AN ABSTRACT OF THE THESIS OF

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Title: AN ANALYSIS OF THE RELATIONSHIP BETWEEN GRADES AND IOWA TESTS OF EDUCATIONAL DEVELOPMENT SCORES OF SECONDARY SCHOOL STUDENTS IN VOCATIONAL EDUCATION CLASSES IN ANCHORAGE, ALASKA

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Dr. E. Wayne Courtney

Purpose of the Study

The primary focus of this study was to compare Iowa Tests of Educational Development (ITED) subtest scores with achievement letter grades (A, B, C, D, and F) in vocational education classes at Bartlett High School, Anchorage, Alaska. The two secondary purposes of the study were to compare:

1. the results of ITED scores of Bartlett students enrolled in vocational education classes at the Career Center, Bartlett students enrolled in non-vocational education classes, and students enrolled in vocational education classes at Bartlett High School, and

2. the results of ITED scores of Bartlett Caucasian vocational education students with Bartlett non-Caucasian vocational education students.

Procedure

The samples were randomly selected from students receiving final grades during the Spring semester of 1979 at Bartlett High School, Anchorage, Alaska.

A fixed one-way analysis of variance design was used to determine if there were significant differences between groups. Where a significant difference was indicated, the Least Significant Difference (L.S.D.) test was utilized to determine the location of these differences.

Conclusions

Based upon the results of this study, the following conclusions were drawn:

1. Mastery of the basic skills for vocational education classes is as important as in the academic areas.
2. The stigma of vocational education classes as a "dumping ground" for the academic classes was shown to be a misconception.
3. Either the ITED is culturally biased, or the basic education classes for minority students are structured such that minority students are not learning the necessary skills to succeed on ITED achievement tests.

AN ANALYSIS OF THE RELATIONSHIP BETWEEN GRADES AND IOWA TESTS OF EDUCATIONAL DEVELOPMENT SCORES OF SECONDARY SCHOOL STUDENTS IN VOCATIONAL EDUCATION CLASSES IN ANCHORAGE, ALASKA

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I. INTRODUCTION

Achievement tests have been used for many years. The first recorded instance of written examinations on a large scale was in Boston Public Schools in 1845. The examinations, consisting of a large number of essay questions on a variety of topics, were administered by the Secretary of the Massachusetts State Board of Education - Horace Mann (Caldwell and Courtis, 1924). At present, achievement tests are administered throughout every state in the nation on an annual basis. The results are used to determine how well the student compares with others in the same school; how well the student compares with others in the same school district; how well the student compares with others nationwide; or, to compare one teacher's methods of instruction to another.

The Anchorage School District is no exception. Standardized tests are administered each Spring. Yet little is known about the scores. Total school scores are compared with other schools; however, little is done

on an individual basis. The present research was conducted in the interest of making better use of these scores.

Purpose of the Study

The primary focus of this study was to compare Iowa Tests of Educational Development (ITED) scores with achievement letter grades (A, B, C, D, F) in vocational education classes at Bartlett High School, Anchorage, Alaska.

Vocational classes are more activity-oriented than most other courses. In Home Economics, the student spends the majority of his and/or her time cooking or sewing individual projects. Business Education students spend their time developing skills with typewriters, dictation procedures, and accounting practice sets. Industrial Education students spend a large amount of their time working with individual wood, metal, plastic, drafting, and graphic arts projects. Theoretically, the major portion of a grade in vocational classes is based upon completion of these activities. However, reading ability may be a factor in Typing success. Math skills may determine success or failure in Drafting classes. A background in science may have an effect on the student's grade in a Natural Resources class. A comparison of ITED subtest scores should indicate whether

these relationships exist.

A secondary purpose of this study was to compare the results of ITED scores of Bartlett students enrolled in vocational education classes at the Career Center, Bartlett students enrolled in non-vocational education classes, and students enrolled in vocational education classes at Bartlett High School. Vocational education has been labeled a "dumping ground" for the academic subjects for many years. The comment is often heard "the only students who enroll in vocational education classes are those who cannot succeed in college-bound courses." It was upon this proposition that the second purpose was based.

Thirdly, the study was designed to compare the results of ITED scores of Bartlett Caucasian vocational education students with Bartlett non-Caucasian vocational education students. The Anchorage School District has been seriously criticized by various minority groups regarding poor scores on standardized achievement tests. A portion of this study was devoted to determining the validity of this criticism.

The results of this study will be used to make recommendations to administrators, counselors, and teachers. It is expected that better curricular, student

placement, and instructional methods decisions will result from these recommendations.

Assumptions of the Study

This research was conducted with the assumption that the data drawn from the students selected at random from Bartlett High School would produce the same results as data drawn from any other high school throughout the city of Anchorage (See Appendix A for data on Characteristics of Anchorage Schools). Furthermore, it was assumed that the data drawn from the 1979 ITED testing would produce the same results as data from any other year or from similar general achievement testing.

Definition of Terms

For purposes of this study, the following definitions are included:

1. Achievement Grade Level - letter grade earned in a particular class (A, B, C, D, F) as determined by transcript.
2. Achievement Tests - tests designed to measure the amount of knowledge or skill or competence that a person has acquired. Achievement tests assess present ability.
3. Aptitude Tests - tests designed to predict how well a person will be able to perform on some

task or in some subject matter, having had appropriate training. Aptitude tests predict future ability or competence in related areas.

4. Bartlett High School - one of six senior high schools in the Anchorage (Alaska) School District.
5. Career Center - a technical school financed by the Anchorage School District. Students from any of the area high schools are eligible to attend the center for a three-hour block of instruction in the vocational area of their choice.
6. GATB - The General Aptitude Test Battery. An aptitude test that includes Finger Dexterity and Manual Dexterity, as well as Intelligence, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, and Motor Coordination (Brown, 1976).
7. Intelligence Tests - tests having some elements of both achievement and aptitude scales.
8. ITED - Iowa Tests of Educational Development. One of a variety of achievement tests available commercially.
9. Non-Caucasian - any race other than Caucasian. Included in this study are Alaska Native,

American Indian, Asian, Black, Philippino, and Hispanic students.

10. Non-Vocational Education Student - any student who was not enrolled in a state-funded vocational education program at the time of the study.
11. Stanine Score - a simplified record system of single-digit scores derived from national ITED norm data. For example, ITED percentiles of 96 - 99 convert to a stanine score of 9; percentiles of 89 - 95 convert to a stanine of 8; and percentiles of 77 - 87 convert to a stanine of 7.
12. STEA - Short Test of Educational Ability. One of the short subtests of the ITED battery.
13. Vocational Education Student - a student who was, at the time of the study, enrolled in a state-funded vocational education class.
14. X-5 and Y-5 - two parallel forms of the ITED developed in 1970.

II. REVIEW OF RELATED LITERATURE

Introduction

Standardized achievement tests can be classified into three groups:

1. General achievement tests
2. Tests in broad subject areas
3. Tests in specific areas.

General achievement tests cover a number of fields of subject matter. Many schools administer a general achievement test to the eighth grade class to evaluate student learning during the previous eight years of elementary school.

Students at the high school level may be required to take a broad subject area test in mathematics in order to determine their abilities in the entire mathematics curriculum. The test usually covers simple addition and subtraction, extending through the spectrum to trigonometry and geometry. In addition, high school students may be scheduled to take a standardized test in a specific area, such as geometry, to evaluate teaching and/or learning during the year.

Achievement tests differ from aptitude tests. Achievement tests measure learning resulting from relatively specific experiences, and focus on past learning

(Brown, 1976). Tests are considered to be an aptitude measure if they measure the results of general and incidental learning experiences. The frame of reference for an aptitude test is toward the future.

The most commonly used achievement tests for the evaluation of elementary, junior high, and senior high school students are listed by Brown (1976) and Davis (1964) as follows:

California Achievement Test

Comprehensive Tests of Basic Skills

Cooperative Achievement Tests

Iowa Tests of Basic Skills

Iowa Tests of Educational Development

Metropolitan Achievement Tests

SRA Achievement Tests

Sequential Tests of Educational Progress

Stanford Achievement Test

Tests of Academic Progress

An extensive listing of these tests is shown in Appendix B. These tests form the basis for much of the testing done in the United States today.

History of Standardized Tests

People have always been interested in the measurement of human attributes, but testing as we know it today

is a phenomenon of the Twentieth Century. Primitive man's testing of the knowledge of tribal customs, endurance, and bravery of their young men before their admission to the ranks of adult male are among the earliest examinations employed by human beings. Elaborate and exhaustive written examinations were used by the Chinese as early as 2200 B.C. in the selection of public officials (Gerberich, Greene, and Jorgensen, 1962). The candidates were largely self-educated men whose own diligence kept them at their studies for decades, despite the realization that the number who would ultimately attain office was exceedingly small. These ancient examinations had many of the characteristics of a good standardized test. First of all, the tests were in written form; secondly, all candidates were assigned the same tasks; and each examinee was placed in a private cell to write his examination. The evaluators were aware of some of the factors which might have an effect on the reliability of the tests. Before being submitted for judging, papers were duplicated by a scribe to ensure anonymity of the testee (Nunnally, 1972).

From the time of the ancient Greeks, the concept of testing the young was well established and very refined. The Spartans, devoted to physical endurance, had elaborate levels of tests through which every boy had to pass

in demonstrating his mastery of the required skills of manhood (Chase and Ludlow, 1966). In Athens, Socrates is known to have employed searching types of oral quizzes, with many of his techniques still popular today.

There is evidence of the use of written tests at the University of Bologna by 1219 A.D., in the University of Paris during the Thirteenth Century, and at Cambridge University in 1702. In many respects, these tests were very similar to modern school achievement tests (Gerberich et al., 1962).

From the first schools in colonial times, the most frequently used achievement tests have been teacher-prepared tests. A step toward standardized testing was introduced by Horace Mann in 1845, when he substituted a uniform written test for oral interrogation of students by school committeemen in the Boston Public Schools. Enrollment had become so large that committeemen could no longer examine all pupils orally, and the more formal test was introduced.

Mann's comments about the advantages of uniform written testing are still applicable today:

1. The examinations are impartial, and there is no possibility of favoritism or "officious interference" by the examiner.

2. Uniform questions eliminate the chance element inherent in oral examinations, where questions vary so widely that a good pupil

may miss a hard question while the dullard answers an easy one correctly.

3. Such examinations conserve the time of examiners and permit many questions to be asked of all pupils - the greater the number of questions, the nearer does the examination approach completeness.

4. Uniform examinations place all students under the same conditions - they all run the same race over the same course (Chase and Ludlow, 1966, p. 11).

Reverend George Fisher, an English schoolmaster, gets credit for developing and using what were probably the first objective measures of achievement. His "scale book" was used in the Greenwich Hospital School as early as 1864 for evaluating accomplishments in handwriting, spelling, mathematics, grammar, composition, and several other school subjects. Examples of student work were compared with "standard specimens" to determine numerical ratings that, especially for spelling and a few other subjects, relied on errors in performance (Gerberich et al., 1962).

