 119. $\begin{array}{r} 1 \\ \times\ 7 \\ \hline \end{array}$ 120. $\begin{array}{r} 1 \\ \times\ 1 \\ \hline \end{array}$ 121. $\begin{array}{r} 4 \\ \times\ 4 \\ \hline \end{array}$

122. $\begin{array}{r} 2 \\ \times\ 5 \\ \hline \end{array}$ 123. $\begin{array}{r} 8 \\ \times\ 8 \\ \hline \end{array}$ 124. $\begin{array}{r} 9 \\ \times\ 4 \\ \hline \end{array}$ 125. $\begin{array}{r} 3 \\ \times\ 1 \\ \hline \end{array}$ 126. $\begin{array}{r} 8 \\ \times\ 6 \\ \hline \end{array}$ 127. $\begin{array}{r} 5 \\ \times\ 1 \\ \hline \end{array}$

128. $\begin{array}{r} 9 \\ \times\ 7 \\ \hline \end{array}$ 129. $\begin{array}{r} 3 \\ \times\ 2 \\ \hline \end{array}$ 130. $\begin{array}{r} 8 \\ \times\ 4 \\ \hline \end{array}$ 131. $\begin{array}{r} 2 \\ \times\ 7 \\ \hline \end{array}$ 132. $\begin{array}{r} 5 \\ \times\ 9 \\ \hline \end{array}$ 133. $\begin{array}{r} 7 \\ \times\ 5 \\ \hline \end{array}$

134. $\begin{array}{r} 2 \\ \times\ 8 \\ \hline \end{array}$ 135. $\begin{array}{r} 9 \\ \times\ 3 \\ \hline \end{array}$

Division:

136. $4 \overline{)28}$ 137. $6 \overline{)48}$ 138. $2 \overline{)14}$ 139. $1 \overline{)9}$

140. $8 \overline{)72}$ 141. $5 \overline{)40}$ 142. $2 \overline{)12}$ 143. $7 \overline{)49}$

144. $3 \overline{)12}$ 145. $5 \overline{)30}$ 146. $6 \overline{)54}$ 147. $1 \overline{)4}$

148. $3 \overline{)18}$ 149. $1 \overline{)7}$ 150. $2 \overline{)10}$ 151. $3 \overline{)15}$

152. $2 \overline{)6}$ 153. $4 \overline{)36}$ 154. $2 \overline{)2}$ 155. $6 \overline{)42}$

156. $2 \overline{)8}$ 157. $5 \overline{)45}$ 158. $1 \overline{)2}$ 159. $6 \overline{)36}$

160. $3 \overline{)27}$ 161. $4 \overline{)32}$ 162. $8 \overline{)64}$ 163. $2 \overline{)16}$

164. $7 \overline{)63}$ 165. $1 \overline{)8}$ 166. $4 \overline{)24}$ 167. $2 \overline{)4}$

168. $9 \overline{)81}$ 169. $1 \overline{)5}$ 170. $5 \overline{)25}$ 171. $4 \overline{)20}$

172. $2 \overline{)18}$ 173. $3 \overline{)21}$ 174. $4 \overline{)16}$ 175. $3 \overline{)9}$

176. $5 \overline{)35}$ 177. $3 \overline{)24}$ 178. $1 \overline{)3}$ 179. $7 \overline{)56}$

180. $1 \overline{)6}$

Section B

Vocabulary:

Note: Match the number of the statement in Column B that completes the meaning of the statement in Column A. There are statements in Column B that you will not need to use.

	Column A	Column B
181. ___	Answer to an addition example	1 - dividend
182. ___	Answer to a subtraction example	2 - addends
183. ___	Numbers being added together	3 - minuend
184. ___	Answer to a multiplication example	4 - sum
185. ___	Number being divided	5 - multiplicand
186. ___	Top number in a multiplication example	6 - difference or remainder
187. ___	Answer to a division example	
188. ___	Top number in a subtraction example	7 - multiplier
		8 - divisor
		9 - product
		10 - quotient

• • •

189. ___	Number below the line in a fraction	1 - improper fraction
190. ___	Top number in a fraction	2 - like fractions
191. ___	A fraction which cannot be divided evenly by any number except one, is said to be	3 - common denominator
192. ___	A fraction whose numerator is larger than its denominator	4 - decimal fraction
193. ___	Fraction such as 2 1/2	5 - denominator
194. ___	Numerator and denominator of a fraction are known as	6 - proper fraction

195. ___ A fraction such as 3/5

196. ___ Before adding or subtracting unlike fractions you must change both denominators to

7 - mixed numbers

8 - numerator

9 - lowest terms

10 - terms of a fraction

11 - whole number

...

197. ___ Number to the right of the decimal point expresses

198. ___ Has four equal sides

199. ___ Distance around a rectangle

200. ___ Surface of a square or rectangle is measured in

201. ___ Has three sides

202. ___ Second number to the right of the decimal point expresses

203. ___ Its length is longer than its width

204. ___ Another name for the "surface" of a square or rectangle

1 - square

2 - rectangle

3 - tenths

4 - area

5 - triangle

6 - perimeter

7 - square measure

8 - hundredths

9 - proper fraction

10 - whole number

...

Fundamental Knowledge:

Note: If the statement is true write "Yes"; if it is false write "No" for each of the following:

205. Twenty-six means 2 ones and 6 tens. _____

206. Five thousand, four hundred, seventy four means 5 thousands, 47 tens and 4 ones. _____

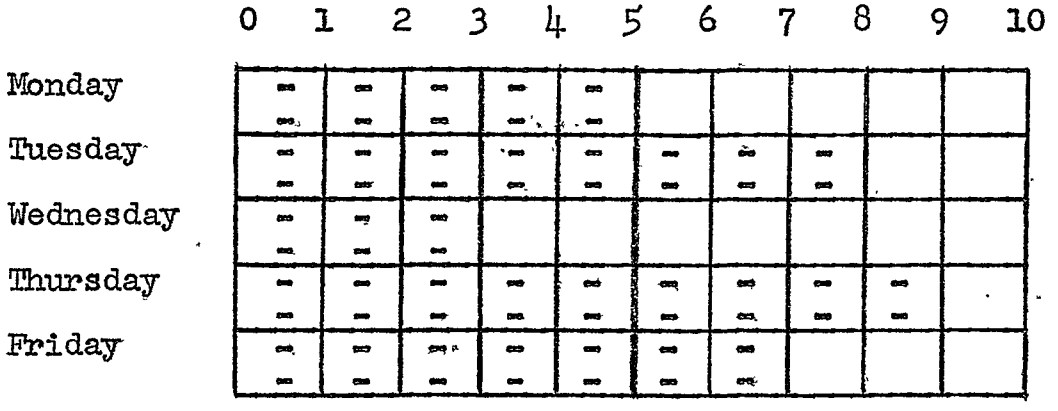
Write the following groups of words using numbers:

207. Two thousand, six hundred thirty three. _____

208. One million, nine hundred fifty thousand, six hundred seventy five. _____

•••

Bar Graph



Sam made a bar graph to show how well he did in arithmetic each day for the week of November 5 - 9. Write the answers in the blanks.

209. On Monday Sam had how many examples right? _____

210. How many examples did he have correct on Thursday? _____

211. On Wednesday Sam did how many examples incorrectly? _____

212. How many examples did he do incorrectly on Monday? _____

213. On what day did Sam do his best work? _____

214. On what day his poorest work? _____

•••

Section C

Time, Weights, Measures:

Note: If the statement is true write "Yes"; if it is false write "No" for each of the following:

215. _____ A quart is equal to two cups.

216. _____ A pint is half a quart.

217. _____ A foot has twelve inches.

218. _____ A gallon is larger than a quart.

219. _____ Twelve months make a year.

220. _____ Forty minutes make an hour.

221. _____ Sixty seconds make a minute.

222. _____ A nickel has half the value of a dime.

223. _____ A half gallon is equal to two quarts.

224. _____ There are eight pints in a gallon.

225. _____ Eighteen inches are equal to half a yard.

226. _____ A peck has four quarts.

227. _____ There are nine dimes in a dollar.

228. _____ Six articles make a dozen.

229. _____ There are fifty years in a century.

230. _____ There are 5,280 feet in a mile.

231. _____ Twenty three hours make a day.

232. _____ Two thousand pounds make a ton.

233. _____ Thirty three inches make a yard.

