

MEASUREMENT  
IN  
SECONDARY EDUCATION

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## PREFACE

It is now nearly two decades since the movement to measure educational products started. The early work was experimental and to a large degree theoretical. The first applications of the measurement movement were made in the elementary field. It was not until after the war that the newer methods of objective measurement were generally used in the construction of examinations on the secondary and higher levels and standardized tests in high school subjects began to appear. Since 1920 the construction and use of objective and standardized tests in the high school has gathered momentum until at present there is a sizable body of material and of techniques available. It is the purpose of this volume to bring together these results, which are to be found mainly in technical periodicals, and make them more generally available.

This book is addressed first of all to high school teachers and principals, and secondarily to students of measurement. It aims to be an introductory book. Its order has been determined by the experience which the author has had in conducting a course bearing the same title as this book. A limited number of standardized tests have been described somewhat at length. Several of them will undoubtedly be supplanted soon by better ones. The purpose of the chapters in which standardized tests are described is not only to introduce them to the reader but to make the discussion of them bring out in a concrete way the characteristics of a good test.

Measurement in secondary education makes use of certain facts and principles which are different from those in the older

and better established measurements in the elementary school. (1) The subject matter of the high school has a natural unit of a year (science, mathematics, or history) or three or four years (foreign language) as against several years (arithmetic, reading, spelling, language) in the elementary school. (2) There is a change in the rate of mental growth during the high school years the nature of which is only partly understood. (3) In secondary education the unit is the subject, whereas in elementary education the unit may be the school year. (4) In the junior high school differentiation begins, and throughout secondary education there is an increasing opportunity for choice. These conditions raise specific problems in connection with the use of derived units in interpreting test scores, in the grouping of pupils, in marking, and in prediction and guidance.

There is a tendency for those interested in measurements in high school to divide into two camps: those who are interested in the development of the informal new-type examination and those interested in the development of standardized tests. This book takes a middle ground. Its thesis is that a truly scientific use of measurements in the high school awaits the development of standardized tests in the high school subjects. But it recognizes the difficulties and dangers that accompany the development of the standardized test. Informal tests are recognized as important and essential instruments which must be used until they can be supplanted by standardized tests.

I take this opportunity to pay tribute to my teachers of measurement. I sat under Dr. M. R. Trabue in a course which is the direct ancestor of this book. Dr. E. L. Thorndike and Dr. W. A. McCall, pioneers in the development of educational measurements, have shared in teaching me, both in class and by their writings, the fundamental principles of measurements. Dr. T. L. Kelley has been an inspiration and guide in the use of statistics. I also wish to acknowledge my indebtedness at this time to those

who have done more than others to further the development of measurements in secondary education, particularly Dr. B. D. Wood, Dr. G. M. Ruch, Dr. H. A. Toops, and Dr. A. S. Otis. Many others have contributed to the movement and their names may be found in the chapter bibliographies. I wish also to acknowledge the counsel and help of my wife, Johnnie Pirkle Symonds.

PERCIVAL M. SYMONDS

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# MEASUREMENT IN SECONDARY EDUCATION

## CHAPTER I

### WHY MEASUREMENT IN HIGH SCHOOL?

The high school has always had measurement and the current interest in the measurement movement is an attempt to make it better. Every judgment made of a student is a measurement. The teacher who reads and grades a number of English compositions is performing a kind of measurement. Perhaps she sorts the papers into five piles according to merit, and roughly makes for herself a five-point scale. If, on the basis of these compositions, this teacher forms opinions as to the general abilities of her pupils, she is, in a rough way, measuring intelligence. Likewise, if a pupil is given a failing mark in algebra or chemistry, a very real and very valuable form of guidance, both as to educational and vocational possibilities, is being offered, for the pupil is discouraged in a decisive way from following a scientific career or even from pursuing further his education along scientific lines. Judgments of pupils' achievement or intelligence or personal qualities are being made constantly by teachers. The present movement in educational measurements endeavors to make these judgments more exact.