J. M. Rice is given credit as the inventor of comparative tests in America. In the year 1894, he set out on what was to be a decade of research into the teaching of spelling across the country. Over sixteen thousand students were tested, and wide variation was found in achievement from class to class, school to school, and community to community, regardless of such factors as

time devoted to study, location of the school, and efficiency of the teacher (Nunnally, 1972). Rice presented his findings to the 1897 session of the Department of Superintendents of the National Education Association, reporting students spelling thirty minutes a day for eight years were no better spellers than children who had studied the subject fifteen minutes a day for eight years (Gerberich et al., 1962).

Professor E. L. Thorndike of Teachers College, Columbia University, was another leader in educational testing. He published the first textbook in educational measurement, An Introduction to the Theory of Mental and Social Measurement, in 1904. This was considered by many to mark the beginning of modern times in testing (Chase and Ludlow, 1966).

The early workers in the measurement of school achievement carried over from the psychological laboratory a concern for careful control of testing conditions and for absolutely objective scoring. They were motivated by experiments that showed how unreliable, and often unfair, was the grading of traditional essay examinations.

Professional organizations were formed by 1915 due to the growth of specialists with the responsibility for educational research. By the early 1920's, over one hundred bureaus of educational research were established in

large city school systems, in state departments of education, and in state universities (Chase and Ludlow, 1966).

Many professional articles on testing and applications of testing in education were published. New professional journals in education and psychology were established in response to the growing activities in these fields. Books were published on statistical methods in educational research.

> A landmark in the history of educational measurement was the publication in 1923 of the first Stanford Achievement Test, a "battery" of standardized achievement tests in elementary school subjects - developed by L. M. Terman (builder of the Stanford-Binet), T. L. Kelley, and G. M. Ruch. This test, and the method used to produce it, foreshadowed many characteristics of modern testing (Chase and Ludlow, 1966, p. 12).

The Stanford Test was the forerunner of several trends to come in the preparation of standardized tests for school use. This elementary school test battery stood out over the collection of unsubstantiated tests of its time for a number of reasons:

1. It was built by a group of highly trained professionals working as a team;

2. Its content was drawn from a survey of many different courses of study, so that its questions were representative of what was being taught in all parts of the country;

3. Its questions were tried out experimentally, to see how well they worked, before they were used in a final test form;

4. The final test forms were given to thousands of school children in many different school systems to obtain comparative samples of performance (norms) (Chase and Ludlow, 1966, p. 13).

The Stanford Achievement Test proved to be extremely helpful to elementary school people in assessing the academic learning of their students. Millions of copies were sold.

The leaders in educational testing continued with their work - trying new approaches, refining ideas, and running experimental tryouts; and the number of professionals grew. The Teachers College at Columbia University led all others in the number of scholars and researchers devoted to psychological and educational testing. Other universities, including Stanford, Chicago, Peabody, and Iowa, began to develop leadership in educational measurement.

The early development of educational testing was not without some negative aspects. Some of the early tests were poor, developed on the basis of strictly recall of specific subject matter. The most detrimental effect of early testing was the disenchantment produced by exaggerating the benefits of tests and overinterpretation of their results. Still, as the preliminary stages of the history of standardized testing were completed, such tests were a part of our educational structure.

Achievement tests, especially those consisting of multiple-choice questions, offer a number of advantages:

1. They are easily scored, either by a template or machine.
2. If machine scored, a larger number of questions is allowed, permitting a wider sampling of the subject matter and the student's abilities.
3. Individual questions on achievement tests have been pretested to eliminate ambiguity.
4. Tests have been validated and proven to be reliable.
5. A large sample is used for setting the norms (Flynn and Gerber, 1967).

For a description of the development of standardized tests, see Appendix C.

As there are advantages to tests, there are also disadvantages:

1. Test scores are often interpreted incorrectly. Scores are meant to be used as a guideline in making a decision - not as a hard and fast rule.
2. There are various reasons for a student scoring poorly on a test - personal problems, illness, and room conditions may each have adverse effects on student scores.

3. Test scores often influence teacher expectations regarding student potential. Rosenthal and Jacobson (1968) reported a study of teachers who were given erroneous information about students' abilities. The resulting actual achievement of the students reflected the teacher expectations.
4. Tests shape school curricula and restrict educational change. When teachers know that the evaluation of students will be based on a specific standardized test, they often teach toward passing that test.
5. Tests may discriminate against some individuals. Some tests are racially and culturally biased, although many of the standardized tests have been revised to alleviate this problem (NEA, 1977).

One of the leading standardized tests of student achievement is the Iowa Tests of Educational Development. This test, used by the Anchorage School District to measure student academic growth, serves as the data base for this study.

Iowa Tests of Educational Development

The Iowa Tests of Educational Development was first published in 1942 (SRA, 1972b). Major authors were

E. F. Lindquist and Leonard S. Feldt, with the assistance of Robert Forsyth and Esther Neckere (Buros, 1978). The original instrument was composed of nine subtests:

1. Background Knowledge in Social Studies
2. Background Knowledge in Natural Sciences
3. Correctness and Appropriateness of Expression (including Spelling)
4. Quantitative Thinking
5. Interpretation of Reading Material in the Social Sciences
6. Interpretation of Reading Material in the Natural Sciences
7. Interpretation of Reading Material in Literature
8. General Vocabulary
9. Use of Sources of Information

(SRA, 1972b, p. 2).

Each of the first seven tests required approximately one hour of administration time, the last two requiring approximately twenty-five minutes each (SRA, 1972).

Since the development of the original test in 1942, the test has been shortened from nine subtests to eight, requiring some 215 minutes of test time. The subtests include the following:

1. Short Test of Educational Ability - STEA (20 minutes)
2. Reading Comprehension (40 minutes)
3. Reading Vocabulary (15 minutes)
4. Language Arts Usage and Spelling (40 minutes)
5. Mathematics (40 minutes)
6. Social Studies (20 minutes)
7. Science (20 minutes)
8. Use of Sources (20 minutes)

(SRA, 1972a, p. 2).

Work on the present ITED began in 1964 when about forty high school teachers and university professors wrote

the questions for the exam. Pretesting was done through the Iowa State Testing Program, with each item being given to approximately 150 students. After item analysis and content and skill specifications were conducted, the original 7,502 questions were narrowed to 660.

The standardization process was accomplished in April, 1971, using 30,085 pupils in 816 schools in 224 districts. The schools were selected through an elaborate system of stratification on both geographic and demographic variables, with special provisions for subgroups of special interest.

In 1970, writers developed two forms of the test, the X-5 and Y-5. Norms for both versions were obtained in the Spring of 1970 from eleven schools in nine states. A version of the Y-5 was standardized in 1971. According to Milholland, the Y version is preferable for middle and higher social classes (Buros, 1978).

Related Research

A number of studies have been conducted to determine relationships between standardized tests and school success. Some involve the California Achievement Test, The Scholastic Aptitude Test, or Tests of Achievement in Basic Skills; others involve the use of Iowa Tests of Educational Development (ITED). Further studies have been

conducted to determine validity of standardized tests with disadvantaged and minority students. The reports are inconclusive. A brief review of those reports follows. The first reviews are of studies involving standardized tests in general, the second reporting the limited relationship of the ITED with other factors, and the final group reporting studies of standardized tests with disadvantaged and minority students.

Young, Regedal, and Knapp (1973) made a comparison of elementary school mathematics grades with scores on the Test of Achievement in Basic Skills (TABS). Over 750 students in grades 4, 5, and 6 participated in this study. The data suggested a moderate correlation between grades and the achievement test.

A study of 100 high school freshman English and Mathematics students by Nolan and Jacobson (1972) compared grades to scores on the California Comprehensive Test of Basic Skills (CCTB), scores on a second scholastic aptitude test, and ratings on a general intelligence test. The CCTB appeared to be a more valid indicator of success than the other tests.

Mauger and Kolmodin (1975) indicated that Scholastic Aptitude Verbal and Mathematics Test scores have sufficient validity for use in predicting how the typical student would do in college. This study followed the

success of its participants through college graduation, indicating some long-term predictive value to the test.

Carlson and Fullmer (1959) reported a relationship of the Iowa Tests of Educational Development to grade point averages of students at Oregon State College and the University of Oregon. Using tenth grade scores, the researchers developed a chart indicating that students who attain a higher total ITED composite score will achieve higher grade point averages in college. That chart is shown in Figure 1.

Aucker (1971) in a study of 218 senior high school students who were enrolled in Boulder Valley Area Vocational Technical Center, found their performance about average on the ITED and GATB. He stated that counselor ratings were more consistently significant predictors of success than the ITED and GATB.

Litherland (1966) conducted a study of 3,358 nursing students in 20 nursing schools in the state of Iowa. He indicated that the ITED had some predictive power for nursing school success, but that high school grade point average was considerably more reliable than the ITED.

Petry and Craft (1977) investigated high risk, disadvantaged, and low income college students who were enrolled in teacher education classes at Memphis State University. An investigation of four standardized