234. _____ There are fifteen ounces in a pound.

...

Finding Averages:

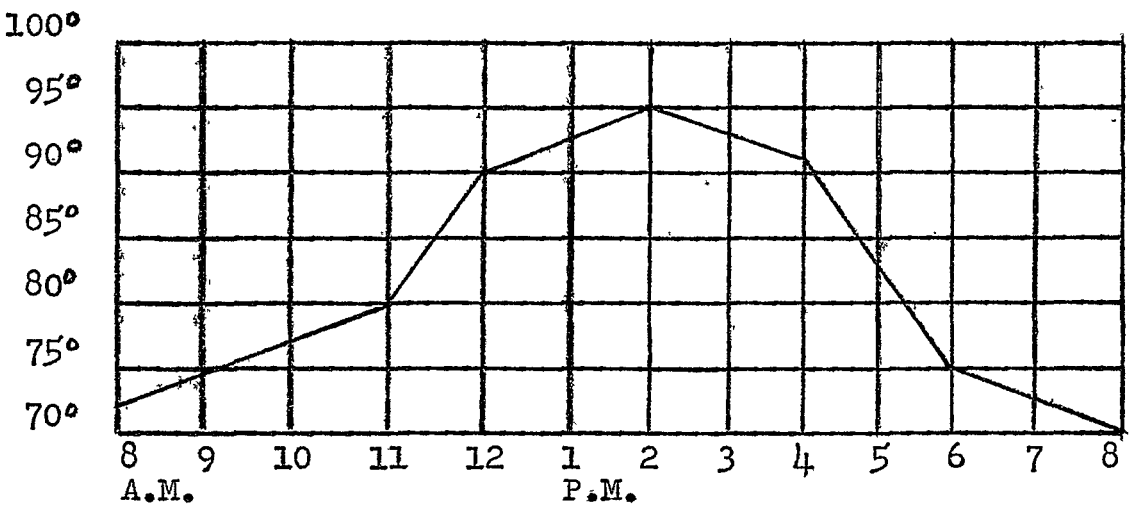
The following chart shows all the scores that Peter received in school for the week of October 4 - 8. Find Peter's average score for each subject. Write your answers in the last column.

	Mon.	Tues.	Wed.	Thurs.	Fri.	Ave.
235. Arith.	90	85	75	100	95	
236. Spell.	75	80	90	100	95	
237. Lang.	80	85	95	75	90	
238. Hist.	88	76	64	97	90	
239. Geog.	93	89	95	90	98	

...

Section D

Line Graph



Before the close of school last spring, Frank had studied line graphs and their importance. The weather man predicted that August 15th. would be a fine day for an

outing. The above graph shows the thermometer readings for that day.

240. What was the temperature at 9 A.M.? _____

241. By 2 P.M. the temperature had gone up to? _____

242. At what hours during the day was the temperature at 80°?

_____ A.M.

_____ P.M.

...

Fundamentals:

Note: Before returning your paper to your teacher, be sure that you have written the necessary commas, dollar signs, and decimal points.

Addition

243.
3746
8654
6136
7403
4784

244.
413
877
489
746
351
432

245.
$376.46
277.54
443.45
968.72

Subtraction

246.
4000
1367

247.
$200.00
84.59

248.
$4500.00
3707.28

Multiplication

249.
401
243

250.
5004
400

251.
$27.43
405

Division

252. 45) 15390

253. 25) $132.75

254. 17) $52.03

...

Section E

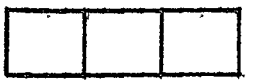
Fractions:

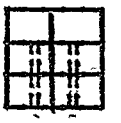
255. Circle the fraction which shows the larger part:

$$\frac{4}{5} \text{ or } \frac{7}{10}$$

256. Circle the fraction which shows the smaller part:

$$\frac{3}{8} \text{ or } \frac{1}{2}$$

257. Circle $\frac{1}{3}$ of the opposite box: 

258. The opposite box is divided into six parts; $\frac{\quad}{3}$ are shaded. 

259. Shade $\frac{2}{5}$ of the opposite box: 

Note: Be sure that all improper fractions have been changed to whole or mixed numbers and that all fractions have been reduced to lowest terms.

Addition

260. $\frac{2}{7} + \frac{3}{7} =$

261. $\frac{7}{12} + \frac{5}{12} =$

262. $6\frac{7}{10} + 3\frac{1}{10} + 4\frac{7}{10} =$

263. $\frac{1}{4} + \frac{1}{2} + \frac{1}{8} =$

264. $\frac{4}{5} + \frac{3}{10} + \frac{1}{2} =$

265. $21\frac{8}{9} + 14\frac{1}{6} =$

...

Subtraction

266. $\frac{7}{8} - \frac{3}{8}$

267. $33\frac{8}{9} - 24\frac{2}{9}$

268. $17\frac{1}{10} - 9\frac{9}{10}$

269. $\frac{5}{6} - \frac{1}{3}$

270. $25 - 7\frac{3}{8}$

271. $49\frac{1}{3} - 29\frac{3}{5}$

• • •

Decimal Fractions

Addition

272. .5 + .6 + .7 + .4

273. 50.01 + 14.84 + 19.82 + 37.68

Subtraction

274. 197.4 − 105.8

275. 123.64 − 97.86

• • •

Find the fractional part of the following:

276. $\frac{3}{8}$ of 240

277. $\frac{2}{5}$ of 655

• • •

Section F

Problem Solving:

Note: Read each problem carefully. Do the work and then write your answer in the answer column. Don't forget to put the necessary dollar signs and decimal points, feet and yards. Fractions must be reduced to lowest terms.

278. Betty made 36 cookies for the Scout Christmas party. If each guest is to receive four cookies, how many people will there be at the party? 278 _____

279. We know that Columbus discovered America in 1492. How many years ago did that take place? 279 _____

280. John worked 3 hours a day for 9 days. How much did he earn if he received $.50 an hour? 280 ____

281. Dick had a piece of board which was 47 inches long. He cut off a piece three feet long. How many inches were left? 281 ____

282. Joe bought twelve 15¢ post cards. How much change did he receive from a $5.00 bill? 282 ____

283. Frank spent 4 hours at the circus. What part of a day of 24 hours did he spend there? 283 ____

284. It is 4/5 of a mile from Don's house to the store and 1/3 of a mile farther from the store to school. How far is it from Don's house to school? 284 ____

285. What was the cost of 3/4 pound of candy that sold at 80¢ a pound? 285 ____

286. Mr. Brook's train was due at 9:50, but it was one hour and twenty minutes late. At what time did it arrive? 286 ____

287. Connie wants to put a fence around her 4H Club garden. She found that it was 10 feet long and 8 feet wide. How many yards of wire does she need to fence in her garden? 287 ____

288. The Clarks want to buy a new carpet for the living room. Cindy told her friends that the room was 15 feet long and 10 feet wide. How many square feet of carpeting do the Clarks need to cover their living room? 288 ____

289. "Grampa" Jones helped Mike make candles. They spent 23¢ for wax and 17¢ for cord. If they made 12 candles and sold them at 10¢ each, how much did they make on candle making? 289 ____

...

BACKGROUND OF TESTING

Community X, a city in the central section of Connecticut, has a population of approximately 25,000 citizens. The test consisting of 289 items was administered to 258 students in eleven classrooms representing diversified economic backgrounds and heterogeneous groups. The intelligence scores used were taken from the school records and were based upon the Otis Quick-Scoring Beta test, Form Fm. The range of intelligence quotients were from 141 to 70, with a mean of 102.4. The chronological ages ranged from 14 years, 3 months to 10 years, 6 months, with a mean of 11 years, 6 months.

PROGRAM OF TESTING

A preliminary trial of the test was made with a small group of students during the summer months to give some idea as to the approximate amount of time that would be needed to administer it and to check on completeness of directions. It was found that an hour and fifteen minutes was sufficient for a child of average ability.

During the week of September 15, 1958, the test was administered by the classroom teachers in six sittings to 258 students in Community X and the entire test consisting of 289 items. The tests were returned to the writer who corrected and analysed them. The results of the analysis are presented in the next chapter.

The enclosed letter was sent to each teacher who administered the tests. Although the teachers had received verbal explanations about the purpose of the test, it was deemed advisable to forward a letter giving further information and directions to aid in administering the test properly.

