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A Study of Pupil Rating in the Field of Industrial Arts

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A STUDY OF PUPIL RATING IN THE FIELD OF INDUSTRIAL ARTS

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I N T R O D U C T I O N

Rating in its many forms and phases seems to be recognized as an integral part of standard classroom procedure. Industrial arts is one of the fields in which there is a great need for the application of the best known principles and procedures in educational measurement. Industrial arts teachers and supervisors need reliable measuring instruments and methods in order to give better educational guidance, to evaluate personality traits, to motivate learning, to study the effectiveness of teaching materials and methods, and to measure pupil progress more accurately through the establishment of more definite standards of performance and through the diagnosis of pupil difficulty. Scientific test construction and interpretation may be applied to the measurement problems of the shop and the drafting room when modified in the light of special needs.

There has been a growth of interest in tests and measurements in recent years. The last century has produced many scientific investigations in the curricular aspects of these special subjects, on which have been built the modern practices of teaching.

This thesis is intended to fit into the program. It is organized so as to bring to the attention of the shop teacher and to students in training a simple and practical discussion of the essential principles of educational shop and drawing courses. In addition to the above functions this thesis is planned to stimulate a renewed interest in the most adequate evaluation of student achievement. It brings together and evaluates some of the most important contributions

to measurements in industrial arts. It is earnestly hoped that it may stimulate further interest along these lines.

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1. Attempt to eliminate some of the unreliability and subjectivity in the industrial arts field.

2. Show the value and use of rating scales as a means of objectifying rating.

3. Determine the percentage that various factors will count as a basis for grades in industrial arts classes.

4. Suggest scales and profiles that may be used in industrial arts classes.

SCOPE OF THE STUDY

In the past few years much has been done in the academic fields to improve pupil rating. Conversely, in the field of industrial arts a limited amount has been done. Keeping in mind that rating in Industrial arts is similar to the academic subjects, I have made an attempt to discover suggestions and applications from the academic subjects that apply to industrial arts. With this thought in mind the writer planned an extensive and intensive examination of available literature, records, forms, scales, and profiles that might aid in improving the grading or marking problem in the industrial arts field.

CHAPTER I

THE HISTORY OF EDUCATIONAL MEASUREMENT

Since our present methods of rating in industrial arts are the results of past experiences in educational measurement, it seems appropriate to give a brief history of the development of educational measurement.

Real pioneers in measurement.- Measurement in education did not leap into sudden existence, but had a gradual development. McCall writes that a student's theme informs us that educational measurement is as ancient as fact, medieval as a process, and modern as a science. Half of Salomon's proverbs are tests of wisdom.[1]

The ancient Chinese used a system of testing for filling government positions. This was somewhat similar to the civil service system used in this country.

The Roman father considered the education of his son finished when his son could read the Roman Law from the tablet in the public forum.

Brief history of examinations.- According to Odell,[2] examinations have been a part of the regular school work for thousands of years. The best known and the most elaborate of the ancient systems of examinations were developed by the Chinese, but the Greeks, Romans, and many others used them also. The form of examinations and methods of using them changed very little until recently. It is only within the last few years that the ordinary examination has been questioned as to value and reliability.

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[1] William A. McCall, How to Measure in Education (New York, the Macmillan Co., 1922), p. 14.

[2] Charles W. Odell, Traditional Examinations and New Type Tests (New York, the Century Co., 1928), p. 30.

Work of Reverend George Fisher.- Professor E.L. Thorndyke[3] has called attention to a plan for measuring the achievements of pupils which was used by the Reverend George Fisher, headmaster of a school in Greenwich, England, as early as 1864. The instrument was called a "scale book" in which were assigned values to each degree of proficiency in the different school subjects. Fisher's work like that of most pioneers produced no lasting results because he lived too far in advance of the thought and practice of his day.

Work of Dr. John Rice.- The beginning of the standardized objective test in this country dates from the work of Dr. John Rice, 1914-95, according to Greene and Jorgensen.[4] After studying in Germany Rice returned to America with the idea that it should be possible to measure efficiently and compare results in education as in other fields of science. However, the work of Rice did not meet with the approval of most of the educators of that day. Little by little the more thoughtful men in the field of education appreciated the work that Rice had done and come to accept his views as being good.

First book in education.- If Rice is acknowledged as the inventor of educational measurement, Professor E.L. Thorndyke may be considered the father of the movement. He devised a scale unit of measurement of educational achievement in handwriting. His book of handwriting scales

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[3] E.L. Thorndyke, "Measurements", Journal of Educational Psychology, Vol. IV, (November, 1936), p.551.

[4] Harry A. Greene and Albert N. Jorgensen, The Use and Interpretation of Elementary School Tests (New York, Longmons, Greene and Co., 1935), p.3.

was published in 1909. This marks the beginning of scientific educational measurement.[5]

Work of Stone, Courtis, and others.-[6] Stone's Arithmetic Tests were worked out under the direction of Professor Thorndyke at Columbia University and were published in 1908. They represent a transition from the Rice Comparative Test to the Thorndyke Handwriting Scale. However, the tests used by Stone were not standardized, even though they were more scientifically derived than the work of Rice.

S.A. Courtis cooperated with Stone in giving arithmetic tests. However; Stone's study was confined to the sixth grade while Courtis conceived the idea of giving tests in all grades, including the high school. The latter's chief interest was in establishing norms of accomplishment for the several grades. As a result of his effort scoring was made objective and the tests standardized.

In 1912-15, L.P. Ayers contributed to the field of educational measurement when he developed a handwriting scale and a spelling scale. The Buckingham Spelling Scale was constructed in 1913. Soon after this Trabue, Woody, Hillegos and Buckingham, stimulated by the preachings of Dr. Rice and Professor Thorndyke, made valuable contributions to the field of educational measurement.

Present day development.- Ayers writes[7] that today tests and scales are used throughout this country and around the world. The importance of

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[5] L.P. Ayres, History and the Present Status of Educational Measurement, Part II, Seventeenth Year Book, National Society for the study of Education (Bloomington, Ill., Public School Publishing Co., 1926.).

[6] Greene and Jorgensen, op. cit., pp. 3-4.

[7] Ayers, op. cit., pp. 14-15.

the movement lies not only in its past and present achievement, but in the hopes of the future. Knowledge is replacing opinion and evidence is supplanting the guess-work in education as in every other field of human endeavor.

The movement, according to McCall,[8] for scientific measurement of education has spread with great rapidity. There are about twenty five formal city bureaus of research and their number is increasing. Foundations such as the Rockefeller foundation have done much to encourage the movement, but perhaps the greatest single force for the advancement of scientific education and psychological measurement was the work of the Psychological Committee of the National Research Council.

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[8] McCall, op. cit., p. 5.

CHAPTER II

THE PURPOSES OF RATING

Before an attempt is made to objectify the system used for rating industrial arts classes, it seems that a discussion should be made of just why marking is done. There are some that would abolish school marks but that viewpoint does not meet with great favor. Modern practice makes a wide use of school marks and at present we find leading educators giving the problem much thought.

Promotion of students.- Dr. Haggerty[1] says that classification of students is important since it involves promotion and demotion of students, the transfer of students from one grade to another and general reclassification of the entire school.

McCall[2] writes that teacher's marks should be used as a basis for classification and promotion of students.

Motivation of learning.- Colvin[3] states that a good marking system should have the following motivating effects upon the student:

1. He will have an incentive to beat his own record.
2. He will try to make better grades than anyone else.
3. It will provide a legitimate stimulus for the pupil himself.

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[1]Melvin E. Haggerty, Uses of Measurement in Situations of School Problems, Part II, Seventeenth Year Book, National Society for the Study of Education (Bloomington, Illinois, Public School Publishing Co., 1926), pp. 25-40

[2]William A. McCall, Measurement (New York, The Macmillan Company, 1939) pp. 156-158.

[3]Stephen S. Colvin, "Marking System as an Incentive to Study" Educational Magazine, Vol. XXXII, No. 6 (May, 1912), pp. 560-572.

Struck[4] says that one of the useful purposes of rating is to motivate learning. He maintains that a man is not paid for what he know but for what he does. In addition to motivation of learning Struck mentions the following purposes of rating:

1. To indicate achievement in school work.
2. To promote desirable competition.
3. To serve as a basis for guidance.
4. To indicate graduation requirements.
5. To indicate the extent of extra-curricular participation.
6. To indicate fitness for higher education.
7. To indicate suitability for types of occupational life.