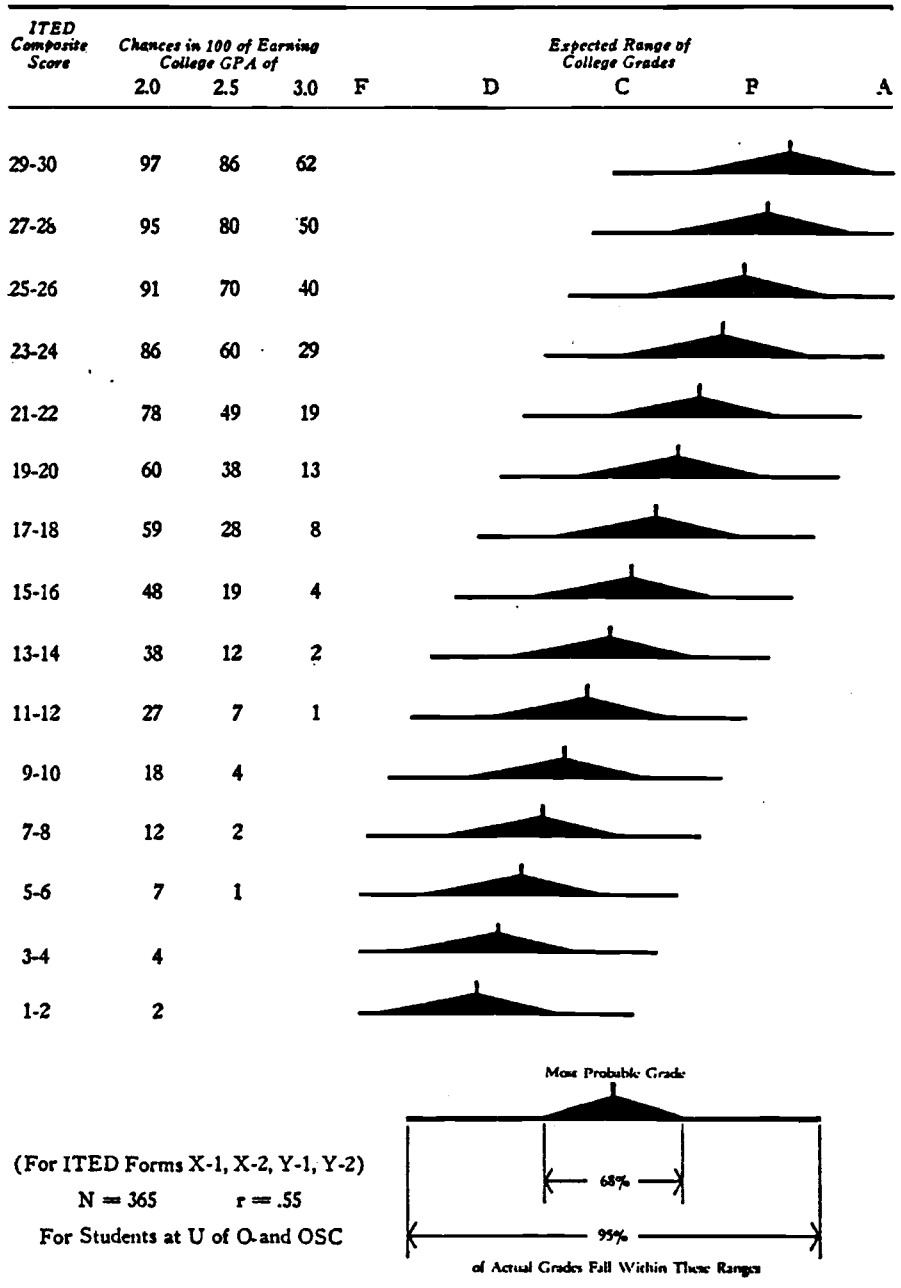

Figure 1. Experience Graph Showing Relationship Between Tenth Grade Composite Scores on the Iowa Tests of Educational Development and Grade Point Average at Oregon State College and at the University of Oregon (Carlson & Fullmer, 1959) p. 11).

instruments resulted in three having low predictive value, with the Cooperative School and College Ability Test (SCAT) having moderate value. The SCAT was the best of the four in over-all comparison with grade point average.

Coombs, Kron, Collister, and Anderson (1969) studied small, rural schools in eleven southwestern states. They administered the California Achievement Test (CAT) to 23,608 students, consisting of 58 percent of Indian heritage. They reported that Caucasian students scored significantly better than non-Caucasian students on standardized achievement tests.

In conclusion, there is conflicting evidence of the value of standardized achievement testing. Nevertheless, these conflicts tend to be overridden by the need for such instruments as the ITED for counseling purposes and curricular work. The present Anchorage study relates closely with these latter needs which exist within the school.

III. DESIGN AND METHODOLOGY OF THE STUDY

The primary focus of this study was to compare Iowa Tests of Educational Development (ITED) scores with achievement letter grades (A, B, C, D, F) in vocational education classes at Bartlett High School, Anchorage, Alaska.

The secondary purposes of this study were to compare:

1. the results of ITED scores of Bartlett students enrolled in vocational education classes at the Career Center, Bartlett students enrolled in non-vocational education classes, and students enrolled in vocational education classes at Bartlett High School, and
2. the results of ITED scores of Bartlett Caucasian vocational education students with Bartlett Non-Caucasian vocational education students.

The Instrument

The Anchorage School District schedules a district-wide assessment of all elementary and secondary students each Spring for the purposes of evaluating the amount of individual student educational growth from year to year. The ITED has been used as an evaluation instrument for

the past ten years. Since this test is noted for its high degree of validity and reliability, its scores were drawn from school records for the purposes of this study. The ITED test scores constituted the dependent variable for the research (for sample questions, see Appendix D)

School records showed that ninety-six percent of Bartlett High School's students completed the ITED exam during the Spring of 1979. Any student with incomplete ITED scores was excluded from the study.

Test Description

The Reading portion of the Iowa Tests of Educational Development is composed of two subtests:

1. Comprehension - designed to measure the student's ability to critically analyze what he/she reads. The student is required to interpret and analyze ideas, and relate these ideas to one another.
2. Vocabulary - designed to measure the student's ability to know the meaning of a variety of words encountered in readings of high school students.

The total reading score is derived from the comprehension and vocabulary sections, providing a measure of the overall reading ability of the student.

The Language Arts test is also composed of subtests:

1. Language Usage - provides a measure of the student's ability to use the basic elements required in correct and effective writing, including punctuation, capitalization, manner of expression, word and sentence order, and organization of ideas.
2. Spelling - measures the student's ability to recognize spelling errors in 160 words, many of which are often misspelled in student writing.

The total score on the Language Arts test measures the student's ability to use the English language correctly.

The Mathematics test measures the student's ability to solve problems drawn from two broad mathematics areas - practical, realistic situations calling for the use of practical mathematics concepts, and problems requiring an understanding of number systems and other advanced mathematical ideas.

The test in Social Studies is constructed in two parts - questions based on the Social Studies passages in the Reading Comprehension subtest, and a Social Studies background test. The score from this test measures the student's ability to read and interpret Social Studies material, and to understand present-day social

institutions, the major factors that affect our economy, and world developments that are important historically.

There are also two parts to the Science test - two Science passages in the Reading Comprehension subtest, and a Science background test. These tests are designed to measure the student's ability to read science material and to understand important facts, principles, applications, and generalizations derived from the biological, physical, and earth sciences.

The Use of Sources test is a measure of the student's familiarity with, and ability to use, library references and other sources of information. The student is required to determine the most appropriate source of information for a specific purpose, and to explain the guides by which library materials are referenced (SRA, 1972a).

Scoring

Scoring the ITED can be accomplished either by hand or by machine. Information is available for hand scorers to convert raw score data to national percentiles, and to a stanine score. When an entire school is tested, the District usually purchases the scoring service. In this case, a special answer sheet is provided with the rented tests, in a Digitek, IBM 1230, NCS, or SRA form.

The results are available in a number of formats. Each student is provided with two self-adhesive Presscore labels for permanent school records. The first contains standard scores, growth scale values, and national percentiles for the ITED battery, and the quotient, national percentile, and stanine for the STEA. The information is placed on the student's official school transcript. The second label, which uses the Student Profile Sheet, contains national percentile and stanine scores for the ITED, and is given to the student or his and/or her parents with an explanation of score interpretation.

The test service makes available a computer printout which lists test results alphabetically by grade level. Average test scores by test and grade level are available to allow comparison from school to school, or comparison to the national average. Available as an optional service is a printout, in descending order, of each student's scores in Reading, Language Arts, Mathematics, and Composite Totals. Likewise, computer punched cards or magnetic tapes of raw scores or converted scores are available as options.

Reliability of the Iowa Tests of Educational Development

Buros (1978) reports:

> The reliability data include K-R 20 coefficients, together with standard errors of measurement for

> each test, subtest, and composite scores at each grade from 9 - 12. The majority of these coefficients are .90 or above, while all but one of the remainder are above .80. The K-R 20 coefficients compare favorably with most other published tests. No parallel-form reliability coefficients are reported (p. 59).

The reliability of the ITED was judged to be adequate for purposes of the study.

The Population

The official population of Anchorage, Alaska is 173,000 people, although the Municipality estimates the population to be closer to 220,000. Of these, 39,000 are enrolled in the Anchorage school system.

Bartlett High School is one of six high schools in the Anchorage area. Located between Elmendorf Air Base and Fort Richardson Army Base, fifty percent of Bartlett's students come from "military" families. Bartlett is a four-year comprehensive high school. A portion of its 1979-80 operating budget lists:

Principals Salaries	$ 224,700
Teachers Salaries	2,115,600
Textbooks	30,000
Teaching Supplies	68,000
Replacement Equipment	5,011
New Equipment	7,769
All Other Expenditures	1,630,182

(Anchorage School District, 1979, pp. 653-660).

The faculty consists of 102 full-time certificated staff members, serving a total enrollment of 1,892 students.

The population is listed as follows:

Freshmen	562
Sophomores	503
Juniors	450
Seniors	377

(Anchorage School District, 1979, n.p.)

Table 1 shows the student population by race. For a more complete description of the student population peculiar to each hypothesis, see Appendix D.

Table 1

Bartlett Student Population by Race

		Alaska Native	American Indian	Asian	Black	Philipp.	Hisp.	Cauc.	Total
9th Grade	Number	21	3	8	46	1	9	474	562
	%	3.7	.5	1.4	8.2	.2	1.6	84.3	
10th Grade	Number	12	1	3	32	1	6	448	503
	%	2.4	.2	.6	6.4	.2	1.2	89.1	
11th Grade	Number	15	0	4	35	2	6	388	450
	%	3.3	0	.9	7.8	.4	1.3	86.2	
12th Grade	Number	7	1	4	23	1	5	336	377
	%	1.9	.3	1.1	6.1	.3	1.3	89.1	
School Total	Number	55	5	19	136	5	26	1,646	1,892
	%	2.9	.3	1.0	7.2	.3	1.4	87.0	

Bartlett students normally enroll in six classes each semester in the available curriculum, including required classes in English, Mathematics, Personal Finance, Physical Education, Science, and Social Studies. Elective classes are also offered in these areas, as well as in Business, Fine Arts, Foreign Language, Home Economics, and Industrial Education.

In addition, students have a variety of learning alternatives, including:

Career Center: A technical school located in the center of the city. Students from each of the high schools may attend for a three-hour block of instruction in any of the following subjects:

Auto Body Repair

Auto/Truck Mechanics

Carpentry

Child Care

Commercial Art

Construction Electricity

Emergency Medical Treatment

Fashion Merchandising

Food Service

Graphic Arts

Masonry

Media Production

Natural Resources

Surveying/Drafting

Tourism

Stellar Alternative School: A school for independent learning.

S.A.V.E. II: A program for students who have problems with regular school classes. It is a "last chance" vocationally-oriented program for potential dropout juniors and seniors.

Work-Study: A location for special education and handicapped students.

Bartlett students are encouraged to take a balanced program of required and elective courses. They are not tracked according to college or vocational career plans. Students make all class selections in a college-type registration process.

Vocational education classes at Bartlett include:

Business Education:

Typing 1, 2, 3, and 4

Bookkeeping 1 and 2

Shorthand 1, 2, 3, and 4

Office Machines 1 and 2

Distributive Education 1, 2, 3, and 4

Office Education 1 and 2

Independent Study

Home Economics:

Foods 1, 2, 3, and 4

Clothing 1, 2, 3, and 4

Creative Stitchery

Child Development

Independent Study

Industrial Arts:

Architectural Drawing 1 and 2

Engineering Drawing

Drafting 1 and 2

Transportation 1 and 2

Woods 1 and 2

Graphic Arts 1 and 2

Photography 1 and 2

Independent Study

Fifty-six percent of Bartlett's students were enrolled in vocational education classes either at Bartlett High School or at the Career Center during the Spring semester of 1979. Of these, 876 attended classes at Bartlett, and 180 attended classes at the Career Center (Anchorage School District, 1979).