September, 1958

Dear Friend,

This inventory test for grade six was developed following a careful analysis of texts and courses of study. It includes material in all the basic skills up to grade six.

It is planned to aid teachers in arranging an arithmetic program based on the needs of the pupils.

The test may be administered in several sittings and can be easily completed within one week, as the approximate working time is seventy-five minutes. Use your judgment in the amount presented per sitting. However, pages 2 and 3 should be given at the same sitting.

Will you please return these tests to your supervisor along with a list of the I.Q. scores based upon the most recent test administered in your school system.

Will you also make sure that each student has properly completed the information on page 1.

Later in the fall I will send you an individual check list and a class analysis by way of a report.

Any comment concerning this series of tests is going to be deeply appreciated. In closing, I take this opportunity to thank you most sincerely for your generous cooperation.

Yours truly,

Harvey A. Savoie

ADMINISTRATING AND SCORING

Administrating:

In order not to take too much time from the regular arithmetic period, this inventory test may be given in six short sittings. The only information to be completed by each student is writing his/her name. The directions are clearly and plainly written for each section, and a note of caution is given to reduce the possibility of unnecessary errors; e.g., writing the dollar signs and decimal points, reducing to lowest terms, etc.

This inventory test is not a timed instrument. Those giving the test may lengthen the time element at their discretion. However, the following procedure is suggested by the writer for better results.

1st. Sitting - Page 1	(approximately)	7 min.
2nd. Sitting - Pages 2 & 3	"	15 min.
3rd. Sitting - Page 4	"	8 min.
4th. Sitting - Page 5	"	15 min.
5th. Sitting - Page 6	"	15 min.
6th. Sitting - Page 7	"	15 min.

Scoring:

As this is an objective test, there is only one possible answer, the one indicated on the answer sheet. Each correct item receives one point, the highest possible score being 289.

A check list was designed by the writer to help those using this test to keep individual records for later reference. This should eliminate the keeping of a stack of papers.

A lithograph copy of the test and check list used is to be found on the back cover.

CHAPTER THREE

ANALYSIS OF DATA

The purpose of this study was to construct and evaluate an inventory test in arithmetic to be used at the beginning of the sixth grade.

After giving and correcting the test papers, in order to determine whether the test had measured accurately what it was intended to measure, it was necessary to find: (1) means and standard deviation, (2) the split-half reliability coefficient, and (3) to compare the means of high and low scores for each item.

Table One shows the distribution of scores on the total test.

TABLE ONE

DISTRIBUTION OF SCORES

Intergral Limits - c.i.	Frequency - f.
280 - 284	4
275 - 279	13
270 - 274	9
265 - 269	21
260 - 264	22
255 - 259	21
250 - 254	29
245 - 249	24
240 - 244	27

Intergral Limits - c.i.	Frequency - f.
235 - 239	27
230 - 234	20
225 - 229	16
220 - 224	6
215 - 219	4
210 - 214	3
205 - 209	0
200 - 204	2
195 - 199	0
190 - 194	2
185 - 189	2
180 - 184	0
175 - 179	2
170 - 174	1
165 - 169	0
160 - 164	0
155 - 159	0
150 - 154	1
145 - 149	0
140 - 144	1
135 - 139	1

The scores ranged from 281 to 139, with a mean of 245.5 and a standard deviation of 22.25.

Table Two shows the number and the corresponding percent of correct responses for all items in the test.

TABLE TWO

NUMBER AND CORRESPONDING PERCENTAGE OF CORRECT RESPONSES

ITEM	NUMBER OF STUDENTS	PERCENTAGE
1	255	98.83
2	257	99.61
3	256	99.22
4	258	100.00
5	258	100.00
6	258	100.00
7	256	99.22
8	256	99.22
9	255	98.83
10	256	99.22
11	255	98.83
12	258	100.00
13	257	99.61
14	255	98.83
15	256	99.22
16	255	98.83
17	257	99.61
18	256	99.22
19	256	99.22
20	255	98.83
21	255	98.83
22	258	100.00

ITEM	NUMBER OF STUDENTS	PERCENTAGE
23	258	100.00
24	254	98.44
25	257	99.61
26	256	99.22
27	258	100.00
28	258	100.00
29	258	100.00
30	257	99.61
31	255	98.83
32	255	98.83
33	256	99.22
34	257	99.61
35	256	99.22
36	257	99.61
37	256	99.22
38	256	99.22
39	255	98.83
40	256	99.22
41	256	99.22
42	256	99.22
43	256	99.22
44	256	99.22
45	255	98.83
46	249	96.51

ITEM	NUMBER OF STUDENTS	PERCENTAGE
47	254	98.44
48	257	99.61
49	256	99.22
50	255	98.83
51	257	99.61
52	251	97.28
53	257	99.61
54	257	99.61
55	257	99.61
56	257	99.61
57	256	99.22
58	256	99.22
59	255	98.83
60	256	99.22
61	256	99.22
62	255	98.83
63	252	97.67
64	254	98.44
65	254	98.44
66	253	98.06
67	255	98.83
68	257	99.61
69	256	99.22
70	255	98.83

ITEM	NUMBER OF STUDENTS	PERCENTAGE
71	255	98.83
72	256	99.22
73	257	99.61
74	254	98.44
75	256	99.22
76	254	98.44
77	257	99.61
78	257	99.61
79	257	99.61
80	255	98.83
81	256	99.22
82	257	99.61
83	255	98.83
84	256	99.22
85	255	98.83
86	257	99.61
87	254	98.44
88	256	99.22
89	257	99.61
90	257	99.61
91	250	96.89
92	246	95.34
93	256	99.22
94	256	99.22

ITEM	NUMBER OF STUDENTS	PERCENTAGE
95	252	97.67
96	253	98.06
97	253	98.06
98	251	97.28
99	254	98.44
100	251	97.28
101	252	97.67
102	253	98.06
103	251	97.28
104	254	98.44
105	252	97.67
106	255	98.83
107	255	98.83
108	249	96.51
109	254	98.44
110	257	99.61
111	256	99.22
112	244	94.57
113	255	98.83
114	252	97.67
115	252	97.67
116	253	98.06
117	245	94.96
118	251	97.28

ITEM	NUMBER OF STUDENTS	PERCENTAGE
119	256	99.22
120	251	97.28
121	251	97.28
122	254	98.44
123	237	91.86
124	250	96.89
125	250	96.89
126	249	96.51
127	251	97.28
128	246	95.34
129	251	97.28
130	244	94.57
131	253	98.06
132	255	98.83
133	254	98.44
134	256	99.22
135	249	96.51
136	247	95.73
137	242	93.79
138	255	98.83
139	251	97.28
140	247	95.73
141	244	94.57
142	249	96.51

ITEM	NUMBER OF STUDENTS	PERCENTAGE
143	242	93.79
144	250	96.89
145	250	96.89
146	242	93.79
147	248	96.12
148	244	94.57
149	251	97.28
150	250	96.89
151	246	95.34
152	252	97.67
153	234	90.69
154	239	92.63
155	243	94.18
156	248	96.12
157	248	96.12
158	234	90.69
159	247	95.73
160	248	96.12
161	246	95.34
162	244	94.57
163	247	95.73
164	246	95.34
165	239	92.63
166	234	90.69

ITEM	NUMBER OF STUDENTS	PERCENTAGE
167	249	96.51
168	251	97.28
169	252	97.67
170	253	98.06
171	248	96.12
172	248	96.12
173	246	95.34
174	247	95.73
175	252	97.67
176	246	95.34
177	245	94.96
178	251	97.28
179	239	92.63
180	250	96.89
181	237	91.86
182	142	55.03
183	215	83.33
184	105	40.69
185	118	45.73
186	130	50.38
187	137	53.10
188	104	40.31
189	154	59.68
190	164	63.56

ITEM	NUMBER OF STUDENTS	PERCENTAGE
191	64	24.80
192	150	58.13
193	153	59.30
194	130	50.38
195	102	39.53
196	66	25.58
197	101	39.14
198	227	87.98
199	115	44.57
200	115	44.57
201	193	74.80
202	89	34.49
203	147	56.97
204	88	34.10
205	204	79.06
206	139	53.87
207	203	78.68
208	160	62.01
209	232	89.92
210	182	70.54
211	156	60.46
212	210	81.39
213	207	80.23
214	207	80.23