Guidance.- McCall[5] says that scientific grading is an aid to diagnostic procedure. The method of diagnosis is to trace abilities so as to discover which of the abilities exists out of standard proportions and to guide the pupil along that line.

Newkirk writes that one of the first essentials of teaching is the necessity for discovering the progress made by the individual pupils and by the class as a whole.

Other uses of marks.- Belting[6] writes,

> "High school marks are essentially an administrative device for the purpose of determining the success of pupils in their class work; they are also sometimes preserved to

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[4] F.T. Struck, Creative Teaching (New York, John Wiley & Sons Inc., 1938), p. 451.

[5] Op. cit., pp. 356-358.

[6] Paul E. Belting, The Community and its High School (New York, D.C. Heath and Co., 1923), p. 241.

> show whether a pupil is capable of doing the work of the next higher grade. Marks are used to determine credits, promotion, retardation, transfer, classification, honors, scholarships, exemptions, college entrance recommendations, interscholastic and intra-mural competition, rewards, punishment, and eliminations. Such records are necessary in managing a high school."

Reasons for measuring progress.- Ericson[7] gives four reasons for measuring the progress of students in shop work:

1. To ascertain the degree of advancement by pupils.
2. To learn of the difficulties experienced by pupils.
3. To motivate the learning process.
4. To measure teaching efficiency.

The statement by William L. Hunter[8] gives a final summary of the purposes of reting.

> "The best purpose that any test or any educational procedure can accomplish is to increase the educational and social status of the child. Many tests do the opposite."

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[7] E. E. Ericson, Teaching Problems in Industrial Arts (Peoria, Illinois, The Manual Arts Press, 1930), p.241.

[8] William L. Hunter, "Socializing Tests and Measurements," Industrial Arts and Vocational Education, Vol. VI, No. 20, pp. 405.

CHAPTER III

SOME FAULTS OFTEN FOUND IN RATING METHODS

Lack of uniformity.- Dr. Newkirk, aware of the variability of marks given by teachers of academic subjects, was interested in determining if marks given by teachers in industrial arts would show like variation when rating shop and drawing projects. To determine the reliability of marks given by teachers of industrial arts, Newkirk made the following study[1]:

Three woodworking, three drawing, and three sheet metal projects were selected for the experiment. These projects were rated by a group of experienced shop teachers; accomplishment by grade was not considered.

The result of the experiment when grading woodworking projects was as follows: values ranging from 41 per cent to 88 per cent were given the "red bird house". The values assigned to the "grey wren house" ranged from 70 per cent to 95 per cent. The "rolling pin" was assigned values ranging from 75 per cent to 98 per cent. This seemed to indicate that a student might get any of the variable passing or failing marks, depending upon the teacher who made the marks. See table I.

The ratings given the drawing projects and sheet metal projects showed a great variation in value assigned as did the woodworking projects. The conclusions which may be drawn from this and similar studies are as follows[2]:

1. Teachers are not consistant in giving high or low grades; therefore,

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[1] Louis V. Newkirk and Harry A. Greene, Tests and Measurements in Industrial Education (New York, John Wiley and Sons, Inc., 1935), pp. 3-9.

[2] Emanuel E. Ericson, "Grading Shop Projects" Industrial Education, Vol. XXVIII, No. 6 (January, 1907), p. 227.

TABLE I

SUMMARY OF RATINGS

Project	Range of Ratings	Corresponding Letter Marks
Woodwork	41; 26; 23	C - F; A - D; A - D
Drawing	69; 58; 24	A - F; B - F; A - D
Sheet Metal	50; 25; 38	B - F; A - F; A - F

no corrective index can be appied to these marks for the purpose of making them comparable to an established average or norm.

2. Teachers marks all were guesses, some good, some poor, and some indifferent. Since they all were guesses, they are not sufficiently reliable to be used for promotion purposes.

3. The pupils have too much at stake for the teacher to continue to use subjective and guess methods of rating.

Pupil guidance is neglected.- Monroe[3] says that guidance is closely related to the promotion and classification of students and as educational guidance is largely a matter of discovery and classification of students according to interest and ability, it is easy to see that the shop teacher is in a better position to do this than anyone else. Monroe continues by saying that a counselor needs to know what the achievement of the student is as well as his intellectual rating before he can give guidance information to the student.

Teachers fail to recognize the psychological effect of poor rating.- According to Cooper[4] the pay checks that a student receives are his grades. His rewards are determined by his achievement. If the student receives a good mark which he did not rightly deserve he may get the idea that he is good and his work will slump off. On the other hand just the

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[3]Walter S. Monroe, An Introduction to the Theory of Educational Measurement (New York, Houghton Mifflin Company, 1923), p. 44.

[4]Allen A. Cooper, "Grading the Industrial Art Student", Industrial Arts and Vocational Education, Vol. XXVII, No. 2 (February, 1938), p. 47

opposite may occur. Often if this happens his ambition may be squelched and adverse attitudes may be set up. If a pupil does his best and is still a failure according to the instructor's poor rating, the result may be strong enough to defeat his personality. Grading is all important in the development of attitudes and self confidence.

Rating systems are inefficiently planned.- Ericson[5] points out two ways to establish the periods for rating:

1. Grade by projects and work accomplished.
2. Grade chronologically.

Each detail in the rating procedure should be planned. The instructor should consider in advance the periods in which tests will be given, the amount of time for each test, and what procedure will be used to determine the mark for each project.

Teachers fail to make ratings based upon the objectives set up for the course.- Schweickhard[6] says, the most desirable plan is one in which the instructor carefully analyzes the field to be covered in each course and selects the principles and processes involved. Study and preparation are necessary in order that the shop teacher may rate students correctly. Some of the factors in good teaching will be lost if tests are not based on the standards of attainment set up, as there are few other means of determining pupil progress.

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[5] E. E. Ericson, Teaching Problems in Industrial Arts (Peoria, Illinois, The Manual Arts Press, 1930), p. 227.

[6] Dean M. Schweickhard, Industrial Arts in Education (Peoria, Illinois, The Manual Arts Press, 1929), p. 256.

Teachers do not agree as to what marks should represent.- Struck[7] says:

> "The chief weakness of school marks is that they stand for too many different things. Teachers are not agreed, and they are not likely to come to a uniform agreement soon, concerning what the school work should represent. Some feel that since the teacher should develop attitudes and ideals as well as knowledges and skills, personality traits and character should be elements in school marks. Those who oppose this argue that the school mark should represent two things only, that is, achievement and ability in the area of learning concerned. They say that a separate mark which can be called citizenship should be used to cover personality and character traits. Others respond that this is unsatisfactory; that too many parents do not concern themselves, seriously, with what their son gets in citizenship as long as he brings home good marks."

Types of grading errors.- Some differences between two instructor's grades are due to individual differences in scale of grading. These differences are of two kinds[8]:

1. Differences in average grades of two instructors. One instructor may be tough and another easy.

2. Differences in the spread of or variability of two series of grades. One instructor may grade between 40 and 100 while another instructor may assign no grade below 80 or above 85.

Some differences in grades are due to differences of opinion on the true quality of the job. These differences are of three kinds[9]:

1. Differences of the factors taken into consideration in

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[7] F. Theadore Struck, Creative Teaching (New York, John Wiley & Sons, Inc., 1938), p. 452.

[8] C. C. Caveny and J. A. Weichelt, "Reliability of Shop Grades", Industrial Arts and Vocational Education, Vol. XXXIV, No. 6 (June, 1945), p. 235.

[9] Ibid., p. 236.

arriving at a grade.

2. Differences in the importances attached to each factor.

3. Differences in the number of oversights.

CHAPTER IV

THE IMPORTANCE OF ACCURATE TESTING

Kinds of tests.- The two kinds of educational tests in common usage are (1) objective and (2) essays.[1] Objective tests are so constructed that they are scored more nearly alike by different teachers. In the traditional or essay type it is unusual for different teachers grading the papers to arrive at the same mark.