The Samples

Comparing ITED Scores with Achievement Grades

For this research, final class rosters were obtained from each vocational education class for the Spring semester of 1979. The student population was divided according to final achievement letter grades (A, B, C, D, or F). If a student was enrolled in two or more vocational

education classes and received different final grades, he and/or she was excluded from the sampling. The grade distribution of the student population consisted of the following:

A = 131

B = 196

C = 240

D = 99

F = 75

Groups of 39 students were randomly selected, with replacements available from each letter grade category. Sample size by achievement grade is shown in Table 2.

Table 2

Sample Size by Achievement Grade

A	B	C	D	F
n = 39	n = 39	n = 39	n = 39	n = 39

This sample size provided a power level which equalled .80, an effect size of .25, and α = .05 (Cohen, 1969). This power level assured that Type I errors would not be committed in the significane testing at the rate of greater than twenty percent of the time.

Comparing ITED Scores of Career Center, Bartlett Vocational Education, and Bartlett Non-Vocational Education Students

Alphabetical rosters by grade level were obtained at the end of the Spring semester of 1979. The student population was classified into three groups: Career Center Students (BCC), Bartlett High School Vocational Education Students (BVE), and Bartlett High School Non-Vocational Education students (BNVE). The number of student population in each group consisted of the following:

Career Center (BCC) = 180

Bartlett High School Vocational Education (BVE) = 876

Bartlett High School Non-Vocational Education (BNVE) = 835

Groups of 74 students were randomly selected, with replacements available for each category. Sample size by category is shown in Table 3.

Table 3

Sample Size by Educational Category

Career Center	Bartlett Vocational Education	Bartlett Non-Vocational Education
n = 74	n = 74	n = 74

With this sample size, the power of the test equalled .90 with an effect size of .25, and $\alpha = .05$ (Cohen, 1969). This level of power conditioned the significance testing such that not more than ten Type I errors were probable in one hundred such tests.

Comparing ITED Scores of Vocational Education Caucasian with Vocational Education Non-Caucasian Students

Class rosters of Bartlett vocational education classes for the Spring of 1979 were obtained. They were divided into two groups - Caucasian and Non-Caucasian. The group for Non-Caucasian consisted of:

1. Alaska Native
2. American Indian
3. Asian
4. Black
5. Philippino
6. Hispanic

There were a total of 835 Caucasian and 117 non-Caucasian students enrolled in vocational education classes. Two groups of 79 students were randomly selected, with replacements available from each group. Sample size by group is shown in Table 4. The power of the test was .80, with an effect size of .25, where $\alpha = .05$ (Cohen, 1969). Hence, Type I errors could not

be committed more than twenty percent of the time when samples of this size were drawn for testing.

Table 4

Sample Size by Race

Caucasian	Non-Caucasian
n = 79	n = 79

Design of the Study

The design of this study called for a fixed one-way arrangement, using Analysis of Variance in testing all three hypotheses. The basic statistical tool used for testing the hypotheses was the F statistic. Snedecor and Cochran (1967) suggest the following mathematical model when analyzing more than two independent samples:

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

Wherein:

Y_{ij} is the dependent variable

μ is the overall mean

α_i is the differential effect due to treatment

ε_{ij} is a random element from a normally distributed population with a mean of zero and variance of σ^2.

All of the student participants were randomly assigned, with replacements being made when ITED subtest scores were incomplete. All data were processed through the Oregon State University Computer Center.

The Major Hypothesis

The hypothesis of major interest in conducting the research was the following:

H_1 There is no significant difference between the ITED subtest scores and student achievement grade levels in vocational education classes.

($\mu A = \mu B = \mu C = \mu D = \mu F$)

The ANOVA layout schema used in testing the hypothesis is illustrated in Table 5.

Table 5

ANOVA Layout Schema for Hypothesis 1.

Sources of Variation	Degrees of Freedom (df)	Sum of Squares	F-Ratio
Between Groups	4	A/4	$\frac{\text{MS Between}}{\text{MS Error}}$
Within (Error)	190	B/156	
Total	194	C/194	

Decision rules for rejection of the null hypothesis were as follows, with the critical tabular value based upon $\alpha = .05$, and df = 4, 190.

If computed $F \geq 2.41$, reject H_1.

If computed $F < 2.41$, retain H_1.

In the event the null hypothesis was rejected, a multiple comparisons test was required to ascertain where significant differences existed. The Least Significant Difference (L.S.D.) test was selected for this analysis, with the following a priori alternate hypotheses being utilized:

$H_{1.1}$ $\mu A > \mu F$

$H_{1.2}$ $\mu B > \mu F$

$H_{1.3}$ $\mu C > \mu F$

$H_{1.4}$ $\mu D > \mu F$

Because the L.S.D. is limited to N-1 comparisons, only four alternate hypotheses could be tested when five means were present. These a priori hypotheses represented the comparison of interest for the study.

Minor Hypotheses

Two additional hypotheses, representing minor areas of concern in the study, are cited as Hypotheses 2 and 3.

H_2 There is no significant difference between the ITED subtest scores for Bartlett students enrolled in vocational Career Center classes, Bartlett students enrolled in non-vocational education classes, and students enrolled in

Bartlett vocational education classes.

(μ BCC = μ BNVE = μ BVE)

The ANOVA layout schema is illustrated in Table 6.

Table 6

ANOVA Layout Schema for Hypothesis 2.

Sources of Variation	Degrees of Freedom (df)	Sum of Squares	F-Ratio
Between Groups	2	A/4	$\frac{\text{MS Between}}{\text{MS Error}}$
Within (Error)	213	B/216	
Total	215	C/220	

Decision rules for rejection of the null hypothesis were established with α = .05 and df = 2, 213.

If computed F $\geq$ 3.04, reject H_2.

If computed F < 3.04, retain H_2.

In the event the null hypothesis was rejected, a multiple comparisons test was required to ascertain the location of significant differences. The L.S.D. test was selected, with the following a priori alternate hypotheses being utlized:

$H_{2.1}$ μ BCC > μ BNVE

$H_{2.2}$ μ BVE > μ BNVE

H_3 There is no significant difference between ITED subtest scores of Caucasian and Non-Caucasian students enrolled in vocational education classes at Bartlett.

The ANOVA layout schema for this hypothesis is illustrated in Table 7.

Table 7

ANOVA Layout Schema for Hypothesis 3.

Sources of Variation	Degrees of Freedom (df)	Sum of Squares	F-Ratio
Between Groups	1	A/1	$\frac{\text{MS Between}}{\text{MS Error}}$
Within (Error)	156	B/156	
Total	157	C/157	

Decision rules for rejection of the null hypothesis utilized a critical F value based upon an $\alpha = .05$, and degrees of freedom (df) = 1, 156. The tabular F was 3.92.

If the computed $F \geq 3.92$, reject H_3.

If the computed $F < 3.92$, retain H_3.

IV. PRESENTATION AND ANALYSIS OF DATA

This chapter presents the results of the statistical analysis of the data. The results are presented in two sections, with the major hypothesis being considered first.

Major Hypothesis

The primary purpose of this study was to compare Iowa Tests of Educational Development scores with achievement letter grades (A, B, C, D, F) in vocational education classes at Bartlett High School, Anchorage, Alaska. Thus, the major hypothesis was:

H_1 There is no significant difference between the ITED subtest scores and student achievement grade levels in vocational education classes.

The information in Table 8 has been synthesized from the computer data pertaining to H_1. Since all of the null hypotheses were rejected, with a computed F being greater than the critical (tabular) value of 2.41, an L.S.D. test was conducted to determine the locations of significant differences. Table 9 provides the results of the testing of these alternate hypotheses.

Table 8

Analysis of Letter Grades and Subtest Scores

Group	Reading Comprehension	Reading Vocabulary	Language Arts Usage	Language Arts Spelling	Mathematics	Social Studies	Science	Use of Sources
F	12.3077	12.2821	10.4359	12.3077	9.0256	11.1538	12.0256	10.9744
D	13.4359	13.0513	11.7436	12.5897	11.6667	11.7436	13.7692	12.4103
C	13.8718	15.2564	14.5385	13.9744	13.3333	13.8974	15.8718	13.7179
B	16.6667	16.5897	15.5385	15.9487	14.9744	15.6144	17.6667	17.2821
A	20.7436	19.5385	18.0256	16.9744	19.0513	15.0256	20.9744	20.7436
Computed F Ratio	18.537	9.862	14.178	6.068	15.556	14.500	15.194	19.472
F Probability	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000
Retain or Reject Hypothesis	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject

As indicated in Table 9, the Reading Comprehension scale showed differences as existing between grade levels A, B, and C when compared to F. Only grade levels D and F contained no significant differences as the L.S.D. test results were evaluated.

Table 9

L.S.D. Results for Hypothesis 1
Reading Comprehension

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_o Decision	
A	20.7436	9.7692	2.5042	$\mu A > \mu F$	Significant Difference
F	10.9744				
B	17.2821	6.3077	2.5042	$\mu B > \mu F$	Significant Difference
F	10.9744				
C	13.7179	2.7435	2.5042	$\mu C > \mu F$	Significant Difference
F	10.9744				
D	12.4103	1.4359	2.5042	$\mu D = \mu F$	No Significant Difference
F	10.9744				

Reading Vocabulary and Language Arts Usage testing reflected differences which were similar to those results reported for the Reading Comprehension Scale. For these results, only grade levels D and F showed no differences when the Least Significant Difference Test was computed. These results are displayed in Tables 10 and 11.

Table 10

L.S.D. Results for Hypothesis 1
Reading Vocabulary

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_o Decision	
A	19.5385	7.2564	2.5820	$\mu A > \mu F$	Significant Difference
F	12.2821				
B	16.5897	4.3076	2.5820	$\mu B > \mu F$	Significant Difference
F	12.2821				
C	15.2564	2.9743	2.5820	$\mu C > \mu D$	Significant Difference
F	12.2821				
D	13.0513	.7692	2.5820	$\mu D = \mu F$	No Significant Difference
F	12.2821				

Table 11
L.S.D. Results for Hypothesis 1
Language Arts Usage

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_o Decision	
A	18.0256	7.5897	2.2425	$\mu A > \mu F$	Significant Difference
F	10.4359				
B	15.5385	5.1026	2.2425	$\mu B > \mu F$	Significant Difference
F	10.4359				
C	14.5385	4.1026	2.2425	$\mu C > \mu F$	Significant Difference
F	10.4359				
D	11.7436	1.3077	2.2425	$\mu D = \mu F$	No Significant Difference
F	10.4359				

The Language Arts Spelling subtest scores were found to be significantly different for grade levels A and F and for grade levels B and F. Other comparisons were not shown to be significantly different. Table 12 shows these results.