Measurements are being used now in high school for the following purposes :

1. To inform pupils of their achievement.
2. As incentives to study.



3. To promote competition
  - a. Between groups;
  - b. Between individuals;
  - c. With one's past record.
4. To determine promotion.
5. To diagnose weak spots in the pupils' achievement.
6. To determine the quality of instruction.
7. To determine admission to high school.
8. To place a pupil in the school.
9. To determine admission to college.
10. To provide reports to parents.
11. To determine credits, honors, etc.
12. Educational and vocational guidance.
13. To rate teachers.
14. To predict a pupil's success.
15. To study the efficiency of the school.

Measurements are being made in all schools, either in the form of offhand judgments, or with the crude instrument which I designate as the traditional examination; and the results are being expressed in terms of the percentage marking system or the letter system so well known in high school practice. Measurements are not an innovation in high school. The purpose of this book is not to invent measurements, but to show how to make them better.

The balance of this chapter describes the nature of measurements in high schools as they have come down to us in tradition. Measurements of this type were universal in high schools ten years ago and are still found in high schools to-day which have remained immune to the contagion of new ideas. The next chapter presents certain criticisms of these traditional methods of measurements and the remainder of the book is devoted to a description of newer measuring instruments and how they may be most effectively used.

The basis of measurements has been the traditional examination. I assume all who read this are familiar with this instrument, as we have all taken these examinations many times in our own school careers. For the sake of definiteness I include samples.

#### EXAMINATION IN BIOLOGY

1. Define (a) chlorophyll, (b) protozoa, (c) protoplasm, (d) osmosis.
2. Trace the life history of mold.
3. What are the distinguishing characteristics of moths and butterflies?
4. Draw a diagram of a complete flower and label.
5. Describe the adaptation of flowers for preventing self-pollination.
6. Name three orders of insects, with two examples of each.
7. What is the theory of evolution? Who is the originator?
8. State how the following measures aid in controlling the spread of epidemics: (a) quarantine, (b) vaccination, (c) boiling drinking water, (d) school nurses.
9. What are the functions of leaves?
10. Name two foods rich in protein, grape sugar, and starch.

#### EXAMINATION IN UNITED STATES HISTORY

1. Define: (a) Squatter Sovereignty, (b) the Missouri Compromise, (c) the Monroe Doctrine, (d) the Pendleton Act, (e) the Virginia-Kentucky resolutions, (f) the Spoils System.
2. Name the five most famous Spanish explorers and their explorations.
3. What were the conditions in Europe that led to the discovery of America?
4. Why did the United States enter the World War?
5. How can the Constitution of the United States be amended?
6. Tell who each of the following was and name the thing he did: (a) Henry Clay, (b) John Marshall, (c) Alexander Hamilton, (d) Benjamin Franklin, (e) Daniel Webster, (f) Thomas Jefferson, (g) William L. Garrison, (h) Calhoun, (i) G. R. Clark, (j) Roger Williams.
7. What motives led immigrants to America?
8. Give the provisions of the Compromise of 1850.

These tests are readily made by the teacher to fit the subject matter which has been covered in the foregoing term. Not much

attention is given to the wording of the questions or to the precise type of mental operation involved. Pure memory questions are frowned upon by progressive teachers although inspection of actual practice will show that they are still very common.

These tests are usually scored on a percentage basis. For a perfect paper the score is 100. For a paper in which nothing is correct the score is zero. Usually questions are assigned arbitrary credits before the examination is given. This defines the maximum per cent that can be made on any single question. These credits are usually intended to bear some relation to the difficulty of the question. The questions hardest to answer usually receive the most credit, although I have heard of a system of scoring where the opposite practice is followed and the hardest questions are given the least credit. A pupil's mark on the examination is then the sum of the credits on each separate question. Practically all schools have an arbitrary passing point in terms of per cent. The following table from Odell<sup>1</sup> shows the passing points in 206 high schools in Illinois using the percentage system :

TABLE I  
PASSING POINTS IN 206 ILLINOIS HIGH SCHOOLS

	NUMBER
PASS AT 70	
No conditions . . . . .	40
Conditions at 60, 65, 67, 68, 69 or indefinite	16
PASS AT 75	
No conditions . . . . .	81
Condition at 70 . . . . .	38
Condition at 60, 65, 72, 73, 74 or indefinite	30
PASS AT 80	<u>1</u>
	206

<sup>1</sup> ODELL, C. W. — "High School Marking Systems," *School Review*, 33 : 346-354.