Advantages of objective test.- Smith[2] says that some phases of a subject do not lend themselves to testing by objective methods and that subjective tests must not be wholly supplanted but rather supplemented by those of objective type. The advantages of objective tests are:

1. They bring results less likely to be modified by the teachers experience or knowledge.

2. They are apt to consider questions better selected and more certain to be improved for future use.

3. They limit the checking to content with disregard to student abilities.

4. They reduce the factor of chance information on the part of the pupil.

5. They assure easier scoring and afford a given grade more ready justification.

6. They locate specific strengths and weaknesses.

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[1] Harry A. Green and Albert N. Jordensen, The Use and Interpretation of Elementary School Tests (New York, Longsman Green & Co., 1935), p. 13.

[2] Homer J. Smith, "Objective Measurement in Industrial Education," Industrial Education Magazine, Vol. XXXI, No. 9 (March, 1930), pp. 331-333.

The procedure to follow in constructing tests.- If a test is to be valid, reliable, and objective; if it is to be comprehensive, discriminating, and easily administered; a definite, systematic procedure must be followed in its construction. One such procedure is itemized briefly below.[4]

1. Decide the specific points or objectives that are to be measured.

2. Write each objective on a separate sheet or card. List items of subject matter which contribute to the realization of each objective.

3. Determine which type of test item will measure best the extent to which specific objectives have been attained.

4. Construct one or more test items for each objective listed.

5. Assemble the items for the test. List all items of the same type together. Arrange questions within each type so that those concerning related material appear together.

6. Write clear and concise directions for each type of question.

7. Study every aspect of the assembled test.

8. Have other instructors criticize and actually take the test.

9. Make any necessary revisions.

10. Construct the key.

11. After the test has been administered to one or two groups of students, study carefully the student response. Correct any weaknesses that they reveal. Continue to revise and improve the test from time to time.

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[4] William J. Michell and M. Ray Karnes, "Construction of Written Achievement Tests," (Industrial Arts and Vocational Education), Vol. XXXII, No. 8, (September 1943), p. 210.

Purposes of Testing.- The purposes of testing are:[5]

1. To present objective standards to the pupils.

2. To measure pupil achievement.

3. To diagnose pupil difficulties.

4. To improve teaching.

5. To compare one class or one school with another.

6. To provide guidance data.

7. To provide promotional data.

The values of tests.- Tests have the following values according to Barr, Burton and Brueckner;[6]

1. They furnish in a short time a wealth of important information about the current status of the educational product.

2. They aid in setting up reasonable goals of attainment adopted to the level of development of the pupils.

3. They help to locate specific weaknesses and deficiencies of pupils which should be corrected.

4. Test scores serve as incentives to learning when the pupils are repeatedly given definite information as to their relative strengths and weaknesses.

5. Standard tests make it possible to measure the progress of pupils at regular intervals so that necessary adjustments of instruction may be made.

6. They are essential tools in the carrying on of experimental studies of organization, methods, materials, and means of instruction.

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[5] R.W. Selvidge and Verne C. Fryklund, Principles of Trade and Industrial Teaching (Peoria, Illinois, The Manual Arts Press, 1930), p. 358

[6] A.S. Barr, William H. Burton & Leo J. Brueckner, Supervision (New York D. Appleton Century Co., 1938), p.274.

TABLE II

OTIS TEST RATING SCALE[3]

Manual	(5)
Validity	(15)
Reliability	(10)
Reputation	(5)
Ease of Administration	(Total 15)
(a) Preparation	(4)
(b) Time limits	(4)
(c) Explanation needed	(3)
(d) Alternative form	(4)
Ease of Scoring	(Total 15)
(a) Objectivity	(10)
(b) Time required	(3)
(c) Simplicity	(2)
Ease of Interpretation	(Total 15)
(a) Norms	(5)
(b) Directions for Interpreting	(4)
(c) Class record	(1)
(d) Application of Results	(5)
Convenient packages	(5)
Typography and make-up	(5)
Test service	(10)
	Total 100 points

[3]A.S. Otis, "Scale for Rating Tests", Test Service Bulletin No. 13, (Yonkers, World Book Company), pp. 1-6.

7. The use of standard tests instead of conventional examinations eliminates the element of personal opinion in marking the work of pupils.

8. The recent emphasis given to the development of tests measuring a wide range of outcomes of learning has brought to the attention of teachers many objectives that have been overlooked by them.

Classification of objective tests.- Objective test exercises to be of use in the industrial arts class room fall into the following classifications according to Newkirk and Greene:[7]

I. Recall

A. Simple recall.

B. Completion exercises with one or more key words omitted.

C. Completion exercises with answers suggested or controlled.

II. Recognition

A. Multiple response test.

(1) One correct answer.

(2) Multiple answers with varying degrees of merit.

(3) Multiple answer with one or more correct answers.

B. True-false exercises.

(1) Yes-no questions.

(2) True-false statements.

(3) Diagram and true-false.

(4) Double true-false statements.

C. Matching exercises.

(1) Word Matching.

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[7] Louis V. Newkirk and Harry A. Greene, Tests and Measurements in Industrial Education (New York, John Wiley and Sons, 1935), pp. 151-152.

(2) Picture matching.

(3) Unbalanced columns.

D. Rearrangement test exercises.

(1) Orders of operations.

(2) Classification.

III Performances

A. Quality or accuracy.

B. Identification of tools and materials.

(1) Simple recognition.

(2) Recognition and analysis.

C. Technique.

D. Speed or rate of response.

Critoria for industrial education tests.- The characteristics[8] of a good test should be considered by the shop teacher in evaluating published tests or tests of his own construction. The most important of these are validity, reliability, objectivity, adequate norms, the existence of duplicate and equivalent forms, ease of administration, and economy. An understanding of these factors will do much to insure the selection or construction of a test suitable for the testing problem at hand.

1. Validity. Validity may be defined as some type of objective expression of the degree to which the particular measuring instrument measures what it is supposed to measure.

2. Reliability. The reliability of a test may be thought of as the consistency with which it performs.

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[8] Ibid., pp. 31-41.

3. Objectivity. Objectivity is that quality in a test exercise which makes for the elimination of the personal judgment of the person who scores it.

4. Norms and standards. Norms represent actual levels of accomplishment for specified groups of individuals; standards are usually considered as representing goals to be attained.

5. Ease of Administration. Ease of administration is the speed, accuracy and simplicity with which an educational test may be given to the class.

6. Mechanical features. The mechanical features are the results of the editing and printing of the test.

7. Economy. The economy of a test is the cost of a test. It should be fairly cheap but should have high reliability coefficients.

8. Numbers and Equivalence of Forms. Multiple forms to be assigned to the different test booklets should be approximately equal in difficulty, not only in terms of the total scores earned by groups of equally able individuals but also in terms of the ratings of items in the different levels in the test.

CHAPTER V

MEANS OF SECURING DESIRED CRITERIA

In an attempt to objectify rating by the proper selection, administration and evaluation of test, it would seem appropriate to consider just how the desirable criteria of a test may be secured.

Securing validity.- Makers of standardized tests have resorted to many types of validation procedures, the majority of which may be classified under the following heads:[1]

1. Analysis of curricular content.
2. Correlation with school marks and achievement.
3. Pooled judgments of experts.
4. Correlation with other known measures.
5. Returns from widely spaced groups.
6. Rise in percentage of success.
7. Social utility.
8. Psychological and logical analysis.

Struck[2] points out that a standardized test may be valid in the sense that it measures what it is supposed to measure, but not valid from the pupil's standpoint if the content is foreign to what he was expected to learn. Similarly, the informal test may be technically valid and practically unfair if it measures other than what was assigned.

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[1] Harry A. Greene and Albert N. Jorgensen, The Use and Interpretation of Elementary School Tests (New York, Longmans, Green and Co., 1935), pp. 132 - 6.

[2] F. Theodore Struck, Creative Teaching (New York, John Wiley and Sons, Inc., 1938), p. 436.

Selvidge and Fryklund[3] have this to say regarding validity of testing,

> "Several factors contribute to the validity of a test. The questions should be representative of the main units of the course. Selection of questions that are seemingly more or less irrelevant cannot be true measures of knowledge or ability in the course. In order to overcome this difficulty in the informal test, the test items should be selected during the progress of the course, rather than at the time of the test."