Table 12

L.S.D. Results for Hypothesis 1
Language Arts Spelling

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_0 Decision	
A	16.9744	4.6667	2.3249	$\mu A > \mu F$	Significant Difference
F	12.3077				
B	15.9487	3.6410	2.3249	$\mu B > \mu F$	Significant Difference
F	12.3077				
C	13.9744	1.6667	2.3249	$\mu C = \mu F$	No Significant Difference
F	12.3077				
D	12.5897	.2820	2.3249	$\mu D = \mu F$	No Significant Difference
F	12.3077				

For the other four analyses, covering Mathematics, Social Studies, Science, and Use of Sources, no significant differences were detected between grade levels D and F. Other multiple comparisons indicated significant differences between levels tested in the a priori research. These results are reported in Tables 13 - 16.

Table 13

L.S.D. Results for Hypothesis 1
Mathematics

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_o Decision	
A	19.0513	10.0257	2.6548	$\mu A > \mu F$	Significant Difference
F	9.0256				
B	14.9744	5.9488	2.6548	$\mu B > \mu F$	Significant Difference
F	9.0256				
C	13.3333	4.3077	2.6548	$\mu C > \mu F$	Significant Difference
F	9.0256				
D	11.6667	2.6411	2.6548	$\mu D = \mu F$	No Significant Difference
F	9.0256				

Table 14

L.S.D. Results for Hypothesis 1
Social Studies

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_o Decision	
A	19.0256	7.8718	2.3359	$\mu A > \mu F$	Significant Difference
F	11.1538				
B	15.6154	4.4616	2.3359	$\mu B > \mu F$	Significant Difference
F	11.1538				
C	13.8974	2.7436	2.3359	$\mu C > \mu F$	Significant Difference
F	11.1538				
D	11.7436	.5898	2.3359	$\mu D = \mu F$	No Significant Difference
F	11.1538				

Table 15

L.S.D. Results for Hypothesis 1
Science

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_o Decision	
A	20.9744	8.9488	2.4870	$\mu A > \mu F$	Significant Difference
F	12.0256				
B	17.6667	5.6411	2.4870	$\mu B > \mu F$	Significant Difference
F	12.0256				
C	15.8718	3.8462	2.4870	$\mu C > \mu F$	Significant Difference
F	12.0256				
D	13.7692	1.7436	2.4870	$\mu D = \mu F$	No Significant Difference
F	12.0256				

Table 16
L.S.D. Results for Hypothesis 1
Use of Sources

Grade	$\bar{X}$	Difference	Critical L.S.D. Value	H_o Decision	
A	20.7436	8.4359	2.1955	$\mu A > \mu F$	Significant Difference
F	12.3077				
B	16.6667	4.3590	2.1955	$\mu B > \mu F$	Significant Difference
F	12.3077				
C	13.8718	1.5641	2.1955	$\mu C > \mu F$	Significant Difference
F	12.3077				
D	13.4359	1.1282	2.1955	$\mu D = \mu F$	No Significant Difference
F	12.3077				

Minor Hypotheses

The secondary purposes of this study were to compare the ITED scores of Bartlett students enrolled in the Career Center, Bartlett students enrolled in non-vocational education classes, and Bartlett students enrolled in vocational education classes; also, to compare Bartlett Caucasian vocational education students with Bartlett Non-Caucasian vocational education students. Thus, the first minor hypothesis was:

H_2 There is no significant difference between the ITED subtest scores for Bartlett students enrolled in Vocational Career Center classes, Bartlett students enrolled in non-vocational education classes, and students enrolled in Bartlett vocational education classes.

The information in Table 17 has been synthesized from the data pertaining to the second hypothesis. Only two of the subtests had a computed $F \geq 3.04$. These included Mathematics and the Use of Sources. An L.S.D. test was conducted for these scores to determine the location of the differences. Tables 18 and 19 show where these differences occur.

Table 17

Analysis of Bartlett Career Center, Non-Vocational Education, and Bartlett Vocational Education Subtest Scores

Group	Reading Comprehension	Reading Vocabulary	Language Arts Usage	Language Arts Spelling	Mathematics	Social Studies	Science	Use of Sources
Bartlett Career Center	16.5676	16.8919	14.7297	14.6081	13.7027	15.7568	17.3378	15.7838
Bartlett Non-Voc. Ed.	17.7027	18.3243	16.5135	16.0405	17.3514	17.5811	18.8108	18.9189
Bartlett Voc. Ed.	15.5405	16.6757	15.4189	14.6081	14.5000	15.4054	16.6081	15.9865
Computed F Ratio	2.605	1.591	2.075	1.752	6.252	3.003	2.494	5.213
F Probability	.0762	.2061	.1281	.1758	.0023	.0517	.0849	.0061
Retain or Reject Hypothesis	Retain	Retain	Retain	Retain	Reject	Retain	Retain	Reject

Table 18

L.S.D. Results for Hypothesis 2 Mathematics

Group	$\bar{X}$	Difference	Critical L.S.D. Value	H_0 Decision	
BCC	13.7027	3.6487	2.1405	μBCC < μBNVE	Significant Difference
BNVE	17.3514				
BVE	14.5000	2.8514	2.1405	μBVE < μBNVE	Significant Difference
BNVE	17.3514				

Table 19

L.S.D. Results for Hypothesis 2
Use of Sources

Group	$\bar{X}$	Difference	Critical L.S.D. Value	Decision	
BCC	15.7838	3.1351	2.1439	μBCC < μBNVE	Significant Difference
BNVE	18.9189				
BVE	15.9865	2.9324	2.1439	μBVE < μBNVE	Significant Difference
BNVE	18.9189				

As indicated by these results, significant differences were found to exist for both the Mathematics and Use of Sources subtests. In both instances, the BNVE group scores were found to be higher than the BCC group score. Concurrently, the BNVE group means were higher than those of the BVE group when these scores were contrasted.

A second minor hypothesis for the study was:

H_3 There is no significant difference between ITED subtest scores of Caucasian and non-Caucasian students enrolled in vocational education classes at Bartlett.

The information in Table 20 has been summarized from the data pertaining to Hypothesis 3.

Table 20

Analysis of Caucasian and Non-Caucasian Subtest Scores

Group	Reading Comprehension	Reading Vocabulary	Language Arts Usage	Language Arts Spelling	Mathematics	Social Studies	Science	Use of Sources
Caucasian	15.8608	16.7215	15.0633	14.9820	15.3291	15.5696	16.9367	16.2405
Non-Caucasian	13.0253	13.7595	13.0000	13.1392	11.8608	12.6835	13.4430	13.3165
Computed F Ratio	10.488	10.452	7.895	4.384	14.209	10.791	12.217	8.228
F Probability	.0005	.0015	.0056	.0379	.0002	.0013	.0008	.0047
Retain or Reject Hypothesis	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject

As indicated in the table, in every instance, Caucasian mean scores were found to be significantly larger than those of the Non-Caucasian group. The probability levels in each case failed to exceed the .05 alpha level established in the hypothesis testing.

Summary of Data

The statistical data for all three hypotheses were assessed using one-way analysis of variance. The analysis of the major hypothesis indicated that the students who achieved high letter grades in vocational education classes scored significantly better on the ITED

achievement test than those students who received low letter grades. The Least Significant Difference (L.S.D.) test showed that those students who received a letter grade of A obtained significantly better scores than all other letter grades. In addition, there was a significant difference between students who received B letter grades and those who received the letter grade of F. The remaining grades had significant ITED score differences in some subtests.

An analysis of Bartlett Career Center, Bartlett Non-Vocational Education, and Bartlett Vocational Education students showed no significant difference on six of the ITED subtest scores: Reading Comprehension, Reading Vocabulary, Language Arts Usage, Language Arts Spelling, Science, and Social Studies. However, the F statistic indicated there was a significant difference between the groups on Mathematics and Use of Sources. The L.S.D. analysis indicated there was a significant difference between non-vocational education students and the other two groups. No significant difference was found between the Bartlett Career Center and Bartlett vocational education students on any of the subtests.

The results indicated a significant difference between the scores of Caucasian and Non-Caucasian vocational education students at Bartlett High School.

V. FINDINGS AND CONCLUSIONS

Achievement tests are administered in every state throughout the nation on an annual basis. The results are used to determine how well the student compares with others in the same school; how well the student compares with others in the same school district; how well the student compares to others nationwide; or to compare one teacher's methods of instruction to another for teacher evaluation purposes. Guidance counselors are given the scores, but seldom use them for student placement in vocational education classes. The focus of the present study was to determine if Iowa Tests of Educational Development scores could be used as a counseling indicator in vocational education classes at the high school level.

Restatement of the Problem

The primary focus of this study was to compare Iowa Tests of Educational Development (ITED) scores with achievement letter grades in vocational education classes at Bartlett High School, Anchorage, Alaska. Secondly, ITED scores were compared with final grades of Career Center students, Bartlett non-vocational education students, and Bartlett vocational education students.

Lastly, a comparison was made of ITED scores of Caucasian vocational education students with non-Caucasian vocational education students.

The Instrument

The instrument used for this study was the Iowa Tests of Educational Development. The test consisted of eight subtests; namely, Reading Comprehension, Reading Vocabulary, Language Arts Usage, Language Arts Spelling, Mathematics, Social Studies, Science, and Use of Sources.

Raw scores in each subtest were analyzed, using one-way analysis of variance procedures. Where the F-statistic indicated a significant difference for three or more groups, the Least Significant Difference (L.S.D.) test, a multiple comparisons technique, was conducted to ascertain the location of the differences.

Findings

Based upon the analysis of the dependent variable, a significant difference was found to exist between ITED scores of students who achieved A or B grades in vocational education classes and scores of students who achieved D or F grades in vocational education classes. Even though vocational education classes are more activity-oriented than other courses, those students who

scored higher on the ITED generally received higher grades in vocational education classes.

Based upon the results of the analysis of ITED subtest scores of Bartlett Career Center, Bartlett non-vocational education, and Bartlett vocational education students, there was no significant difference in scores in Reading Comprehension, Reading Vocabulary, Language Arts Usage, Language Arts Spelling, Social Studies, and Science. However, the research did indicate a significant difference between scores of non-vocational education students, of Bartlett Career Center students, and the Bartlett vocational education sample in the Mathematics and Use of Sources subtests.

The results of the Caucasian versus non-Caucasian data indicated that minority students scored lower on the ITED than did Caucasian students who were enrolled in vocational education classes at Bartlett High School.

Conclusions

Based upon the results of this study, the following conclusions were drawn:

1. Mastery of the basic skills for vocational education classes is as important as in academic areas, as reflected by the number of students who had low ITED scores and achieved D or F grades in vocational education classes.