ITEM	NUMBER OF STUDENTS	PERCENTAGE
215	229	88.75
216	203	78.68
217	253	98.06
218	248	96.12
219	253	98.06
220	255	98.83
221	254	98.44
222	252	97.67
223	206	79.84
224	184	71.31
225	204	79.06
226	149	57.75
227	257	99.61
228	247	97.73
229	241	93.41
230	210	81.39
231	257	99.61
232	230	89.14
233	253	98.06
234	236	91.47
235	163	63.17
236	165	63.95
237	161	62.40
238	151	58.42

ITEM	NUMBER OF STUDENTS	PERCENTAGE
239	147	56.97
240	245	94.96
241	237	91.86
242	112	43.41
243	196	75.96
244	206	79.84
245	188	72.86
246	217	84.10
247	209	81.00
248	181	70.15
249	196	75.96
250	175	67.82
251	94	36.43
252	194	75.19
253	147	56.97
254	122	47.28
255	199	77.13
256	206	79.84
257	247	95.73
258	154	59.68
259	111	43.02
260	238	92.38
261	216	83.72
262	121	46.89

ITEM	NUMBER OF STUDENTS	PERCENTAGE
263	183	70.93
264	115	44.57
265	77	29.84
266	175	67.82
267	105	40.69
268	111	43.03
269	130	50.38
270	108	41.86
271	58	22.48
272	101	39.14
273	148	57.36
274	146	56.58
275	142	55.03
276	84	33.55
277	69	26.74
278	228	88.37
279	190	73.64
280	163	63.17
281	159	61.62
282	136	52.79
283	101	39.14
284	71	27.51
285	147	57.97
286	63	24.41

ITEM	NUMBER OF STUDENTS	PERCENTAGE
287	44	17.05
288	68	26.35
289	108	41.86

As shown in the preceding table, there were nine addition facts upon which the group achieved 100%. All of the 180 basic facts were answered correctly by at least 90% of the students. However, as shown in Table Five, 35 of the facts had a critical ratio significant enough to be retained in the Revised Test in the Appendix of this study. Item 287 had the lowest percent of correct responses, 44 students or 17.05%. The problem required finding the perimeter in feet and changing it to yards.

Table Three shows the distribution of the odd and even scores on one hundred random test papers, selected and used to compute the split-half reliability coefficient. The selection of the papers was made by taking every third and fourth paper at certain intervals. Each of these one hundred papers was analysed to determine the number of correct odd and even items. As the Pearson product-moment method[1] was used to compute the reliability coefficient, the range of odd item scores was tabulated vertically, and the range of the even item scores was tabulated horizontally.

[1] Greene, Jorgensen, and Gerberich, op. cit., p. 377

TABLE THREE

DISTRIBUTION OF THE ODD AND EVEN SCORES ON ONE HUNDRED RANDOM CASES

Odd Scores \ Even Scores	65–69	70–74	75–79	80–84	85–89	90–94	95–99	100–104	105–109	110–114	115–119	120–124	125–129	130–134	135–139	140–144	Fy
140–144														1	2	1	4
135–139														5	4	1	10
130–134											1		8	8	2		19
125–129											3	8	10	1			22
120–124										4	9	3	2				18
115–119									3	5	5	1	1				15
110–114								1	1	1	1	1					5
105–109							1		1	1							3
100–104																	0
95–99																	0
90–94							1										1
85–89				1		1											2
80–84																	0
75–79	1																1
Fx	1	0	0	1	0	1	2	1	5	11	19	13	21	15	8	2	

Mean even scores 120.47

Mean odd scores 123.98

The mean for the odd items which were tabulated vertically in Table Three, was found to be 123.98, and the mean for the even items tabulated horizontally was 120.47. The Pearson method revealed a reliability coefficient of .918. Then, by the Spearman-Brown prophecy formula,[1] the reliability coefficient of .918 was raised to .957, thus increasing the reliability of the test.

Table Four shows the correct number of the odd and even items on the one hundred random papers selected to determine the reliability coefficient and to tabulate Table Three.

TABLE FOUR

NUMBER CORRECT OF ODD AND EVEN ITEMS ON ONE HUNDRED RANDOM SCORES

SCORE NUMBER	CORRECT ODD ITEMS	CORRECT EVEN ITEMS
1	141	140
2	142	138
3	138	140
4	140	138
5	139	138
6	138	138
7	141	134
8	136	138
9	137	137
10	139	132

[1] Ibid., p. 386

SCORE NUMBER	CORRECT ODD ITEMS	CORRECT EVEN ITEMS
11	132	138
12	136	133
13	135	132
14	130	137
15	135	132
16	134	133
17	132	134
18	131	134
19	135	130
20	133	131
21	131	132
22	132	131
23	134	128
24	130	131
25	134	127
26	130	130
27	133	127
28	130	129
29	130	129
30	130	129
31	132	127
32	128	130
33	129	128
34	129	127

SCORE NUMBER	CORRECT ODD ITEMS	CORRECT EVEN ITEMS
35	130	126
36	128	127
37	128	126
38	128	126
39	129	125
40	126	127
41	125	127
42	126	126
43	128	124
44	122	129
45	129	122
46	126	125
47	125	124
48	126	123
49	128	121
50	121	127
51	131	116
52	127	120
53	127	120
54	124	122
55	126	120
56	116	129
57	124	120
58	128	116

SCORE NUMBER	CORRECT ODD ITEMS	CORRECT EVEN ITEMS
59	125	119
60	123	119
61	122	120
62	122	119
63	126	115
64	124	117
65	123	118
66	122	118
67	121	118
68	118	121
69	121	117
70	124	114
71	121	117
72	119	119
73	122	115
74	119	118
75	117	119
76	116	119
77	121	113
78	113	121
79	116	117
80	121	111
81	120	111
82	118	113

SCORE NUMBER	CORRECT ODD ITEMS	CORRECT EVEN ITEMS
83	113	117
84	115	114
85	116	113
86	117	111
87	116	111
88	114	112
89	118	107
90	117	108
91	117	105
92	113	107
93	106	112
94	112	104
95	106	106
96	105	95
97	94	95
98	85	93
99	89	84
100	77	65

The possible score for the odd items was 145. The highest score attained by any student was 142, and the lowest was 77. The mean score for the odd items was found to be 123.98. For the even items, the highest possible score was 144. The highest score achieved was 140, while the lowest was 65. The even items have a mean score of

120.47.

To discover whether an item discriminated between high and low achievers, it was necessary to analyze each item to determine its critical ratio. To find the significant difference as shown in Table Five, the highest 50 and the lowest 50 papers were used. The data were tabulated to show the percent of correct responses, the difference in percent, the standard error of difference, and the critical ratio for each item. The Edgerton tables[1] were used to compute the standard error of percent.

[1] Harold A. Edgerton and Donald G. Paterson, "Table of Standard Errors and Probable Errors of Percentages for Varying Number of Cases," Journal of Applied Psychology, (10: 378-391, September 1926)

TABLE FIVE

ITEM ANALYSIS OF THE TOP AND BOTTOM FIFTY SCORES

ITEM	PERCENTAGE OF CORRECT RESPONSES: HIGH 50 PUPILS	PERCENTAGE OF CORRECT RESPONSES: LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
1	100	96	4	.0313	1.27
2	100	100	--	-----	----
3	100	100	--	-----	----
4	100	100	--	-----	----
5	100	100	--	-----	----
6	100	100	--	-----	----
7	100	100	--	-----	----
8	100	98	2	.0244	0.82
9	100	98	2	.0244	0.82
10	100	100	--	-----	----
11	98	100	2	-.0244	-0.82
12	100	100	--	-----	----
13	100	100	--	-----	----
14	100	96	4	.0313	1.27
15	100	98	2	.0244	0.82
16	100	98	2	.0244	0.82
17	100	100	--	-----	----
18	100	100	--	-----	----
19	98	100	2	-.0244	-0.82
20	98	98	--	-----	----

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
21	96	98	2	-.0344	-0.58
22	100	100	-	-----	----
23	100	100	-	-----	----
24	100	98	2	.0244	0.82
25	100	98	2	.0244	0.82
26	100	98	2	.0244	0.82
27	100	100	-	-----	----
28	100	100	-	-----	----
29	100	100	-	-----	----
30	100	98	2	.0244	0.82
31	100	96	4	.0313	1.27
32	100	96	4	.0313	1.27
33	100	100	-	-----	----
34	100	100	-	-----	----
35	100	100	-	-----	----
36	100	100	-	-----	----
37	100	100	-	-----	----
38	100	98	2	.0244	0.82
39	96	100	4	-.0313	-1.27
40	100	100	-	-----	----
41	100	100	-	-----	----
42	100	98	2	.0244	0.82
43	100	98	2	.0244	0.82