A good procedure for securing validity of a test is the one by Newkirk and Greene.[4] They say the first thing to do is to establish a basis for the validation of the content by use of a course of study. This means clearly enough, that the teacher must have an intimate knowledge of the content of the course. The second step in the validation of the content of an informal objective test is to select, in the light of the objectives set up, the groups of skills which are informational in character and which can be measured by means of a paper-and-pencil test.

Securing objectivity.- The inexperienced teacher should consider the following general principles[5] before attempting to construct informal objective test exercises in order that the test will be more objective:

1. Objective test exercises should always be preceded by explicit directions as to just what is to be done.

2. It is important that a fairly large number of items be included in an examination.

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[3] R.W. Selvidge and Verne C. Fryklund, Principles of Trade and Industrial Teaching (Peoria, Illinois, The Manual Arts Press, 1930) p. 370.

[4] Louis V. Newkirk and Harry A. Greene, Tests and Measurements in Industrial Education (New York, John Wiley & Sons, Inc., 1935), p. 132.

[5] Greene and Jorgensen, op. cit., pp. 71-76.

3. Care should be exercised in the selection of the items so as to make the questions objective.

4. Statements should be carefully worded to avoid ambiguity.

5. The examination in each item and also as a whole should be of such a degree of difficulty that a minimum of either perfect or zero scores will be made.

6. The items included in an objective examination should be arranged in such a way that there is no regular sequence of answers.

7. The directions should require the pupil's responses to be recorded so that scoring is simplified.

8. The items within an examination should be arranged in ascending order of difficulty as soon as possible.

9. Ambiguous and other faulty items which do not discriminate properly between the achievements of pupils with different levels of mastery should be eliminated or revised as soon as possible.

The importance of objectivity in the selection of tests is declared by Dr. McCall[6] as follows:

> "Objectivity is an extremely important consideration. So important is it that there is little exaggeration in stating that this criterion is the mother of scientific educational measurement. For educational tests are an out-growth of the extreme dissatisfaction with the subjectivity of previous methods of measuring the educational output.
>
> How may a test's objectivity be increased? The problem in education is no different from the problem in other sciences. The first step in its solution is to do everything possible toward increasing the reliability of the test according to the methods sketched in the previous section. The second step is to determine, wherever possible, the amount and direction of the personal equation of the different examiners, and to allow for them. For some time to come improvement in reliability

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[6] William A. McCall, Measurement (New York, The Macmillan Co., 1939) pp. 59-60.

will be the most convenient and promising method of improving objectivity.

> As with reliability, objectivity can be increased by a careful standardization of the entire testing process. If two examiners apply the test in different ways, disagreement is assured. If the method of scoring leaves room for the exercise of much judgment, disagreement is almost certain to arise. If there is a variation in the statistical method of computing pupil or class scores, it is hardly reasonable to expect results to agree. Adequate description can avoid most of the variation due to test application and statistical treatment. Much ingenuity is now being applied to developing completely objective means of measuring pupils."

Securing Reliability.- Reliability is obtained by sampling over a wide range of content and by stating a large number of valid questions in objective forms which are within the mental and educational range of the pupils to be tested. The following suggestions[7] have been found useful in securing high validity in objective informal tests.

1. Include from fifty to one hundred items, each item being selected from definite units covering the entire area of the unit of the course.

2. Make the questions objective in type. This eliminates the variable factor of the teacher's subjective judgment and gives assurance that all responses will be rated on the same basis.

3. Eliminate the dead weight from the test. Do not include items which are so easy that over 80 per cent of the class answers them correctly. Do not include items which are so difficult that less than 20 per cent give the correct response.

4. Control the conditions for giving the test. Define specific directions and conditions for administering the test.

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[7] Newkirk and Greene, op. cit., pp. 138-139.

5. Provide a key with the correct responses. It may be necessary to modify or give alternate answers on some completion exercises. The key, like other phases of the test, can be refined best after the test has been given.

Greene and Jorgensen[8] write that reliability in a test arises from two sources: (1) the adequacy of the sampling represented by the test, and (2) the variation in the human response itself which has nothing to do with the content of the test. The first of these factors in reliability may be controlled somewhat by selecting the test items carefully and extensively from the field which it is supposed to measure. The second of these factors may be controlled by eliminating the chance factors such as temporary physical disturbances, fatigue, etc., which affect the consistency with which individuals react to tests.

Securing a valid sampling.- The following rules[9] demonstrate how it is possible to secure a valid sampling of the informational content of the course.

1. Keep clearly in mind the objectives of the course. Try to formulate questions which will measure the extent to which the objectives have been achieved. Emphasize the relative and social utility of the subject matter and avoid purely factual questions unless they are essential to building up concepts.

2. Ask questions which the objectives indicate are of most importance, but under no circumstances ask questions included merely to "stump" the

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[8] Greene and Jorgensen, op. cit., pp. 110-112.

[9] Newkirk and Greene, op. cit., pp. 37-38.

pupils. Trick questions and unusually difficult ones are only dead weight in the test, waste valuable time, and in general, lower the validity of the test.

3. Ask a large number of questions over all parts of the course. The different types of objective test exercises are best suited for testing a large number of items in the time ordinarily alloted to measurement.

4. Have other teachers make suggestions as to the importance of the exercises selected for the test. Take into consideration the comments of pupils as to the value of the different test items. If the pupils consider them unfair, obscure and too easy, they should be eliminated or modified before the test is used again.

5. The test can not be more valid than the course of study on which it is based. The progressive teacher will revise his course and tests from time to time to bring the work abreast of good practice.

Securing ease of administration.- A significant phase of the administrability of a test is the examiner's manual which accompanies it. The manual should contain the following:

1. A clear statement of the qualities measured by the test.

2. A clear statement as to how the test is to be administered so that it may be followed verbatum by the classroom teacher.

3. Adequate explanation of the methods by which the reliability and validity were obtained.

The better standardized tests provide the uses with carefully formulated statements on the following types of items:

1. Number of parts in the test.

2. Directions for each part or division of the test.

3. Sample exercises to acquaint the pupils with the methods.

of work.

4. Directions for stopping at the end of a test part or for turning the page when necessary.

5. Definite statements of time limits when required.

6. Directions for scoring the test.

7. Explanation of the norms or standards of accomplishment.

8. Statement of the total possible scores on each test part and the method of securing them.

9. Explanation and illustration of method of interpretation of results in terms of instructional needs.

10. Suggestions for definite remedial attack on the weaknesses revealed by the test.

CHAPTER VI

TESTS IN RELATED EDUCATIONAL FIELDS

Achievement in industrial arts cannot be measured accurately without information that is procurable only through the use of educational tests selected from other related fields.

Relation of other educational achievement to industrial arts.- Newkirk and Greene[1] write:

> "Achievement in the content subjects is limited to a very high degree by the student's reading ability. The comprehension of the precise types of directions, symbols, and instructions given in the industrial arts subjects is basic. Certain skills in arithmetic, algebra, and the sciences are essential in shop work. Mastery of certain English usages and mechanics is an essential to acceptable achievement in this field as in almost any other. A reasonable skill in freehand drawing, lettering, and handwriting is also an important limiting factor in industrial arts achievement."

In this chapter a number of the most useful tests selected from important fields related to industrial arts are described.

Reading Tests

1. Haggerty Reading Examination, Sigma 3, Forms A and B.[2]

This valuable test is designed to measure general silent reading ability from the fifth grade through the twelfth. The total score on the test indicates a measure of general reading comprehension. The test is composed of three subtests of vocabulary, sentence reading, and paragraph reading.

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[1] Louis V. Newkirk and Harry V. Greene, Tests and Measurements in Industrial Arts (New York, John Wiley and Sons, 1935), p. 91.

[2] M.E. Haggerty and Laura C. Haggerty, "Reading Examination, Sigma 3" (Yonkers, World Book Company, 1920).

2. Iowa Silent Reading Test; Advanced Forms A and B (Revised).[3]

This test is designed to secure an analytical measurement of the silent reading skills used in reading of the work study type. By the use of a series of tests sampling into several different types of reading skills the total comprehension score is intended to reveal general reading ability. The scores on the separate test parts afford the basis for the analysis of the strengths and weaknesses of individual pupils.

English Tests

1. The Iowa Grammar Information Test.[4]

This test is designed to meet the need for a test of the purely informational aspects of English grammar. In addition to its survey use in English classes, it should prove to be a valuable measure of the formal background of grammar needed by students who are beginning the study of a foreign language.