2. The stigma of vocational education classes as a "dumping ground" for the academic classes was shown to be a misconception. Based upon the results of the student scores on the English, Science, and Social Studies subtests, there was no difference between vocational and non-vocational students. However, the non-vocational students did score higher on the Mathematics and Use of Sources subtests.
3. Either the ITED is culturally biased, or the basic education courses for minority students are structured such that minority students are not learning the necessary basic skills to succeed on the ITED achievement test. The scores of the minority students agreed with the findings of Coombs et al. (1969) that minority students do not achieve as well as Caucasian students on achievement tests.

Observations

The following observations are given in order to provide further detail to the findings. These observations are based upon on-site instructional matters peculiar to the Anchorage School District.

1. Approximately fifty percent of the student population are Bartlett High School originate from a

military background. Having moved from base to base, state to state, and even country to country may have had a positive effect upon the Social Studies scores of these students on the ITED.

2. The absentee rate of students in the Anchorage high schools is low compared to the national average. This is partially due to the Anchorage School Board's policy stating "a student may have class credit withheld after ten absences." This School Board policy may have had a positive effect on ITED scores.
3. The curriculum conditions within Bartlett High School require all students to enroll for equal amounts of credit in English, Science, and Social Studies. These requirements may account for the lack of variation among students who participated in the study. When testing samples of students using ITED subtests, especially those of Reading Comprehension, Reading Vocabulary, Language Arts Usage, Language Arts Spelling, Social Studies, and Science, it may be that this influence is a contributing factor in not finding statistically significant differences.

Suggestions for Action

On the basis of the findings, the following suggestions for action are provided. These actions are

believed to be of practical value for curriculum development and counseling in vocational education.

1. Test contamination, in the form of "test wiseness", may have contributed to the levels of achievement shown in the ITED subtest scores. Many students complain that the same form of the test is given each year, and state that they "know the questions by heart." Therefore, administrators should choose different forms of the test each year.
2. The non-Caucasian students may have been substantially handicapped because of their apparent inexperience in taking such tests in a formal school setting. In addition, in some cases, motivational issues may have contributed to the lowered scores for non-Caucasian students. Therefore, administrators should assist non-Caucasian students in building their test-taking vocabulary.
3. Because of the relationship between vocational education grades and ITED scores, it is suggested that the basic skills of reading, math, and science are important to success in vocational education classes. Because of this, all teachers should be aware of ITED scores for each of their students. As a weakness in the basic skills is indicated, the vocational education teacher should take special measures to help

that student improve these needed skills.

4. It is suggested that counselors meet with each student at least once each semester to discuss that student's ITED scores, including weaknesses and strengths. ITED scores should be considered in course and career planning.
5. Administrators in the Anchorage School District should consider having a resource person in each area of the basic skills available at all times for referral of vocational education students.

Suggestions for Further Study

The following areas of concern may be considered for additional study:

1. A comparison of ITED scores of vocational education students with non-vocational education students needs to be done within the same grade, such as seniors with seniors, and freshmen with freshmen.
2. A similar study should be conducted using the General Aptitude Test Battery or Tests of Academic Progress, both taking less testing time than the ITED.
3. A follow-up study needs to be designed to determine if the groups of students in the non-vocational education classes had taken more than the minimum

number of Mathematics classes for graduation, or had taken higher levels of English classes, such as Honors English, or Advanced Placement English.

4. A replication of the same design as the present study should be planned, drawing random samples from future enrolled populations of students in Anchorage and other cities in Alaska.
5. A replication of the same design using the X-5 version of the ITED test is suggested.
6. A comparison study should be conducted to determine if there is a relationship between grades in specific vocational education classes and specific ITED subtests, i.e., Typing with reading skills, or Machine Shop and Carpentry with mathematics skills.

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APPENDICES

APPENDIX A

Characteristics of Anchorage Schools

Characteristics of Anchorage Schools

ITED Composite Scores by Grade and School

Grade	Bartlett	Chugiak	Dimond	East	Service	West
9	14.0	14.5	14.1	13.2	14.9	14.2
10	16.8	16.6	16.7	15.9	16.7	16.3
11	18.3	18.1	18.8	18.4	19.4	17.3
12	19.7	18.8	20.3	19.9	19.5	19.5
$\bar{X}$	17.20	17.00	17.48	16.85	17.63	16.83

High School Population by Sex and Race

	Grades	Male	Female	Total	Alaska Native Am. Indian	Asian	Hispanic	Black	Caucasian
Bartlett	9-12	1056	977	2033	63	26	25	155	1764
%		51.94	48.06		3.10	1.28	1.23	7.62	86.77
Chugiak	7-12	810	671	1481	83	7	14	16	1361
%		54.69	45.31		5.60	.47	.95	1.08	91.90
Dimond	7-12	1403	1220	2623	159	37	34	54	2339
%		53.49	46.51		6.06	1.41	1.30	2.06	89.17
East	9-12	1047	1008	2055	159	54	30	210	1602
%		50.95	49.05		7.74	2.63	1.46	10.22	77.96
Service	7-12	1377	1288	2665	123	23	19	52	2448
%		51.67	48.33		4.62	.86	.71	1.95	91.86
West	9-12	1124	1037	2161	199	75	51	133	1703
%		52.01	47.99		9.21	3.47	2.36	6.15	78.81
District Total		6817	6201	13018	786	222	173	620	11217
%		52.37	47.63		6.04	1.71	1.33	4.76	86.17

APPENDIX B

DESCRIPTIONS OF ACHIEVEMENT TESTS

Commonly Used Achievement Tests

California Achievement Tests (California Test Bureau). Five levels (Grades 1 - 2, 2 - 4, 4 - 6, 7 - 9, 9 - 14); equivalent forms; 1 1/2 - 3 hours. Measures Reading (vocabulary, comprehension), Arithmetic (reasoning, fundamentals), and Language (mechanics and spelling). Measures educational attainment and diagnoses learning difficulties in basic skills.

Comprehensive Tests of Basic Skills (California Test Bureau). Four levels (2.5 - 4, 4 - 6, 6 - 8, 8 - 12); equivalent forms; 3+ hours. Reading (vocabulary, comprehension), Language (mechanics, expression, spelling), Arithmetic (concepts, computations, applications). Study Skills (reference materials, graphic materials). Emphasis on basic concepts, relations, skills.

Cooperative Achievement Tests (Educational Testing Service). Measures specific content in many typical high school courses....

- Languages
  - English Expression
  - French
  - Latin
  - Spanish
- Mathematics
  - Elementary Algebra (through Quadratics)
  - Intermediate Algebra (Quadratics and beyond)
  - Plane Geometry
  - Solid Geometry
  - Plane Trigonometry
- Social Studies
  - American Government
  - American History
  - World History
  - Ancient History
  - Modern European History

Iowa Tests of Basic Skills (Houghton Mifflin). Grades 3 - 9; equivalent forms; 6+ hours. Vocabulary, Reading Comprehension, Language (spelling, capitalization, punctuation, usage), Work-Study Skills (graphs, reference materials, tables, maps), Arithmetic Skills (concepts, problem solving). Uses generalized skills approach.

Commonly Used Achievement Tests (Continued)

Iowa Tests of Educational Development (Science Research Associates). Grades 9 - 12; equivalent forms; 2 days. Understanding of basic social concepts, Background in the natural sciences, Correctness and appropriateness of expression, Ability to do quantitative thinking, Ability to interpret reading materials in social sciences, Ability to interpret reading materials in natural sciences, Ability to interpret literary materials, General vocabulary, Uses of sources of information. Measures broad and generalized intellectual skills and abilities; what student can do, not what he knows.

Metropolitan Achievement Tests (Harcourt, Brace & World). Six levels (1, 2, 3 - 4, 5 - 6, 7 - 9, high school 9 - 13); equivalent forms; 2 - 4 hours. Content varies by level: Primary II (grade 2) tests Word Knowledge, Word Discrimination, Reading, Spelling, Arithmetic Concepts and Skills. Intermediate (5 - 6) covers Word Knowledge, Reading, Spelling, Language, Language Study Skills, Arithmetic Problem Solving and Concepts, Social Studies Information, Social Studies Study Skills, Science, Concepts and information tested separately.

SRA Achievement Series (Science Research Associates). Four levels (1 - 2, 2 - 3, 3 - 4, 4 - 9 multilevel); equivalent forms. Content varies by level: Multilevel (4 - 9) covers Reading (vocabulary, comprehension), Arithmetic (reasoning, concepts, computations), Language Arts (capitalization and punctuation, grammar usage, spelling), Social Studies, Science, Work-Study Skills (optional). Also has an optional test of modern math understanding.

Sequential Tests of Educational Progress (Cooperative Tests Division, Educational Testing Service). Four levels (4 - 6, 7 - 9, 10 - 12, 13 - 14); equivalent forms; 70 minutes per test. Reading, Writing, Listening (questions on orally presented materials), Mathematics, Science, Social Studies.

Commonly Used Achievement Tests (Continued)

Stanford Achievement Test (Harcourt, Brace & World). Six levels (1.5 - 2.4, 2.5 - 3.9, 4.0 - 5.9, 6.0 - 6.9, 7.0 - 9.9, high school); equivalent forms; up to 5+ hours. Coverage varies by level: Reading (word meaning, paragraph meaning), Language Arts, Arithmetic (computations, concepts), appear at all levels; Science and Social Studies from grade 4 up; other tests at various levels. (Brown, 1971, pp. 190-191).

Tests of Academic Progress (TAP) (Houghton Mifflin Company). Grades 9 - 12. Seven scores: Social Studies, Composition, Science, Reading, Mathematics, Literature. Two nonequivalent editions (Buros, 1974, p. 18).

APPENDIX C

DEVELOPMENT AND USES OF STANDARDIZED TESTS

Development of Standardized Tests

The basic procedure for developing a test is:

A. Planning the test
B. Writing the items
C. Pretesting items
D. Preparing the final form
E. Collecting reliability and validity evidence
F. Developing normative and interpretive material (Brown, 1976, p. 274).

Planning the Test

The test authors must first answer the question of what to measure - what content to put into the test. The test must be applicable to students from vastly different socioeconomic and home backgrounds, who have been taught by different teachers, and who attend schools, large and small, from all parts of the United States. Planners use one of three methods, or a combination of the three, in deciding what content shall be used.

1. Analysis of Outcomes.

   Pupils acquire new or modified ways of behavior as a result of instruction or learning. These changes indicate the degree to which instructional objectives have been attained. Determining the appropriate pattern of skills, knowledges, understandings, attitudes, and other outcomes is one way of deciding what content to include in a test.

2. Analysis of Textbooks and Courses of Study.
   Test authors sometimes analyze the content of a number of different textbooks and course outlines to determine test content.
3. Judgments of Qualified Persons.
   A panel may be chosen from groups of persons whose backgrounds and experiences qualify them as experts. Human judgment is the ultimate authority for final selection of valid content.