There is a tacit assumption that a school with a higher passing point is a school with higher standards. A school with a passing point of 80% is credited with having considerably higher standards than a school with a passing point of 60%. With this examination system we have all become per cent-minded with reference to school work.

The results of examinations are summarized in school marks given at the end of certain periods, as at the end of semesters, terms, or even months, to indicate the quality of work done during the period. These marks are supposed to include the results of examinations and other evidences of the pupils' ability as accumulated by the teacher in the daily class period. Some schools go so far as to determine that the final term mark shall be based one third on the final examination, one third on informal quizzes given throughout the term, and one third on class work. Several letter systems are in vogue. One of the most common is allotting *A*, *B*, *C*, and *D* to four degrees of quality of passing work and *F* to work of a failing quality. These letter grades are generally preferred to per cents, since there are fewer letters than per cents and such fine distinctions are not demanded. That is, in the system above outlined there are only four passing letters, *A*, *B*, *C*, and *D*, whereas there are forty percentage steps from 60 to 100. Some teachers who wish to make finer distinctions than *A*, *B*, *C*, *D*, and *F*, use plus and minus; thus *C*+ means better than *C*, and *B*- means better than *C*+ but not as good as *B*.

This is about the extent of measurements in the old-fashioned high school. Pupils are informed of their achievement by the percentages on examinations and quizzes. These examination marks are the only incentives to study that the pupils gain as a result of their work — all other incentives must come as pressure from without. Term marks also inform pupils of their school standing. They are usually considered as rewards or prizes to be wrung from the teacher rather than as the result of the pupil's

growth in learning. This last point is very important. In the old-fashioned school it is very seldom that the pupil is made to consider himself a learner. Hence under this system his effort is directed toward impressing the teacher rather than in mastering subject matter.

Under this system very little individual diagnostic work is done. When a pupil fails, no analysis is made of the fact. A failure is a failure and can be made up only by repeating the course or being tutored. The work made up is tested by an examination covering the work of the course even though the pupil has shown himself deficient in only one phase of the work.

Pupils are admitted to high school on the basis of similar marks in the elementary school. Colleges in the east, however, have not been willing to accept high school marks at their face value and have set their own examinations or have made use of the examinations set by the College Entrance Examination Board. In the west a more liberal attitude has established the system whereby the marks of an accredited school are accepted as a means of determining admission to college. Promotions within the high school have been determined entirely on the basis of marks. As stated before, each school sets up its own passing standard in terms of its marking system and that passing mark is made the dividing point between promotion or repetition of the subject or class.

Reports to parents are again in terms of these same marks. As most parents are already familiar with the system in their own school experience, report cards are readily interpreted. The critical point is the passing point, as that tells whether or not the child will progress with the rest of his classmates. Failure implies failure of promotion and that means "something must be done." Special credits — honors, prizes, and the like — are also determined from these same marks. One school that the writer knows stars the names of pupils on the graduation program who

make an average mark of *B* or over, thus creating an honor rank. *A* and *B* have come to be considered as honor marks, and ambitious parents are not satisfied unless their children attain *A* or *B* in their studies. Less ambitious sons and daughters, however, are only too satisfied with a *C*; and at some colleges a mark of *C* used to be known as a "gentleman's mark," because it could be achieved while living the life of a "gentleman."

The efficiency of instruction is gauged by the number of failures in a school. If a teacher has a large percentage of failures, her efficiency is at once questioned. If the percentage of failures is low, the teacher is a successful teacher. For the teacher, it is always a constant battle between the examination results and the judgment that will be pronounced by the authorities when the marks are reported. A young and inexperienced teacher will set stiff examinations, abide by the results, and suffer the consequences in failures and in being judged as an unsuccessful teacher. With experience the same teacher will learn the secret of reducing the number of failures and gaining the consequent approval of pupils and administration by setting easier examinations. This latter procedure is not possible, however, in schools which prepare for college examinations, as duplicity on the part of the teacher in marking will be later exhibited in the results of the college entrance examinations.