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
44	98	100	2	-.0244	-0.82
45	100	98	2	.0244	0.82
46	100	92	8	.0405	1.97
47	100	94	6	.0369	1.62
48	100	98	2	.0244	0.82
49	98	98	-	-----	----
50	100	96	4	.0313	1.27
51	100	98	2	.0244	0.82
52	100	96	4	.0313	1.27
53	100	98	2	.0244	0.82
54	100	98	2	.0244	0.82
55	100	98	2	.0244	0.82
56	100	98	2	.0244	0.82
57	98	96	2	.0344	0.58
58	100	96	4	.0313	1.27
59	98	96	2	.0344	0.58
60	100	98	2	.0244	0.82
61	100	96	4	.0313	1.27
62	100	98	2	.0244	0.82
63	96	94	2	.0441	0.45
64	98	96	2	.0344	0.58
65	100	96	4	.0313	1.27
66	98	98	-	-----	----

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
67	98	98	-	-----	----
68	100	98	2	.0244	0.82
69	98	98	-	-----	----
70	98	98	-	-----	----
71	98	92	6	.0429	1.39
72	100	96	4	.0313	1.27
73	100	98	2	.0244	0.82
74	100	98	2	.0244	0.82
75	100	96	4	.0313	1.27
76	100	96	4	.0313	1.27
77	100	98	2	.0244	0.82
78	100	98	2	.0244	0.82
79	100	98	2	.0244	0.82
80	100	98	2	.0244	0.82
81	100	96	4	.0313	1.27
82	100	98	2	.0244	0.82
83	100	94	6	.0369	1.62
84	100	98	2	.0244	0.82
85	98	98	-	-----	----
86	100	98	2	.0244	0.82
87	96	98	2	-.0344	-0.58
88	100	98	2	.0244	0.82
89	100	98	2	.0244	0.82

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
90	100	98	2	.0244	0.82
91	100	92	8	.0405	1.97
92	100	76	24	.0616	3.90
93	100	94	6	.0369	1.62
94	100	96	4	.0313	1.27
95	100	92	8	.0405	1.97
96	98	92	6	.0429	1.39
97	100	92	8	.0405	1.97
98	100	94	6	.0369	1.62
99	100	92	8	.0405	1.97
100	100	94	6	.0369	1.62
101	100	92	8	.0405	1.97
102	100	94	6	.0369	1.62
103	100	86	14	.0509	2.76
104	100	94	6	.0369	1.62
105	98	92	6	.0429	1.39
106	100	94	6	.0369	1.62
107	100	96	4	.0313	1.27
108	96	92	4	.0472	0.84
109	98	96	2	.0344	0.58
110	100	96	4	.0313	1.27
111	100	94	6	.0369	1.62
112	98	82	16	.0576	2.77

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
113	100	94	6	.0369	1.62
114	96	92	4	.0472	0.84
115	100	94	6	.0369	1.62
116	100	96	4	.0313	1.27
117	96	80	16	.0635	2.51
118	100	90	10	.0442	2.26
119	100	94	6	.0369	1.62
120	98	96	2	.0344	0.58
121	100	92	8	.0405	1.97
122	100	94	6	.0369	1.62
123	94	82	12	.0638	1.88
124	100	80	20	.0587	3.40
125	100	96	4	.0313	1.27
126	100	82	18	.0558	3.22
127	100	94	6	.0369	1.62
128	100	76	24	.0616	3.90
129	100	94	6	.0369	1.62
130	100	84	16	.0538	2.97
131	100	98	2	.0244	0.82
132	100	96	4	.0313	1.27
133	100	94	6	.0369	1.62
134	100	98	2	.0244	0.82
135	98	90	8	.0465	1.72

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
136	98	88	10	.0502	1.99
137	100	82	18	.0558	3.22
138	100	94	6	.0369	1.62
139	100	92	8	.0405	1.97
140	100	90	10	.0442	2.26
141	100	90	10	.0442	2.26
142	100	90	10	.0442	2.26
143	100	78	22	.0606	3.63
144	100	80	20	.0587	3.40
145	100	88	12	.0481	2.49
146	100	90	10	.0442	2.26
147	100	86	14	.0509	2.75
148	100	80	20	.0587	3.40
149	100	86	14	.0509	2.75
150	100	84	16	.0538	2.97
151	100	84	16	.0538	2.97
152	98	84	14	.0557	2.51
153	100	72	28	.0645	4.34
154	100	78	22	.0606	3.63
155	100	78	22	.0606	3.63
156	100	80	20	.0587	3.40
157	100	88	12	.0481	2.49
158	100	84	16	.0538	2.97

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
159	100	76	24	.0616	3.90
160	100	74	26	.0636	4.08
161	100	76	24	.0616	3.90
162	100	74	26	.0636	4.08
163	100	86	14	.0509	2.75
164	100	80	20	.0587	3.40
165	100	92	8	.0405	1.97
166	100	90	10	.0442	2.26
167	100	90	10	.0442	2.26
168	98	88	10	.0502	1.99
169	100	84	16	.0538	2.97
170	98	90	8	.0465	1.72
171	100	82	18	.0558	3.22
172	100	86	14	.0509	2.75
173	100	80	20	.0587	3.40
174	100	82	18	.0558	3.22
175	96	90	6	.0505	1.18
176	100	80	20	.0587	3.40
177	100	82	18	.0558	3.22
178	98	86	12	.0529	2.26
179	100	70	30	.0665	4.51
180	98	82	16	.0576	2.77
181	100	74	26	.0636	4.08

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
182	88	32	56	.1004	5.57
183	96	46	50	.0813	6.15
184	78	8	70	.1157	6.05
185	66	36	30	.1096	2.74
186	72	18	54	.1156	4.67
187	86	42	44	.0943	4.66
188	78	32	46	.1068	4.30
189	88	34	54	.0993	5.43
190	86	30	56	.1034	5.41
191	64	8	56	.1205	4.64
192	90	20	70	.1051	6.66
193	86	18	68	.1086	6.26
194	80	4	76	.1150	6.60
195	68	24	44	.1151	3.82
196	66	18	48	.1178	4.07
197	66	24	42	.1156	3.63
198	98	68	30	.0689	4.35
199	82	46	36	.0935	3.85
200	66	62	4	.0962	0.41
201	92	66	26	.0770	3.37
202	56	26	30	.1164	2.57
203	90	36	54	.0959	5.63
204	62	28	34	.1153	2.94

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
205	98	58	40	.0728	5.49
206	70	50	20	.0963	2.07
207	98	70	28	.0680	4.11
208	92	32	60	.0986	6.08
209	96	76	20	.0662	3.02
210	84	32	52	.1032	5.03
211	86	36	50	.0992	5.04
212	94	56	38	.0778	4.88
213	96	52	44	.0763	5.76
214	96	56	40	.0754	5.30
215	92	76	16	.0710	2.25
216	92	72	20	.0736	2.71
217	100	98	2	.0244	0.82
218	96	94	2	.0440	0.45
219	100	96	4	.0313	1.27
220	100	98	2	.0244	0.82
221	96	100	4	-.0313	-1.27
222	100	96	4	.0313	1.27
223	90	64	26	.0799	3.25
224	70	52	18	.0963	1.86
225	98	64	34	.0709	4.79
226	60	48	12	.1010	1.18
227	100	98	2	.0244	0.82

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
228	100	90	10	.0442	2.26
229	100	86	14	.0509	2.75
230	94	68	26	.0742	3.50
231	100	98	2	.0244	0.82
232	96	74	22	.0680	3.23
233	100	92	8	.0405	1.97
234	100	78	22	.0606	3.63
235	80	30	50	.1074	4.65
236	82	26	56	.1075	5.20
237	88	30	58	.1020	5.68
238	82	24	58	.1086	5.34
239	80	12	68	.1142	5.94
240	100	86	14	.0509	2.75
241	98	80	18	.0604	2.98
242	68	18	50	.1173	4.26
243	92	68	24	.0762	3.14
244	96	56	40	.0754	5.30
245	86	62	24	.0846	2.83
246	96	64	32	.0735	4.35
247	94	60	34	.0769	4.42
248	88	32	56	.1004	5.57
249	88	68	20	.0804	2.48
250	88	40	48	.0945	5.07