A final step of test planning involves, in some manner, interrelationships between instructional objectives and subject matter units or subdivisions. Decisions must be made concerning appropriate degrees of emphasis or content areas and pupil behaviors to be measured. Considerations are made of the number of objective items, the number in each of several levels of difficulty, and the number using verbal, numerical, graphical, or other forms of presentation (Gerberich et al., 1962).

Writing the Items

Test items may be written by individuals or a team. Following that, each test item is evaluated, with revisions made where necessary, or with rejection of the item entirely (Gerberich et al., 1962).

Trying Out the Items

All test items are pretested by the appropriate test group representing the correct age group, grade level, subject background, type of school, and section of the country. Following that, test papers are analyzed two major ways:

1. Item Analysis.

   Each test item is converted to a percentage of the pupils who received the correct answer. This figure is called the "index of item difficulty". Tests can thus be constructed with items of the same degree of difficulty.

2. Item Discriminative Power.

   Item responses are also analyzed separately for students who receive exceptionally high scores and students who receive exceptionally low scores. Numbers and percentages are obtained for both groups. The percentage for the "low" group is then subtracted from the "high" group, resulting in an "index of item discrimination" for each item. The test maker then uses this information as a basis for summarily rejecting a few items, for revising other items, and for retaining still others without change (Gerberich et al., 1962).

Assembling the Test

Items that are included in the final test are selected upon their discriminative power, their index of difficulty, and their contribution to attainment of the balance between subject content and behavioral outcome. After the items have been tentatively selected, and the necessary instructions written, they are once again evaluated by a review committee, where changes are made before sending the test to the publisher for printing.

Preparing the Accessory Materials

Any accessory material that is needed, including directions, answer sheets, scoring sheets, and profile sheets, must be prepared for teachers and other school personnel. In addition, information for student and parent interpretation of test data must be prepared.

Interpreting Test Results

After the test has been administered to large numbers of students of the appropriate type, those scores are used to establish norms necessary for giving meaning to test scores (Gerberich et al., 1962).

Uses of Standardized Tests

Standardized tests have many uses:

1. Determining Initial Status.

   Standardized tests can be used to group students

according to ability levels. Quite often schools and universities will administer standardized tests for the purpose of determining the number of different levels of Math or English courses to be offered. Many educators believe it is better for students to be placed in courses with others of approximately the same level, rather than being a low achiever or high achiever placed in a class with those of opposite abilities. Those students whose test scores vary greatly may be referred to the school psychologist for special diagnostic testing.

2. Determining Final Status.

   Teachers will often administer standardized tests to their students to see how they compare to others in the same school, district, state, or nation. Sometimes they are even used to determine final course grades.

3. Assessing Change.

   Public schools sometimes administer standardized tests twice a year - in the Fall and again in the Spring - comparing results to determine the student's educational growth during the year.

4. Guidance.

   The results of standardized achievement scores, in conjunction with past course grades, can show how well a student has progressed to a certain point. They are helpful in planning future careers and schooling.

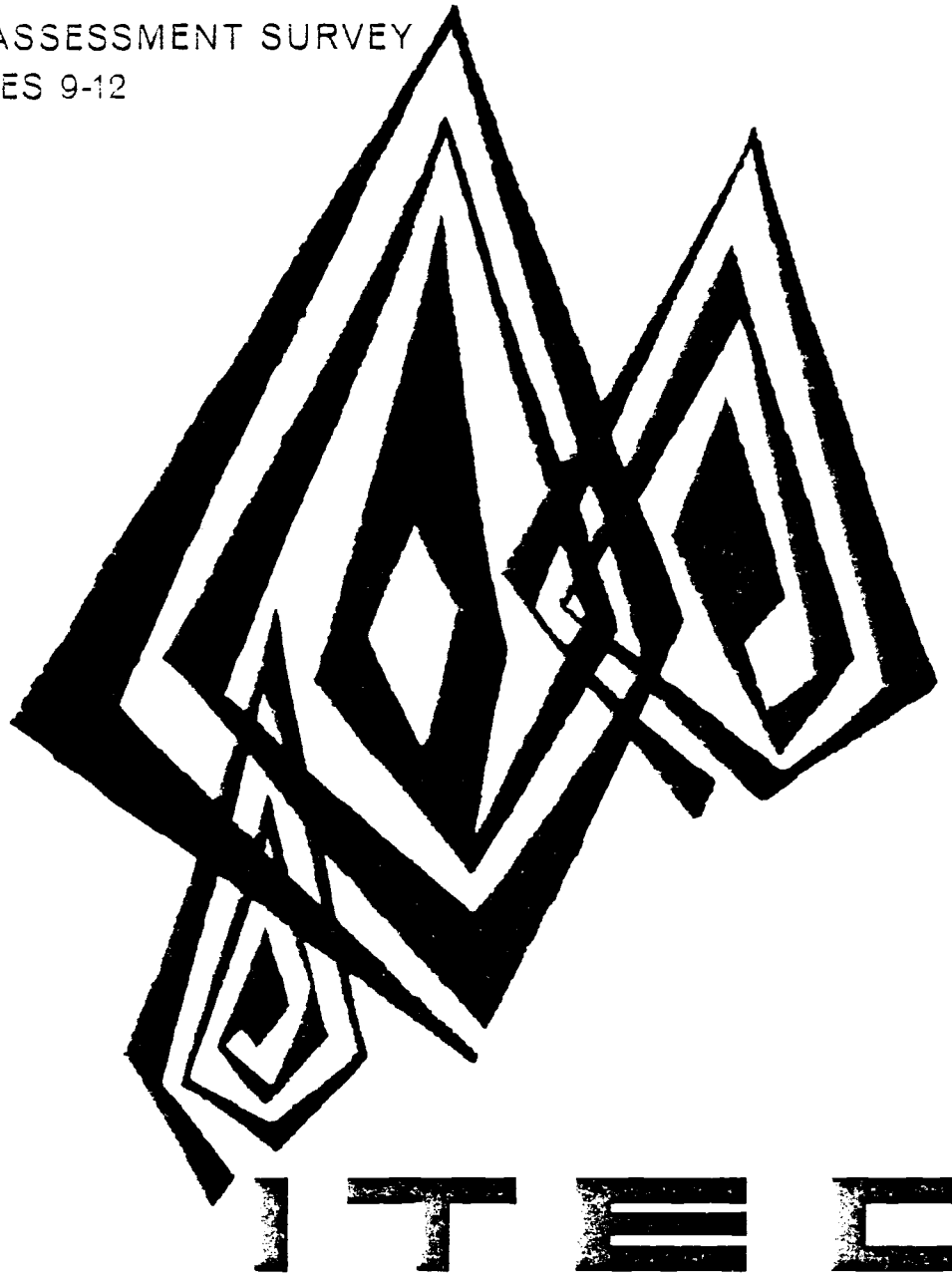
5. Conducting Research.

   Standardized achievement scores are helpful to a school district in comparing with other districts, or with previous years in the same district, for the purposes of evaluation of the instructional program. Scores from one school using a particular method of instruction may be compared with scores of another school using another method to determine which is best (Brown, 1976, and Davis, 1964).

APPENDIX D

ITED SAMPLE QUESTIONS

SRA ASSESSMENT SURVEY
GRADES 9-12



ITED

IOWA TESTS OF EDUCATIONAL DEVELOPMENT
FORM X5

SRA

DIRECTIONS TO STUDENTS

MARKING THE DIGITEK GRIDS

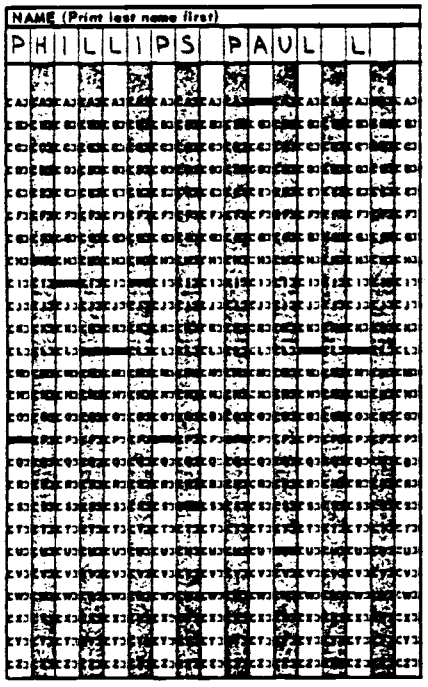
Your answer sheet will be scored by a machine. The scoring machine can also read your name and other information your school wants if the grids on your answer sheet are properly marked.

Look at the sample name grid below. This has been correctly marked for the name Paul L. Phillips. Notice that the name has been printed in the boxes across the top of the grid with the last name first. One letter is printed in each box, and an empty box is left between the parts of the name. Below each box the rectangle with the same letter has been blackened in the alphabetical column. For the name Phillips, the P rectangle is blackened in the first column, the H rectangle in the second and so on. Where an empty box occurs there are no marks in the grid.

Study this sample carefully, but do not mark the grid on your answer sheet until you receive further instructions.

Follow the same procedure when filling in the other grids on your answer sheet.

SAMPLE NAME GRID

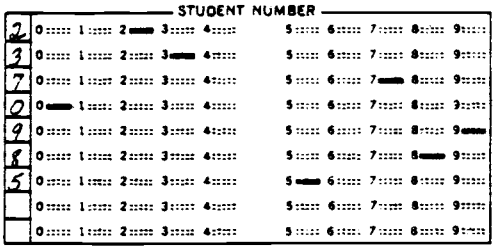


MARKING THE IBM 1230 IDENTIFICATION GRID

Your answer sheet will be scored by a machine. The scoring machine can also read your student identification number if this grid is properly marked.

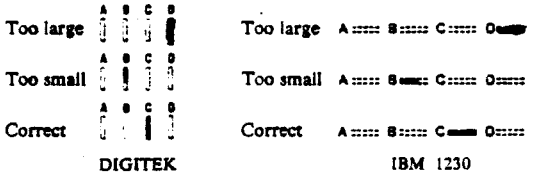
Look at the sample grid below. It has been correctly marked for a student with number 2370985. Notice that the number has been written in the boxes along the side of the grid beginning with the top box. Across from each box the rectangle containing the same number has been blackened. Do not blacken any rectangle across from an empty box. Study this sample but make no marks on your grid until you are told to do so.

SAMPLE IDENTIFICATION GRID



MARKING TEST QUESTIONS

The answer sheet is divided into sections, one for each test. In most tests, each exercise consists of a question followed by several possible answers. You are to decide in each case which answer is best. To answer a question, find the set of answer spaces numbered the same as that question; then blacken the space corresponding to the best answer. Your mark should fill the space without going outside the lines. If your marks are too large or too small they may cause scoring errors. The examples below illustrate good and poor marking.



The important things to remember in marking are:

1. Use a soft (No. 2) lead pencil.
2. Make your mark as large as you can without going outside the space provided.
3. Make heavy, shiny black marks.