With these applications marks have been stretched almost to the limit. In the older schools there is practically no attempt at ability sectioning. When the school is large enough to have more than one section in a subject, strange methods of sectioning are employed. Pupils are sectioned according to the alphabetical order of their names, or in the order in which they were registered, or according to the exigencies of program making. But often failure to section according to ability is due to a definite belief that such a procedure is harmful and undemocratic. Practically no use of marks is made for prediction or prognosis. The main



reason for this is a firm belief that marks do not predict. "Anything is possible" was the belief of the older educator. Any boy is a possible "A." One hundred per cent is a possible goal for all. Likewise failure stares every pupil in the face and fear of failure is the main incentive for striving. When pupils fail to achieve the maximum, it is moral perversity or obstinacy or laziness or some other moral defect. "If you would only quit your fooling and get down to work you could pass, I am sure" is the teacher's attitude. With such a philosophy, prediction is an impossibility. It is like trying to predict the temperature to-morrow or the size of a cloud in half an hour.

With prediction an impossibility, guidance is not attempted. That high school is to prepare for college is the guiding principle, and so the school is organized around the college preparatory course. For those who do not wish to go to college a general course is provided. A commercial course cares for those whose interests are still less academic. If interest lags and enthusiasm for Latin and algebra wanes, it is best to get out and go to work. This again is a moral perversity, a kind of wildness that makes a boy spurn the advantages offered to him and wilfully refuse them. Some pupils, who are persuaded to believe that all virtue lies in the path to college, manfully stick to the course even with failure piled on failure — confident that industry can win.

The efficiency of the school is also a new conception in education. Previously the principal's only measure of his school's efficiency was the number of boys and girls he could get into college, their success with the College Entrance Examination Board's examinations, and their success in college as compared with boys from other schools. Direct comparison with other schools was not possible because the technique of this comparison was not available.

Why measurements in secondary education? Because measurement is essential in the education process. Psychologists tell us that learning takes place more readily when the results are

accompanied by satisfaction. Much of the learning in school does not result in immediate satisfaction as does the hitting of a target or the drop kicking of a ball between the goal posts. In fact, much of the learning in school is like driving a golf ball over a hill. One may practice indefinitely driving a golf ball over a hill without any gain in accuracy or distance, because he cannot see where the ball lands. Activity is essential in learning, but one must be able to measure success or failure and improvement. That is what measurement in education aims to accomplish.

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## CHAPTER II

### WHY BETTER MEASUREMENT IN HIGH SCHOOL?

Since measurement is a necessary part of the educative process, it is worth while trying to improve it and to make it as accurate as possible. It is often surprising for a teacher to learn that her judgments of pupils are much in error or differ widely from those of other persons. Better measurements are needed in high school because the present measurements are faulty.

In the first place, the scoring of examination papers is an exceedingly subjective process. Ruch<sup>1</sup> has demonstrated this by an experiment. To ninety-one teachers he submitted a single question in geography, together with three answers actually written by pupils in a geography class. These answers were selected from the best, median, and poorest papers in the class. The question, directions for grading it, and the three answers are repeated below:

*Directions:* Below are three actual answers to the question: "Name and locate five of the largest cities of the United States and name their leading industries, exports, and imports."

Grade each of the three answers on a scale of 0 to 20, according to your best judgment of its merit, 20 being an answer ordinarily accepted by teachers as entirely satisfactory, and 0 being an answer practically without discernible merit.

#### Answer 1

Five of the largest cities in the United States is Detroit. An export is Cars. And industry is Manufacturing. Chicago is an important city and an export is Manufactured and canned goods. An industry of Chicago is

<sup>1</sup> RUCH, G. M. — *Improvement of the Written Examination*, pp. 54-57, 1924.