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
251	68	22	46	.1156	3.97
252	90	44	46	.0892	5.15
253	76	18	58	.1140	5.18
254	78	20	58	.1037	5.59
255	98	56	42	.0728	5.76
256	92	66	26	.0770	3.37
257	100	88	12	.0481	2.49
258	88	32	56	.0769	4.42
259	76	34	42	.1065	3.39
260	100	76	24	.0616	3.90
261	98	58	40	.0728	5.49
262	82	14	68	.1122	6.06
263	94	28	66	.0984	6.70
264	78	2	76	.1160	6.55
265	58	26	32	.1164	2.74
266	86	26	60	.1051	5.70
267	74	4	70	.1154	6.06
268	72	52	20	.0949	2.10
269	84	14	68	.1106	6.14
270	74	12	62	.1168	5.30
271	58	4	54	.1219	4.42
272	64	18	46	.1184	3.88
273	88	40	48	.0945	5.07

ITEM	HIGH 50 PUPILS	LOW 50 PUPILS	DIFF. %	S.E. PERCENT	C.R.
274	88	38	50	.0963	5.19
275	88	18	70	.1073	6.52
276	70	4	66	.1192	5.53
277	56	6	50	.1216	4.11
278	98	60	38	.0718	5.29
279	88	46	42	.0981	4.28
280	90	34	56	.0975	5.74
281	86	30	56	.1034	5.41
282	82	18	64	.1110	5.76
283	74	4	70	.1154	6.06
284	62	4	58	.1214	4.77
285	94	18	76	.1027	7.04
286	48	8	40	.1239	3.22
287	34	2	32	.1331	2.40
288	52	12	40	.1218	3.28
289	80	6	74	.1147	6.45

There were 164 items out of 289 showing a critical ratio of less than 2.56, which is considered statistically significant. From those 164 items, 30 had no significant difference as the percent of the students responding correctly was the same. There were seven items in which the low achievers did better than the high achievers. These items were differentiated in Table Five by placing a minus

sign. With the exception of 19 items out of the 164 showing a significant difference of less than 2.56, all the items referred to the basic facts.

There were 125 or 43% of the items in the test with a significant critical ratio of 2.56. These 125 items were grouped to form the Revised Test in the Appendix of this study.

CHAPTER FOUR

SUMMARY AND CONCLUSIONS

The purpose of this study was to construct and evaluate an inventory test in arithmetic to be used at the beginning of the sixth grade.

Courses of study, textbooks, and workbooks were analyzed for content. An initial test comprising all concepts presented up to grade six was constructed and consisted of 487 items. In order to shorten the instrument, items checking several processes were retained, and Roman numerals were excluded entirely as they seem to have little social value at the present time. As many items as possible were set up objectively, and all items had only one possible answer. A preliminary trial of the instrument was made during the summer months to determine the approximate amount of time that would be needed to administer it and to check on completeness of directions. During the week of September 15, 1958, the instrument was administered by classroom teachers in six sittings, to 258 students in Community X. The tests were returned to the writer who corrected and analyzed them. The findings were as follows:

(a) A mean of 245.5 and a standard deviation of 22.25 were found.

(b) There were 76% of the test scores falling between the range of 267.8 and 223.2.

(c) The reliability coefficient established by the Pearson product-moment method is .918, and by the Spearman-Brown method, the coefficient reliability is .957.

(d) There were 125 or 43% of the items that were good because of a significant difference of 2.56.

(e) The addition, subtraction, and multiplication facts could be eliminated, as only seven multiplication facts indicated a significant difference of 2.56.

(f) There were 28 of the division facts with a significant difference of 2.56, retesting for further elimination seemed necessary.

(g) Revision work is needed on the items dealing with time, weights, measures, as only seven items in twenty had a significant difference of 2.56.

(h) The items on vocabulary, computational work, and problem solving certainly could be useful to discover the strength and weaknesses of beginning sixth graders.

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APPENDIX

Part One.....Answers to Original Test

Part Two.....Revised Inventory Test

Part Three.....Answers to Revised Test

Part One

Answers to Original Test

Section A

1. 14 2. 15 3. 9 4. 9 5. 4 6. 9 7. 12 8. 17 9. 10
10. 5 11. 15 12. 11 13. 6 14. 12 15. 7 16. 7 17. 10
18. 13 19. 8 20. 13 21. 10 22. 4 23. 11 24. 16 25. 2
26. 6 27. 11 28. 6 29. 7 30. 18 31. 12 32. 8 33. 11
34. 10 35. 14 36. 8 37. 5 38. 10 39. 12 40. 16 41. 13
42. 3 43. 9 44. 8 45. 14 46. 3 47. 6 48. 3 49. 1
50. 1 51. 7 52. 3 53. 7 54. 1 55. 1 56. 3 57. 1
58. 8 59. 4 60. 1 61. 2 62. 5 63. 7 64. 2 65. 2
66. 1 67. 4 68. 4 69. 2 70. 3 71. 5 72. 4 73. 6
74. 6 75. 5 76. 3 77. 9 78. 1 79. 2 80. 8 81. 5
82. 5 83. 3 84. 4 85. 2 86. 2 87. 6 88. 4 89. 2
90. 1 91. 21 92. 54 93. 18 94. 4 95. 25 96. 24
97. 72 98. 12 99. 2 100. 81 101. 28 102. 8 103. 49
104. 20 105. 9 106. 18 107. 24 108. 36 109. 6 110. 15
111. 4 112. 42 113. 30 114. 12 115. 9 116. 8 117. 56
118. 40 119. 7 120. 1 121. 16 122. 10 123. 64 124. 36
125. 3 126. 48 127. 5 128. 63 129. 6 130. 32 131. 14
132. 45 133. 35 134. 16 135. 27 136. 7 137. 8 138. 7
139. 9 140. 9 141. 8 142. 6 143. 7 144. 4 145. 6
146. 9 147. 4 148. 6 149. 7 150. 5 151. 5 152. 3
153. 9 154. 1 155. 7 156. 4 157. 9 158. 2 159. 6
160. 9 161. 8 162. 8 163. 8 164. 9 165. 8 166. 6

167. 2 168. 9 169. 5 170. 5 171. 5 172. 9 173. 7
174. 4 175. 3 176. 7 177. 8 178. 3 179. 8 180. 6

Section B

181. 4 182. 6 183. 2 184. 9 185. 1 186. 5 187. 10
188. 3 189. 5 190. 8 191. 9 192. 1 193. 7 194. 10
195. 6 196. 3 197. 3 198. 1 199. 6 200. 7 201. 5
202. 8 203. 2 204. 4 205. No 206. Yes 207. 2,633
208. 1,950,675 209. 5 210. 9 211. 7 212. 5 213. Thursday 214. Wednesday

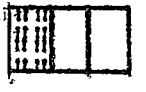
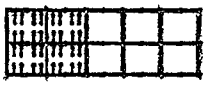
Section C

215. No 216. Yes 217. Yes 218. Yes 219. Yes 220. No
221. Yes 222. Yes 223. Yes 224. Yes 225. Yes 226. No
227. No 228. No 229. No 230. Yes 231. No 232. Yes
233. No 234. No 235. 89 236. 88 237. 85 238. 83
239. 93

Section D

240. 75° 241. 95° 242. 11A.M., 5:30P.M. 243. 30,723
244. 3,308 245. $2,066.17 246. 2,633 247. $115.41
248. $792.72 249. 97,443 250. 2,001,600 251. $11,109.15
252. 342 253. $5.31 254. $3.06 r 1 or 1/17

Section E

255. 4/5 256. 3/8 257.  258. 2/3 259. 
260. 5/7 261. 1 262. 14 1/2 263. 7/8 264. 1 3/5
265. 36 1/18 266. 1/2 267. 9 2/3 268. 7 1/15 269. 1/2
270. 17 5/8 271. 19 11/15 272. 2.2 273. 122.35

274. 91.6 275. 25.78 276. 90 277. 262

Section F

278. 9 279. 466 280. $13.50 281. 11 in. 282. $3.20

283. 1/6 284. 1 2/15 mi. 285. 60¢ 286. 11:10 287. 12 yds.