2. The Kirby Grammar Test.[5]

This test is intended to be used in the measurement of usage and grammatical errors in grades VII to XII. The pupil is tested on his knowledge of verbs, pronouns, and certain miscellaneous usages. For convenience in administration, the exercises are arranged in five divisions, each containing usage exercises of the alternate-response type. The pupil is required

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[3] H. A. Greene, A. N. Jorgensen, and V.H. Kelley, "Iowa Silent Reading Test, Advanced" (Yonkers World Book Company, 1931).

[4] Fred D. Cram and H. A. Greene, "The Iowa Grammar Information Test," Bureau of Educational Research and Service, Extension Division, University of Iowa, Iowa City, 1935.

[5] Thomas J. Kirby. "The Kirby Grammar Tests", Bureau of Educational Research and Service, Extension Division, University of Iowa, Iowa City, 1929.

to select the correct form for a given exercise and then to indicate the grammatical rule which governs its use.

3. The Wilson Language Error Test.[6]

This test is available in two parts, each consisting of three forms. The forms consist of short stories of about 300 words which contain a number of common language errors. The pupil is to read the story and correct the language errors. The test is simple to administer and has a valuable diagnostic power.

Spelling Tests

1. Sixteen Spelling Scales Standardized in Sentences for Secondary Schools.[7]

These scales frequently called the Seven-S Scales, consist of sixteen separate and scaled lists of twenty words each. It requires about five minutes to give any one of the scales. The tests are carefully prepared and afford a very satisfactory means for industrial arts teachers to measure the spelling ability of their students.

2. Simmons-Bixler Standard High School Spelling Scale, Forms I, II, III, IV.[8]

This unusually valuable spelling scale for high school use is based upon an extensive program of investigation in high school spelling by Mr. Simmons,

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[6] G.M. Wilson, "Wilson Language Error Tests" (Yonkers, World Book Co., 1923).

[7] Earl Hudelson, F.L. Stetson and Ella Woodyard, "Sixteen Spelling Scales Standardized in Sentences for Secondary Schools," Bureau of Publications, Teachers College, Columbia University, New York, 1920.

[8] Earnest P. Simmons and H. H. Bixler, "A Standard High School Spelling Scale" (Atlanta, Turner E. Smith and Company, 1928).

and supplemented by a revision of the material under the direction of Dr. Bixler. The result is a series of four forms of scales each containing a preliminary spelling test of 100 words, and sixty-four scaled lessons of forty words each.

Vocabulary Tests

1. Hunter's W-4 Trade Names Test in Woodwork.[9]

This is one of the pioneer efforts of industrial arts teachers to develop tests along the line of a technical vocabulary. The inability of a pupil to understand the meaning of words used in a given course does not necessarily mean that he should not take the course but shows that there is a need for special instruction.

2. The Pressey Technical Vocabularies of the Public School Subjects.[10]

This vocabulary list, which includes technical vocabularies for fifteen school subjects, contains a list of technical words pertaining to woodwork and mechanical drawing, but it is not entirely adequate as it covers these two courses only.

Writing Scales

1. Ayers Handwriting Scale.[11]

This test is often known as the "Gettysburg Edition" because the samples of the scale are based upon copy from the first four sentences of Lincoln's Gettysburg Address. The scale consists of nine widely varying specimens of

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[9] W.L. Hunter, "Shop Tests", (Peoria, The Manual Arts Press, 1930).

[10] Luella C. Pressey, "Technical Vocabularies of the Public School Subject" (Bloomington, Public School Publishing Company, 1923).

[11] L. P. Ayres, "The Ayres Handwriting Scale" (New York, Russell Sage Foundation, 1912).

handwriting graduated by tens from twenty to ninety. Each section on the scale is represented by a twelve line section from the Gettysburg Address. The merit of the specimen was determined by the differences in the lengths of time required by trained judges to read each sample.

2. Freeman's Diagnostic Handwriting Scale.[12]

By the use of this analytical chart, attention may be focused upon such qualities as uniformity of slant, uniformity of allignment, quality of line, letter formation, and letter and word spacing. The critical and ambitious teacher of industrial arts will find this scale helpful in bringing about distinct improvements in the handwriting of his students.

Other Tests

There are many other test in fields relating to industrial arts. In fact, so many that it would be impossible to name them all in a study of this nature. However; the important thing to remember is that achievement in industrial arts cannot be completely and effectively measured without the use of supplementary educational tests selected from other related fields.

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[12] F.N. Freeman, "Chart for Diagnosing Faults in Handwriting" (Boston, Houghton-Mifflin Company, 1914).

CHAPTER VII

OBJECTIVES FOR THE COURSE AS THE BASIS FOR TEACHING AND TESTING

Objectives for the course should be outlined. Teaching and testing should be based on these objectives so that the teacher can determine whether or not the pupils are being tested on the points that should be tested.

Presentation of objective standards.- Selvidge and Fryklund[1] say that it is well for the learner to know that at a given time in the future he will be tested on the things he is expected to know. These tests will be based on the objectives outlined by the teacher.

The viewpoint of McCall[2] is that the common practice of setting up no definite visible objective at all could not be expected to produce other than the current indifference toward improvement. McCall compares the practice of not setting up definite objectives to a man who is in a hurry but does not know where he is going.

Problems in formulating objectives.- Two problems usually involved in formulating the objectives of a particular course are:[3]

1. Compiling a list of objectives which is reasonably complete, that is, one which includes all of the important objectives to be reached.

2. Stating the problems in such clear and definite terms that they can be used to serve as guides in the marking of examination questions.

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[1] R. A. Selvidge and Verne C. Fryklund, Principles of Trade and Industrial Teaching (Peoria, The Manual Arts Press, 1930), p. 358.

[2] William A. McCall, Measurement (New York, The Macmillan Co., 1939), p. 408.

[3] Herbert E. Hawkes, E.F. Lindquist, and C.R. Mann, The Construction and Use of Achievement Examinations (New York, Houghton Mifflin Co., 1936), p.8.

When objectives are conceived as goals[4] to be attained by the students, teaching becomes an attempt to reach these goals and testing is used to see if the student has reached the goals.

Objectives of the course.- The objectives of a course in hand woodwork are presented as an example of those that should be presented as a basis for objective examinations and goals to be attained by the pupil.

Objectives of the Course.[5]

1. To develop an appreciation of good materials and workmanship.
2. To develop handy man abilities with common tools and materials.
3. To develop hobbies for leisure time activities.
4. To develop desirable social traits and attitudes.
5. To motivate and vitalize academic learning.
6. To provide opportunity for planning and problem solving.
7. To give information about the industries and their workers.

What the Boys Should be Able to do With Woodworking Tools

1. To use a rule in measuring.
2. To use dividers or compasses for laying out curves and dividing spaces.
3. To use a try-square for testing.
4. To adjust a plane.
5. To square a piece of stock.

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[4] Ibid., p. 13.

[5] Report of Committee on Standards of Attainment in Industrial Arts, Bulletin of the American Vocational Association, Industrial Arts Section, (December, 1930), pp. 35-38.

6. To saw to a line with a rip or cross cut saw.

7. To use a hack saw.

8. To use a coping saw.

9. To bore holes in wood.

10. To fasten with screws.

11. To trim a hole with a chissel.

12. To use a scraper.

13. To use sandpaper.

14. To drive and clew nails.

15. To lay out and cut a chamfer.

16. To glue up work.

17. To fit hinges.

18. To make butt joints.

19. To make dowel joints.

20. To sharpen edge tools.

What the Boys Should Know About Wood and the Divisions of the Industry

1. The principal characteristics, marking qualities, principal uses, and sources of supply of the common words.

2. How lumber is cut and milled.

3. Standard dimensions of lumber.

4. Knowledge of veneer and plywood.

5. Kinds of glue and its preportion.

6. Kinds of nails and their sizes.

7. Kinds and sizes of screws.

8. Kinds and grades of sandpaper.

9. Grades and uses of steel wool.

10. Distinguishing characteristics of period furniture.

11. Basic principles of good design in furniture.

12. Use of common types of hinges and fasteners on woodworking projects.

13. Kinds of grinding and sharpening stones.

14. Location of manufacturing concerns and labor conditions.

What the Attitude of the Boy Should Be.