If you are careful, you should be able to make satisfactory marks very quickly. Do *not* waste time trying to make overly neat marks, but make sure each mark is heavy and black. Very neat or fussy marking is not necessary.

Mark *only one* answer space for each question. If you mark more than one space, you will not receive any credit for that question. If you change your mind about an answer, erase your first mark thoroughly.

Make no *stray* marks anywhere on your answer sheet. Keep it clean and free from smudges. Do not fold the answer sheet or bend the corners.

Your test booklet will be used later by other students. Keep it in good condition. Make no marks on any pages of the test. Do not fold or tear the pages.

DO NOT LOOK AT ANY TEST UNTIL YOU ARE TOLD TO DO SO.

Language Arts Usage

Whenever I want to retreat, for some reason, into a quiet world of my own; I go out on the front porch of my house. The Dogwood tree on my right and the elm on my left are my sole companions, not taking into consideration the squirrels and birds that stop briefly to stare. I sit on the top step and begin to think, to look, and to listen. There isn't anyplace quite like it.

In the summer there is a remarkable stillness about the scene. The air is full of the scent of newly mown grass; the swaying branches of the elm is tracing a pattern against the sky. Occasionally one of the local residents strolls slowly along the sidewalk.

As fall approaches, the leaves begin to annually drift into colorful heaps on the ground. Passersby going down the street with their hands gloved for protection from the air, because it is chilly. The spicy odor of burning leaves lingers even after nightfall. Ever changing patterns are being formed on the pavement as the streetlight shines through trees tossing their branches. The moon is a giant globe, being close and familiar.

When December comes, winter clamps her frosty hand over all the whole world. The shrubs and the elm become bare and stark, stripped of all its glory. Hunched figures go swiftly down the street. Muffled against the biting wind. The first snowfall softens the sharp outlines of familiar objects and seems to whitewash the whole scene. With spring comes all the exuberance that life can muster. The air is fresh and invigorating, people move with springy steps. The birds sing of new life for all things.

It gives me a sense of peace to view the world from my retreat. The reason is that when similar changes take place all over the earth, I feel that I am part of nature and of all mankind.

Whenever I want to retreat, for some reason, into a (21)

quiet world of my own; (22) I go out on the front porch of my

house. The Dogwood tree (23) on my right and the elm on my left

are my sole companions, not taking into consideration (24)

the squirrels and birds that stop briefly to stare. I

sit on the top step and begin to think, to look, and to (25)

listen. There isn't anyplace quite like it. (26)

In the summer there is a remarkable stillness about

the scene. The air is full of the scent of newly mown

grass; the swaying branches of the elm is tracing (27) a pattern

against the sky. Occasionally one of the local residents

strolls slowly (28) along the sidewalk.

As fall approaches, the leaves begin to annually drift (29)

into colorful heaps on the ground. Passersby going (30) down

the street with their hands gloved for protection from the

21. A (No change)
    B retreat (for some reason)
    C retreat, for some reason
    D retreat for some reason—

22. A (No change)
    B own,
    C own then
    D own.

23. A (No change)
    B Dogwood
    C tree
    D dogwood tree

24. A (No change)
    B without taking into account
    C except for
    D not counting on

25. A (No change)
    B to think and look and to
    C thinking, looking, and
    D to think, look as well as

26. A (No change)
    B Nothing is like my porch in this respect.
    C Nothing else is quite like it.
    D (Omit)

27. A (No change)
    B are tracing
    C trace
    D traces

28. A (No change)
    B stroll ever so slowly
    C slowly stroll
    D stroll slowly

29. A (No change)
    B drifting
    C their annual drifting
    D to drift annually

30. A (No change)
    B stepping along
    C stride
    D gliding

GO ON TO THE NEXT PAGE

MATHEMATICS

directions

In each exercise, solve the problem; then mark the space on your answer sheet that corresponds to the answer you choose. In some problems the fifth alternative, E, is "None of these." If your answer to such a problem is not included in the possible answers, you should mark E, "None of these." Do not waste time on problems you find too difficult; go on, and return to them later if you have time. The sample problems have been marked correctly on your answer sheet.

S1. Another way to say that A equals B is

A $A \neq B$
B $A = B$
C $A > B$
D $A = B$
E $A < B$

S2. Mrs. Smith buys 60 cents worth of groceries and gives the clerk a dollar bill. How much change should she receive?

A 25¢
B 30¢
C 50¢
D 60¢
E None of these

---

1. The sale price of baby food is 9 cents a jar. The regular price is 3 jars for 31 cents. How much is saved by buying 21 jars on sale?

A 21¢
B 24¢
C 25¢
D 28¢
E None of these

2. The table below shows the change in the population of five cities in one year. What is the total change?

City	A	B	C	D	E
Thousands of People	+9	−12	+3	−10	+8

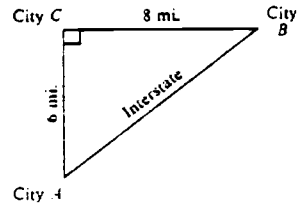
A −2,000
B −22,000
C +5,000
D +42,000
E None of these

3. If 3 tablespoons of weed killer are to be added to each gallon of water, how many tablespoons should be added to 10 quarts of water?

A $3\frac{1}{4}$
B 6
C $6\frac{1}{2}$
D 7
E None of these

4. The diagram below shows two routes from City A to City B. Approximately how many miles shorter is the Interstate?

A 6
B 5
C 4
D 3
E 2



5. Two numbers are relatively prime if 1 is their only common factor. Which pair of numbers is relatively prime?

A 4 and 6
B 9 and 12
C 6 and 9
D 4 and 9
E 10 and 12

6. Three lines, a, b, and c, lie in the same plane. If line a is perpendicular to line b, and line c is perpendicular to line b, then

A lines a, b, and c have no points in common
B line a is parallel to line c
C line c is parallel to line b
D line a is parallel to line b
E line a is perpendicular to line c

7. If a shipyard can produce 48 ships a year when it operates at full capacity, how many ships can it produce each year when it operates at 25 percent below capacity?

A 12
B 24
C 40
D 60
E None of these

8. A new car can be bought for $500 down and $25 a week for two years (52 weeks per year), or it can be purchased for $2760 cash. How much would be saved by paying cash?

A $240
B $260
C $340
D $460
E None of these

9. On a road map scaled so that 1 inch represents 24 miles, two towns are $2\frac{3}{4}$ inches apart. To the nearest tenth, how many miles apart are these two towns?

A 57.0
B 54.4
C 54.0
D 48.4
E None of these

Mathematics

10. The expression $12 \div [(4 + 3)2]$ represents the same number as

A 12
B 9
C $\frac{24}{7}$
D $\frac{8}{7}$
E $\frac{4}{7}$

11. The table below gives the cost C (in dollars) of N ounces of a chemical. Which formula, if any, expresses the correct relation between N and C?

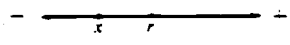
N	1	2	3	4	5
C	8	10	12	14	16

A $C = 6N + 2$
B $C = 2N + 6$
C $C = 3N + 4$
D $C = N + 7$
E None of these

12. Given: $(b - 3)(3b + 8)(2b + 5) = 0$. Which of the factors MUST equal zero?

A $(b - 3)$
B $(3b + 8)$
C $(2b + 5)$
D Any one of the three factors
E All three factors

13. Consider a point r on the real number line below. A point x is 5 units to the left of r. Which of the following, if any, is true?



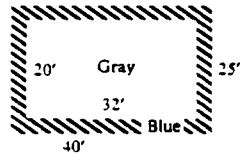
A $x - 5 = r$
B $x - r = 5$
C $x = 5 - r$
D $x = r - 5$
E None of these

14. The table below gives hourly production data for a factory. During which hour was the highest percentage of defective items recorded?

A 1
B 2
C 3
D 4
E 5

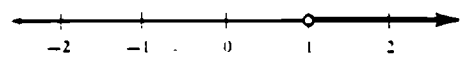
Hour	Items Completed	Items Defective
1	128	8
2	130	8
3	131	7
4	127	7
5	129	8

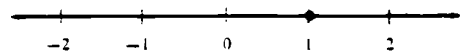
15. Tile is to be laid on a rectangular floor in the pattern shown in the diagram. Which of the following, if any, represents the number of square feet of blue tile that will be needed?

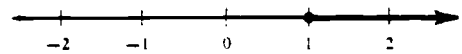


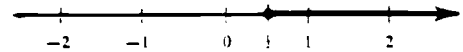
A $(40 - 32) \times (25 - 20)$
B $(5 \times 25) + (8 \times 40)$
C $(40 \times 25) - (32 \times 20)$
D $(8 \times 25) + (5 \times 40) - (4 \times 8 \times 5)$
E None of these

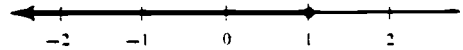
16. Which of the following is the graph of the solution set for the sentence $4x - 1 \geq x - 2$, when x is a real number?

A


B


C


D


E


17. If sod comes in pieces that are 2 feet long by $1\frac{1}{2}$ feet wide, about how many pieces will be needed to sod a rectangular yard that measures 60 feet by 51 feet?

A 1020
B 1220
C 1550
D 2040
E 3060

18. Which expression, if any, is equivalent to 2^5?

A 8^2
B $(2^4)(2^4)$
C $(2^4)(2^2)$
D $(2)(8)$
E None of these

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APPENDIX E

STUDENT POPULATION CHARACTERISTICS FOR EACH HYPOTHESIS

Student Population Characteristics for Each Hypothesis

	Cell Size	Male	Female	9th Grade	10th Grade	11th Grade	12th Grade	Alaska Native	American Indian	Asian	Black	Philippino	Hispanic	Caucasian
Hypothesis 1:														
A	39	16	23	12	3	11	13	1	0	0	2	1	1	34
B	39	17	22	18	9	9	3	0	0	0	2	0	1	36
C	39	22	17	18	14	7	0	1	0	0	2	0	1	35
D	39	20	19	17	13	7	2	0	0	0	5	0	1	33
F	39	21	18	22	8	7	2	0	0	0	6	0	1	32
Total	195	96	99	87	47	41	20	2	0	0	17	1	5	170
Hypothesis 2:														
BCC	74	35	39	1	5	32	36	2	0	0	8	0	2	62
BNVE	74	36	38	17	34	17	6	5	0	1	4	0	0	64
BVE	74	32	42	31	14	18	11	1	0	1	2	1	1	68
Total	222	103	119	49	53	67	53	8	0	2	14	1	3	194

Student Population Characteristics for Each Hypothesis

	Cell Size	Male	Female	9th Grade	10th Grade	11th Grade	12th Grade	Alaska Native	American Indian	Asian	Black	Philippino	Hispanic	Caucasian
Hypothesis 3:														
Caucasian	79	41	38	39	19	17	12	0	0					79
Non-Caucasian	79	32	47	32	15	20	12	12	0	6	50	3	8	0
Total	158	73	85	63	34	37	24	12	0	6	50	3	8	79