288. 150 sq. ft. 289. 80¢

Part Two

On the next page is a copy of the revised inventory test. It contains 125 items, all of which appeared in the original test. They are those items which denoted a significant difference or critical ratio of 2.56 as shown in Table Five, Chapter Three.

It will be noted that the arrangement of the revised test is somewhat different from the original. The revised test was condensed into five sections, whereas the original form had six sections. As most items not showing a significant difference of 2.56 occured mostly in Section A, the facts, and Section C, time, weights, measures, the writer combined those items, also the bar graphs which were originally in Section B. These changes were made to equalize somewhat the computational work and working time.

Section B, vocabulary, in the revised form is the only section which hasn't any computational work. It is strictly matching work. This arrangement was made because the number of students responding correctly to those items was relatively low, Table One, Chapter Three.

The procedure for testing and scoring this revised form of the inventory test is the same as explained in Chapter Two.

Revised Form of Inventory Test

Section A

Multiply the following:

1. $\begin{array}{r} 6 \\ \times\ 9 \\ \hline \end{array}$ 2. $\begin{array}{r} 7 \\ \times\ 7 \\ \hline \end{array}$ 3. $\begin{array}{r} 7 \\ \times\ 6 \\ \hline \end{array}$ 4. $\begin{array}{r} 9 \\ \times\ 4 \\ \hline \end{array}$ 5. $\begin{array}{r} 8 \\ \times\ 6 \\ \hline \end{array}$ 6. $\begin{array}{r} 9 \\ \times\ 7 \\ \hline \end{array}$ 7. $\begin{array}{r} 8 \\ \times\ 4 \\ \hline \end{array}$

Divide the following:

8.	$6\overline{)48}$	9.	$7\overline{)49}$	10.	$3\overline{)12}$	11.	$1\overline{)4}$		
12.	$3\overline{)18}$	13.	$1\overline{)7}$	14.	$2\overline{)10}$	15.	$3\overline{)15}$		
16.	$4\overline{)36}$	17.	$2\overline{)2}$	18.	$6\overline{)42}$	19.	$2\overline{)8}$		
20.	$1\overline{)2}$	21.	$6\overline{)36}$	22.	$3\overline{)27}$	23.	$4\overline{)32}$		
24.	$8\overline{)64}$	25.	$2\overline{)16}$	26.	$7\overline{)63}$	27.	$1\overline{)5}$		
28.	$4\overline{)20}$	29.	$2\overline{)18}$	30.	$3\overline{)21}$	31.	$4\overline{)16}$		
32.	$5\overline{)35}$	33.	$3\overline{)24}$	34.	$7\overline{)56}$	35.	$1\overline{)6}$		

Time, Weights, Measures:

Note: If the statement is true write "Yes"; if it is false write "No" for each of the following:

36. _____ A pint is half a quart.

37. _____ A half gallon is equal to two quarts.

38. _____ Eighteen inches are equal to half a yard.

39. _____ There are fifty years in a century.

40. _____ There are 5,280 feet in a mile.

41. _____ Two thousand pounds make a ton.

42. _____ There are fifteen ounces in a pound.

Finding Averages:

The following chart shows all the scores that Peter received in school for the week of October 4 - 8. Find

Peter's average score for each subject. Write your answers in the last column.

	Mon.	Tues.	Wed.	Thurs.	Fri.	Ave.
43. Arith.	90	85	75	100	95	
44. Spell.	75	80	90	100	95	
45. Lang.	80	85	95	75	90	
46. Hist.	88	76	64	97	90	
47. Geog.	93	89	95	90	98	

...

Fundamental Knowledge:

Note: If the statement is true write "Yes"; if it is false write "No" for each of the following:

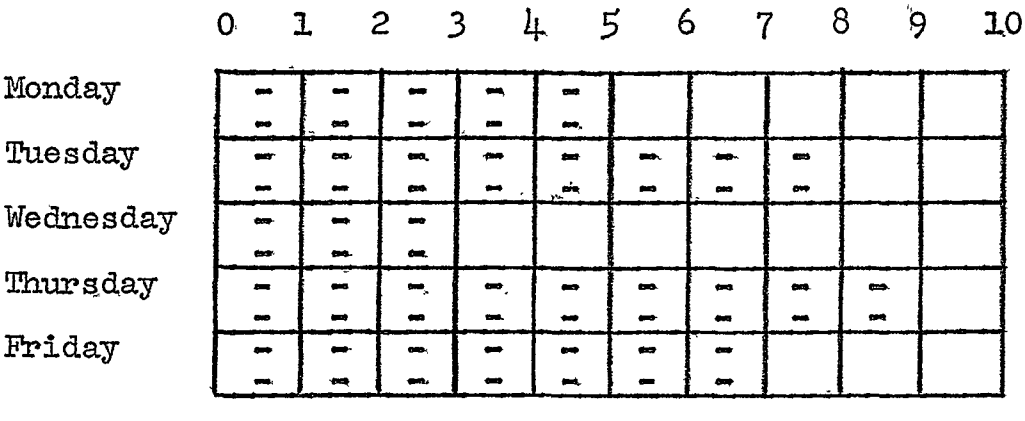
48. Twenty-six means 2 ones and 6 tens. _____

Write the following groups of words using numbers:

49. Two thousand, six hundred thirty three. _____

50. One million, nine hundred fifty thousand, six hundred seventy five. _____

Bar Graph:



Sam made a bar graph to show how well he did in arith-

metic each day for the week of November 5 - 9. Write the answers in the blanks.

51. On Monday Sam had how many examples correct? _____

52. How many examples did he have right on Thursday? _____

53. On Wednesday Sam did how many examples incorrectly? _____

54. How many examples did he do incorrectly on Monday? _____

55. On what day did Sam do his best work? _____

56. On what day his poorest work? _____

...

Section B

Vocabulary:

Note: Match the number of the statement in Column B that completes the meaning of the statement in Column A. There are statements in Column B that you will not need to use.

	Column A	Column B
57. ___	Answer to an addition example	1 - dividend
58. ___	Answer to a subtraction example	2 - addends
59. ___	Numbers being added together	3 - minuend
60. ___	Answer to a multiplication example	4 - sum
61. ___	Number being divided	5 - multiplicand
62. ___	Top number in a multiplication example	6 - difference or remainder
63. ___	Answer to a division example	
64. ___	Top number in a subtraction example	7 - multiplier
		8 - divisor

9 - product

10 - quotient

***

65. ___ Number below the line in a fraction

66. ___ Top number in a fraction

67. ___ A fraction which cannot be divided evenly by any number except one, is said to be

68. ___ A fraction whose numerator is larger than its denominator

69. ___ Fraction such as 2 1/2

70. ___ Numerator and denominator of a fraction are known as

71. ___ A fraction such as 3/5

72. ___ Before adding or subtracting unlike fractions you must change both denominators to

1 - improper fraction

2 - like fractions

3 - common denominator

4 - decimal fraction

5 - denominator

6 - proper fraction

7 - mixed numbers

8 - numerator

9 - lowest terms

10 - terms of a fraction

11 - whole number

***

73. ___ Number to the right of the decimal point expresses

74. ___ Has four equal sides

75. ___ Distance around a rectangle

76. ___ Has three sides

77. ___ Second number to the right of the decimal point expresses

1 - square

2 - rectangle

3 - tenths

4 - area

5 - triangle

6 - perimeter

78. ___ Its length is longer than its width

79. ___ Another name for the "surface" of a square or rectangle

7 - hundredths

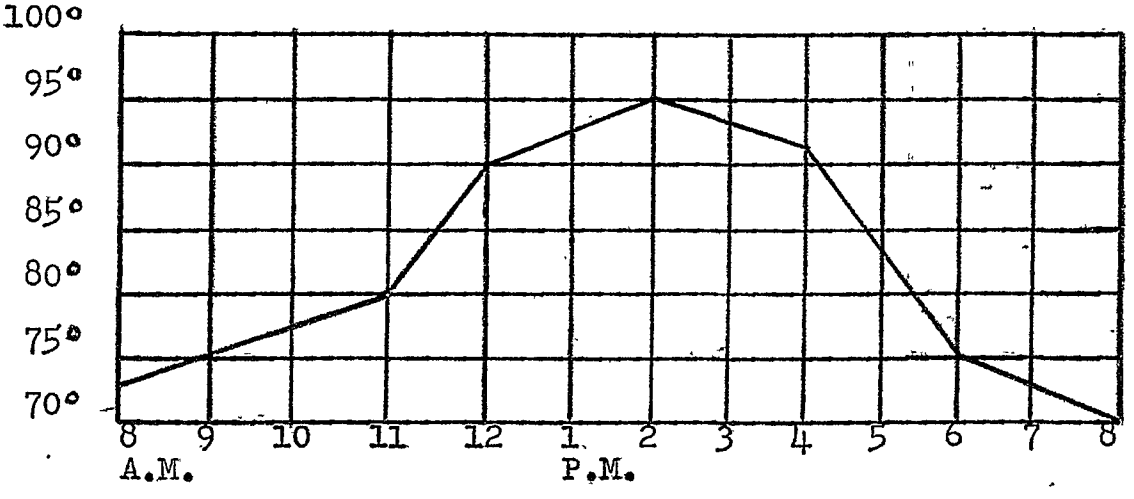
8 - proper fraction

9 - whole number

• • •

Section C

Line Graph:



Before the close of school last spring, Frank had studied line graphs and their importance. The weather man predicted that August 15th. would be a fine day for an outing. The above graph shows the thermometer readings for that day.