1. Industrious.

2. Cooperative.

3. Self-reliant.

4. Considerate of the rights of others.

5. Ready to assume responsibility.

6. Loyal.

7. Fair minded.

8. Optimistic toward life.

9. Law abiding.

10. Appreciative of duty in common things.

Selection of major groups of informational items.- Newkirk and Greene[6] say the next step in the validation of subject matter for objective tests in the light of subject matter set up for the course is the grouping of skills that are informal in nature and which can be measured by tests. The following summaries represent informational aspects found in the foregoing outline on woodworking.

1. Different types of planes.

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[6]Louis V. Newkirk and Harry A. Greene, Tests and Measurements in Industrial Education, (New York, John Wiley & Sons, Inc., 1935), pp. 134-135.

2. Different types of saws.
3. Sizes of wood bits.
4. Sizes of screws.
5. Kinds and sizes of chissels.
6. Procedure in squaring a block.
7. Sizes of sandpaper.
8. Sizes of nails.
9. Glue and its use.
10. Different types of hinges.
11. Kinds of wood stain.
12. Types of fillers.
13. Different types of brushes.
14. Composition of shellac.
15. Enamel and its composition.
16. Varnish and its composition.
17. Different kinds of paint.
18. Composition of wax.
19. Composition of lacquer.
20. Common joints.
21. Steps in applying finishes.
22. Steps in assembling stock.
23. Principal characteristics and uses of wood.
24. Dimensions of lumber.
25. How lumber is cut and milled.
26. Veneer and plywood.
27. Grades and uses of steel wool.
28. Principles of design.

29. Characteristics of period furniture.

30. Types of grinding and sharpening stones.

31. Manufacturing concerns and labor conditions.

Objectives of industrial arts.- In addition to the objectives for each course, much broader objectives should be developed for the entire industrial arts curriculum. One of the most widely used definitions of industrial arts is given by Bonser and Mossman.[7]

> "Industrial arts is a study of the changes made by man in the forms of materials to increase their values, and of the problems of life relating to these changes."

These authors classify the objectives of industrial arts under the following five major heads: (1) health (2) economic (3) art or aesthetic (4) social and (5) recreational. They also point out that in addition to these five major purposes, industrial arts on the elementary school level should strive to develop such attributes or qualities as consumer appreciation; love for beauty; harmony and appropriateness of materials; sensitivity to the well-being of industrial workers; permanent interest in materials, processes, and products of manufacture.

The objectives of industrial arts were studies by Warner.[8] He found that the following are among the most important objectives of industrial arts on the junior high school level:

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[7] F.G. Bonser and L. C. Mossman, Industrial Arts for Elementary Schools (New York, The Macmillan Co., 1927), p. 5.

[8] William E. Warner, Policies of industrial Arts Education (Columbus, Ohio, State University, Studies, 1928), pp. 5-45.

TABLE III

OBJECTIVES OF INDUSTRIAL ARTS

1. Exploration.	6. Consumers knowledge and appreciation.
2. General Guidance.	7. A degree of skill.
3. Household Mechanics.	8. Correlation or integration.
4. Avocation, hobbies.	9. Vocational purposes.
5. Social habits and insights.	

The objectives of industrial arts as set forth by Friese[9] are quite similar. He groups them into manipulative and non-manipulative aims. Included in the latter are studies in vocational economics closely related to everyday life.

A more recent statement of objectives for the industrial art teacher has been given by Selvidge.[10] The twelve items set forth by him do not differ greatly from those given by Warner, Friese, and others except that the emphasis is to develop in each pupil the goals set forth.

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[9] John T. Friese, Exploring the Manual Arts (New York, The D. Appleton Century Co., 1926), pp. 41-45.

[10] Manual Arts Conference, Industrial Arts in Modern Education (Peoria, The Manual Arts Press, 1934), pp. 33-34.

CHAPTER VIII

THE SCALE AS A MEANS OF OBJECTIFYING RATING

Need of scales for rating projects in industrial arts.- Student rating cards are gaining popularity with many of the shop teachers of today. They are gradually becoming one of the main methods of objectifying rating. Newkirk and Greene[1] say that as rating projects calls for the keenest of discrimination there is a need of objectifying standards of quality. For example in a project such as a funnel there are such factors as forming, turning, wiring and seaming. Morever; it must be of the proper size and of suitable material. Thus size, shape, quality of material, suitability of material and quality of workmanship as revealed in many small details must be recognized and evaluated by the judge.

Constructing a project rating scale.- Newkirk and Greene[2] write that they have found the following principles helpful in the construction of rating scales for shop and drawing projects:

1. Make a careful analysis of the course of study for the purpose of selecting the factors to be put in the rating scale.

2. Group the factors into classes according to method of rating to be used.

3. Put the factors into a rating scale so that each part of the project can be given an individual objective rating and the ratings combined.

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[1] Louis V. Newkirk and Harry A. Greene, Tests and Measurements in Industrial Education (New York, John Wiley and Sons., 1935), p. 150.

[2] Ibid., pp. 151-152.

4. Prepare a set of directions for using the project rating scale.

5. Prepare a key for transforming the distance ratings into objective values for use in computing the composite rating.

Ericson's rating cards.- Table IV shows a card designed for rating the various operations in woodwork. This type of rating card provides for frequent ratings.

The grading chart in table V according to Ericson[3] provides for daily grading at a minimum of expense of time. It is based on, namely: (1) quality, (2) quantity, (3) effort, (4) knowledge of facts, (5) proper attitude, (6) regularity of attendance.

The large square in the upper left corner gives the key to the meaning of the marks in the various locations. Attendance is not given a place with the other marks, for the reason that if the student is absent a large "A" is placed in the middle of the square for that day and no other mark is necessary.

The marking of the chart may be done in two ways. The one shown in table IV makes use of a plus or minus sign to show good or bad work. Unless there is cause for comment no mark is given.

Another way of keeping the chart is to use the chart to mark only in case of deficiencies. In that case no marks are recorded unless the student shows a deficiency when measured in regard to the five points.

A project or problem rating card.- Radford[4] says that a good idea in

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[3]Emanuel E. Ericson, Teaching Problems in Industrial Arts (Peoria, Illinois, The Manual Arts Press, 1930), pp. 228-229.

[4]Stanley S. Radford, "Methods of Testing in Mechanical Drawing," Industrial Arts and Vocational Education, Volume XXXI, No. 1 (1942) p. 13.

TABLE IV

A GRADING CARD

GRADING CARD	Grades
Article constructed.....	.....
Getting out rough stock.....	.....
Laying out.....	.....
Mortises and tenons.....	.....
Jointing and gluing top.....	.....
Smoothing parts.....	.....
Assembling.....	.....
Finishing.....	.....
Final Grade.....	.....

TABLE V

DAILY GRADING CHART

Key to Grade Marks	
Quality	Quantity
Attitude	
Effort	Knowledge

Quality	25
Quantity	25
Effort	20
Knowledge	20
Care of tools	10

DATE															
Andrews, Albert	+	+	+	+											
Andrews, John	+	+	+	-											
Bowman, Charles	+	+	+	-											
Cellman, Peter	+	+	-	-											
Davis, George	+	-	+	+											
Evans, Bill	-	+	-	+											
Hall, Frank	+	+	-	+											

testing is to select a problem that brings out as much practical knowledge as possible and to set up a point basis to follow as a guide in rating. A sample form may be seen in table VI.

A student rating sheet.- The student rating sheet by Paul Wenger,[5] see Table VII is an excellent example of a general purpose rating sheet. It is so designed that it can be used in practically any of the classes in industrial arts. It provides a place for the student to score himself. This should be a valuable asset to any rating card. Mr. Wenger also suggests that a project planning sheet, see table VIII, is helpful to both the student and the teacher as it provides for careful planning on the part of both. For the teacher's convenience it has a special place for the grade.

A self checking code.- To help the student find and correct his errors in drawing Mottingly and Scrogin[6] suggest the self checking code in table IX.

The drawing is worked by the instructor, using the symbol as outlined in the table. The student studies the marking by the instructor, checks his work carefully, and then makes all corrections promptly. One value in a chart of this type is that it brings to the student's attention the smallest details.