80. What was the temperature at 9 A.M.? _____

81. By 2 P.M. the temperature had gone up to? _____

82. At what hours during the day was the temperature at 80°?

____A.M.

____P.M.

Fundamentals:

Note: Before returning your paper to your teacher, be sure that you have written the necessary commas, dollar signs, and decimal points.

Addition

83.
$$\begin{array}{r} 3746 \\ 8654 \\ 6136 \\ 7403 \\ 4784 \\ \hline \end{array}$$

84.
$$\begin{array}{r} 413 \\ 877 \\ 489 \\ 746 \\ 351 \\ 432 \\ \hline \end{array}$$

85.
$$\begin{array}{r} \$376.46 \\ 277.54 \\ 443.45 \\ 968.72 \\ \hline \end{array}$$

Subtraction

86.
$$\begin{array}{r} 4000 \\ 1367 \\ \hline \end{array}$$

87.
$$\begin{array}{r} \$200.00 \\ 84.59 \\ \hline \end{array}$$

88.
$$\begin{array}{r} \$4500.00 \\ 3707.28 \\ \hline \end{array}$$

Multiplication

89.
$$\begin{array}{r} 5004 \\ 400 \\ \hline \end{array}$$

90.
$$\begin{array}{r} \$27.43 \\ 405 \\ \hline \end{array}$$

Division

91. $45\overline{)15390}$

92. $25\overline{)\$132.75}$

93. $17\overline{)\$52.03}$

...

Section D

Fractions:

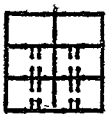
94. Circle the fraction which shows the larger part:

$$\frac{4}{5} \text{ or } \frac{7}{10}$$

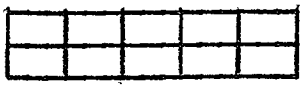
95. Circle the fraction which shows the smaller part:

$$\frac{3}{8} \text{ or } \frac{1}{2}$$

96. The opposite box is divided into six parts; $\frac{\quad}{3}$ are shaded.



97. Shade $\frac{2}{5}$ of the opposite box:



Note: Be sure that all improper fractions have been changed to whole or mixed numbers and that all fractions have been reduced to lowest terms.

Addition

98. $\frac{2}{7} + \frac{3}{7} =$

99. $\frac{7}{12} + \frac{5}{12} =$

100. $6\frac{7}{10} + 3\frac{1}{10} + 4\frac{7}{10} =$

101. $\frac{1}{4} + \frac{1}{2} + \frac{1}{8} =$

102. $\frac{4}{5} + \frac{3}{10} + \frac{1}{2} =$

103. $21\frac{8}{9} + 14\frac{1}{6} =$

Subtraction

104. $\frac{7}{8} - \frac{3}{8} =$

105. $\frac{8}{9} - \frac{2}{9} =$

106. $\frac{5}{6} - \frac{1}{3} =$

107. $25 - 7\frac{3}{8} =$

108. $49\frac{1}{3} - 29\frac{3}{5} =$

...

Decimal Fractions

Addition

109. $\begin{array}{r} .5 \\ .6 \\ .7 \\ .4 \\ \hline \end{array}$

110. $\begin{array}{r} 50.01 \\ 14.84 \\ 19.82 \\ 37.68 \\ \hline \end{array}$

Subtraction

111. $\begin{array}{r} 197.4 \\ 105.8 \\ \hline \end{array}$

112. $\begin{array}{r} 123.64 \\ 97.86 \\ \hline \end{array}$

Find the fractional part of the following:

113. $\frac{3}{8}$ of 240

114. $\frac{2}{5}$ of 655

...

Section E

Problem Solving:

Note: Read each problem carefully. Do the work and then write your answer in the answer column. Don't forget to put the necessary dollar signs and decimal points, feet and yards. Fractions must be reduced to lowest terms.

115. Betty made 36 cookies for the Scout Christmas party. If each guest is to receive four cookies, how many people will there be at the party? 115 _____

116. We know that Columbus discovered America in 1492. How many years ago did that take place? 116 _____

117. John worked 3 hours a day for 9 days. How much did he earn if he received $.50 an hour? 117 _____

118. Dick had a piece of board which was 47 inches long. He cut off a piece three feet long. How many inches were left? 118 _____

119. Joe bought twelve 15¢ post cards. How much change did he receive from a $5.00 bill? 119 _____

120. Frank spent 4 hours at the circus. What part of a day of 24 hours did he spend there? 120 _____

121. It is 4/5 of a mile from Don's house to the store and 1/3 of a mile farther from the store to school. How far is it from Don's house to school? 121 _____

122. What was the cost of 3/4 pound of candy that sold at 80¢ a pound? 122 _____

123. Mr. Brook's train was due at 9:50, but it was one hour and twenty minutes late. At what time did it arrive? 123 _____

124. The Clarks want to buy a new carpet for the living room. Cindy told her friends that the room was 15 feet long and 10 feet wide. How many square feet of carpeting do the Clarks need to cover their living room? 124 _____

125. "Grampa" Jones helped Mike make candles. They spent 23¢ for wax and 17¢ for cord. If they made 12 candles and sold them at 10¢ each, how much did they make on candle making? 125 _____

...

Part Three

Answers to Revised Test

Section A

1. 54 2. 49 3. 42 4. 36 5. 48 6. 63 7. 32 8. 8 9. 7

10. 4 11. 4 12. 6 13. 7 14. 5 15. 5 16. 9 17. 1

18. 7 19. 4 20. 2 21. 6 22. 9 23. 8 24. 8 25. 8

26. 9 27. 5 28. 5 29. 9 30. 7 31. 4 32. 7 33. 8

34. 8 35. 6 36. Yes 37. Yes 38. Yes 39. No 40. Yes

41. Yes 42. No 43. 89 44. 88 45. 85 46. 83 47. 93

48. No 49. 2,633 50. 1,950,675 51. 5 52. 9 53. 7

54. 5 55. Thursday 56. Wednesday

Section B

57. 4 58. 6 59. 2 60. 9 61. 1 62. 5 63. 10 64. 3

65. 5 66. 8 67. 9 68. 1 69. 7 70. 10 71. 6 72. 3

73. 3 74. 1 75. 6 76. 5 77. 7 78. 2 79. 4

Section C

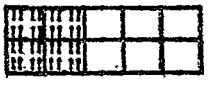
80. 75° 81. 95° 82. 11A.M., 5:30P.M. 83. 30,723

84. 3,308 85. $2,066.17 86. 2,633 87. $115.41

88. $792.72 89. 2,001,600 90. $11,109.15 91. 342

92. $5.31 93. $3.06 r 1 or 1/17

Section D

94. 4/5 95. 3/8 96. 2/3 97.  98. 5/7 99. 1

100. 14 1/2 101. 7/8 102. 1 3/5 103. 36 1/18 104. 1/2

105. 9 2/3 106. 1/2 107. 17 5/7 108. 19 11/15 109. 2.2

110. 122.35 111. 91.6 112. 25.78 113. 90 114. 262

Section E

115. 9 116. 466 117. $13.50 118. 11 in. 119. $3.20 120. 1/6 121. 1 2/15 mi. 122. 60¢ 123. 11:10 124. 150 sq. ft. 125. 80¢