Suggested progress rating cards.- After a careful study of the existing rating cards, the writer arrived at the conclusion that many of the scales in use now are inadequate in or much as they:

1. Do not provide for rating factors other than projects.

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[5] Paul N. Wenger, "A Student Rating Sheet", Industrial Arts and Vocational Education, Vol. XXXIV, No. 8 (1945), p. 373.

[6] Mottingly and Scrogin, Applied Drawing and Design (New York, McCormick Mathers and Company, 1940), p. 1.

TABLE VI

TECHNIQUE GRADE

TECHNIQUE GRADE			
FREEHAND SKETCH			
MECHANICAL DRAWING			
TRACING			
NO.	POINT BASIS	PERFECT	ACTUAL
1	LAYOUT	15	
2	LINEWORK (Projection)	25	
3	DIMENSIONING	25	
4	LETTERING	10	
5	NEATNESS	10	
6	TIME	15	
TOTAL POINTS EARNED		100	

STUDENT RATING SHEET

The Laboratory of Industries
Teachers College of Connecticut
New Britain, Connecticut

Instructor _____

Name of Course _____

Name of Student _____

Date _____

Highest possible score	Student's self-rating score	Instructor's score	Scoring based upon:	
55			Projects	(a) Quality of workmanship (b) Amt. of work accomplished (c) No. of advanced processes completed
10			Planning Sheets	(a) Completeness of details (b) Quality of drawings (c) Accuracy in computing bills of material (d) Originality of ideas, etc.
10			Class Attitudes	(a) Interest (b) Initiative (c) Co-operation (d) Respect for rights of others, etc.
10			Shop Organi-zation	(a) Proper use of equipment (b) Fulfillment of cleaning responsiblilities (c) Return of tools and materials to proper locations (d) Respect for rules of safety, etc.
15			Written Work	(a) Knowledge of subject matter (b) Related informations (c) Correct usage of laboratory terms (d) Thoroughness of study
100			Total score is found by adding individual scores.	

TABLE VIII

A PROJECT PLANNING SHEET

PROJECT PLANNING SHEET

The Laboratory of Industries
Teachers College of Connecticut
New Britain, Connecticut

Approved by_____

Project Grade----------

Name..... Grade..... Date.....

Name of project..... Activities in.....and .....

My idea came from..... ....
reference author page

Make a working drawing of your project on this sheet. Mark all dimensions carefully. Use a pencil and ruler.

Bill of Material

Name of part	No. of prices	Size T x W x L	Kind of Material	List Price	Cost

Date of Completion..... Date of payment.....

Total Cost.....

TABLE IX

SELF CHECKING CODE

SYMBOL	CLASSIFICATION OF ERRORS
1	Errors in Layout. Check sheet layout, composition, arrangement of elements, centering, margins.
2	Errors in Views. Check top, front, side views; orthographic, isometric, oblique, cabinet projections.
3	Errors in Use of Tools. Check pencil, pen, ink; drawing instruments; other equipment.
4	Errors in Lines. Check weight of lines, contrast of lines; refer to Alphabet of Lines.
5	Errors in Lettering. Check caps and lower-case, slant and vertical size and weight, spacing, spelling.
6	Errors in Draftsmanship. Check ragged corners, joining arcs, tangents, omissions, superfluities.
7	Errors in Dimensioning. Check scale; lengths, widths, thicknesses; tolerances; numerals.
8	Errors in Specifications. Check notes, suggestions, requirements, witness data.
9	Errors in Bill of Material. Check materials listed, number wanted, sizes, cost, date.
10	Errors in Scholarship. Check punctualiry, attendance, tardy work, repetition of errors.

To the Student: "Details are trifles-but trufles make perfection and perfection is no trifle." Plesse check drawings carefully and make corrections promptly. Your work will then be nearer to the perfection toward which we all should strive.

E Explanation of Grade Symbols: E--Excellent. G--Good. F--Fair.

.....

Instructor

2. Are not objective.

3. Do not provide for rating the proper operations.

4. Are not easily understood by the pupil.

5. Are not practical for permanent records.

6. Do not include progress and rating on the same scale.

In an attempt to correct some of the faults of the scales now in use, the rating progress charts on the following pages are suggested. These progress rating cards are intended to serve as a guide in constructing rating cards as to form, operations included, and the factors to be included in a final grade, however operation and final grade factors may be changed without affecting the value of the scale.

Instructions for using the suggested progress rating card.

Grading the Project

1. A point value evaluating each operation is assigned by the instructor. See table XIII.

2. To find the average operation point values, average point values assigned to each project. Refer to the table on the back of the rating card for the operation grade.

3. To find the average project point values for the different operations, average the point values assigned to each project for the various operations. Refer to the table on the back of the rating card for the final projects grade.

4. Refer the sum of the average operation point values to the table on the back of the rating card for the final project grade.

Determining Final Grades

1. Multiply 4 times the average project point value. Record in the "final points" column. This is the number of points projects will count on a final grade.

2. Multiply..3 times the average point values of the tests. Record in the "final points" column. This is the number of points test will count on a final grade.

3. Multiply..1 times the average attitude point value. Record in the final points column. This is the number of points attitude will count on a final grade.

4. Multiply..2 times the average "use of tools" point values. Record in the final points column. This is the number of points use of tools will count on a final grade.

5. Add all of the points contributed by projects, tests, attitude, and use of tools. Refer this to the table on the back of the rating card for the final semester grade.

A Suggested Progress Graph - Table XIV

Figure I is a progress chart of the students accomplishment in projects and tests. The black line on the graph represents projects grades and the yellow line represents the different test grades.

Figure 2 is the combined quality rating of both tests and projects for six week periods. These graphs should be made by the students on a piece of drawing paper 9" x 12" and placed in the front of their note books. All entries on the graphs will be made by the student.

TABLE X

A SUGGESTED PROGRESS RATING CARD

.....Name WOODWORK ----- Date.....																
.....Age	PROJECTS														AVER. OPERATION POINT VALUE	OPERATION GRADE
.....Grade																
Operations																
Preparing Stock																
Design																
Squaring																
Joints																
Assembling																
Gluing																
Sanding and finishing																
Miscellaneous																
Av. Project pt. Value																
Final Projects grade																
Final Grades															AVERAGE PT. VALUE	FINAL GRADE
Projects- (40%)																
Tests- (30%)																
Attitudes- (10%)																
Use and Care of tools- (20%)																
Semester Grade																

TABLE XIII

SUGGESTED POINT VALUE CORRESPONDING

TO LETTER GRADES*

Grade	Point Value	Percentages
A+	12	98-100
A	11	95-97
A-	10	92-94
B+	9	89-91
B	8	86-88
B-	7	83-85
C+	6	80-82
C	5	77-79
C-	4	74-76
D+	3	71-73
D	2	68-70
D-	1	65-67
F	0	Below

* This table will be on the back side of the rating cards.

TABLE XI

A SUGGESTED PROGRESS RATING SCALE

.....Name DRAWING Date.....

.....Age

.....Grade

Operations	PROJECTS										AVER. OPER. POINT VALUE	OPER GRADE
Accuracy												
Appearance												
Technique												
Prob. Solving												
Projection												
Punctuality												
Av. Project Pt. Value												
Final Projects Grade												

Final Grades	AVER PT. VALUE	FINAL GRADE
Projects- (40%)		
Tests- (30%)		
Attitude-(10%)		
Use and Care of Tools-(20%)		

Semester Grade

TABLE XII

A SUGGESTED PROGRESS RATING SCALE

.....Name SHEET METAL Date.....

.....Age

.....Grade

Operations	PROJECTS												AVER. OPERATION POINT VALUE	OPERATION GRADE
Soldering														
Accuracy														
Forming														
Crimping														
Joints														
Design														
Proportion														
Neatness														
Av. Project Pt. Value														
Final Projects Grade														

Final Grades	AVER. PT. VALUE	FINAL POINTS
Projects- (40%)		
Tests- (30%)		
Attitude- (10%)		
Use of tools- (20%)		
Semester Grade		

TABLE XIV

PROGRESS GRAPH

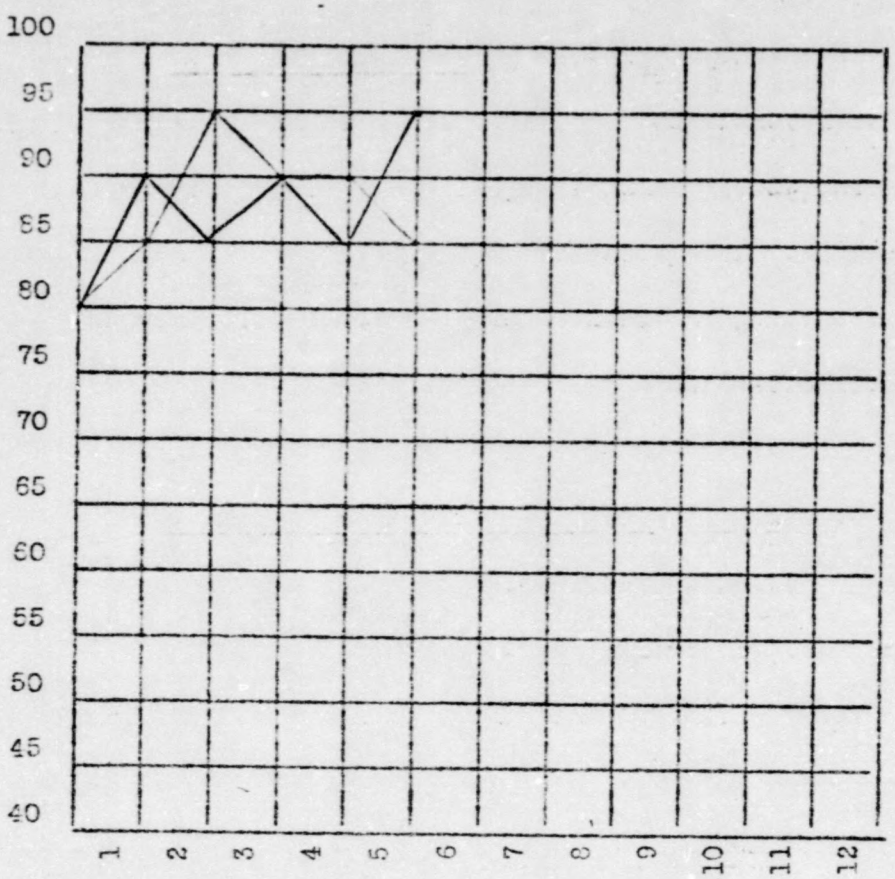

FIG. I

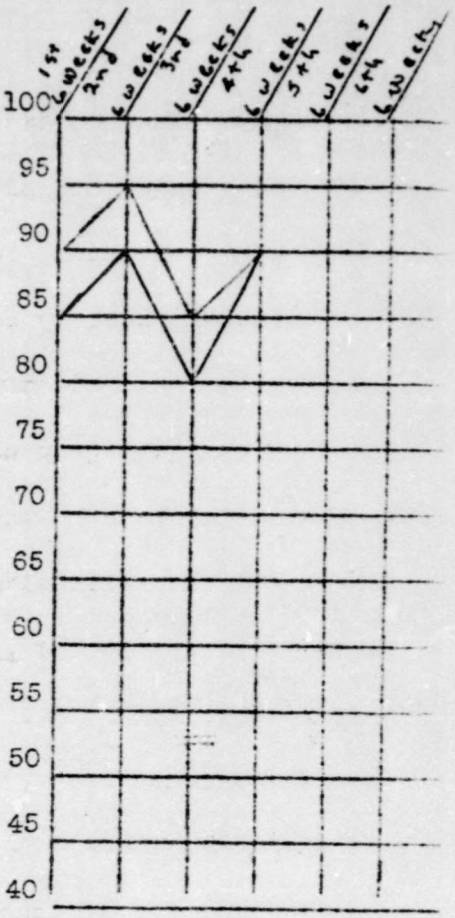

FIG. II

CHAPTER IX

ESTABLISHING THE MEASURABLE FACTORS

Measurable factors.- Fifteen of the measurable factors in industrial arts are: information, quality, technique, speed, reading of technical symbols, reading, spelling, mathematics, appreciation of industrial products, language, inventiveness, personality traits, mechanical aptitude, planning, and intelligence.[1] See table XVI. In general the measurable factors in industrial education can be tested more effectively when they are measured individually or in a separate division of a test.

Causes of variability of teachers' marks.- The variability of teachers' marks, as revealed by experiments[2] in grading, raises the important question as to what factors produce such wide divergence in the evaluation of school work. The following factors[3] should be taken into account:

1. Differences due to different standards of judgment in different schools.

2. Differences in the standards of different teachers within the same school.

3. Differences in the same teacher at different times.

4. Differences in the estimates of the relative worth of various elements.

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[1]Louis V. Newkirk and Harry A. Greene, Tests and Measurments in Industrial Education (New York, John Wiley & Sons Inc., 1935), pp. 43-44.

[2]Daniel Starch and Edward C. Elliot, "Reliability of Grading," School Review, Vol. XXI (April, 1913), p. 254-259.

[3]Paul E. Belting, The Community and its High School (New York, D.C. Heath and Co., 1923), pp. 159-160.

TABLE XVI

MEASURABLE FACTORS IN INDUSTRIAL EDUCATION[4]

Measurable Factors	Comments
1. Information	Factual information about tools, materials, and vocations. (Oak is a cabinet wood; the micrometer is an instrument used to measure in thousandths of an inch; outside paint contains oil).
2.	Evaluation of the product of manipulative work in the light of tool, instrument or machine operations (drawing, hammering, house wiring, bookcase, cement lawn pedestal.
3. Technique	Evaluation of skill in manipulating tools, instruments, or machines in executing tool operations (method of using a plane, a compass, a lathe).
4. Speed (Rate of Response)	The time required to accomplish a piece of work employing commercial standards (time required to make a drawing, a table, wire a house).
5. Reading technical symbols	Ability to read marking drawings, wiring diagrams, architectural drawings, etc.
6. Reading	Ability to read and comprehend instructions or related information from the printed page.
7. Spelling	Evaluation of ability to spell common words and necessary technical terms.
8. Mathematics	Evaluation of mathematics required in the various shop courses (woodwork, drawing, sheetmetal, machine shop, home mechanics).
9. Appreciation of Industrial Products	Evaluation of ability to rank industrial products according to merit (furniture, electrical devices, finishes, automobiles, houses, radio).

[4] Newkirk and Greene, Op. Cit, pp. 43-44

TABLE XVI CONTINUED

MEASURABLE FACTORS IN INDUSTRIAL EDUCATION

Measurable Factors	Comments
10. Planning	Evaluation of ability to develop a suitable plan for doing a job (building a lawn bench, a dog house, a fence, a radio, etc.).
11. Language	Ability to use correct English in written and oral form.
12. Inventiveness	Ability to see new relations and develop devices and machines for the improvement of society.
13. Personality Traits	Rating of traits generally recognized as essential to success (industry, co-operation, consideration for others, self-reliance, aggressiveness.)
14. Mechanical Aptitude	Natural aptitude for manipulating mechanical devices and an understanding of their operation.
15. Intelligence	Ability of an individual to learn as measured in terms of the extent a pupil has acquired a number of specific and largely unrelated abilities.

5. Differences in the inability to distinguish between close degrees of merit.

Differences in the estimates of the relative worth of various elements.- Professor Bricson[5] suggests that the industrial art teachers use the following main factors when grading student accomplishment.

1.	Quantity of work	25 per cent
2.	Quality of work	25 per cent
3.	Effort put forth	20 per cent
4.	Knowledge acquired and applied	10 per cent
5.	Proper attitude	10 per cent
6.	Care of tools	10 per cent
7.	Regular attendance	

While Bricson included regular attendance in his factors, he does not include it in his rating of achievement. He writes that it has been found more satisfactory to grade these factors negatively when final grades are made out, that is deduct a certain specific amount for each unexcused absence.

Carl J. Hogger[6] of Jefferson, Wisconsin, in formulating a method of determining the grade for shop projects, suggests that the following factors should be weighed as sighted below:

1.	Speed	12 per cent
2.	Accuracy	25 per cent

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[5]Emanuel E. Bricson, Teaching Problems in Industrial Arts (Peoria, The Manual Arts Press, 1930), p. 229.

[6]Carl J. Hogger, "A systematic Method of Grading Shop Projects," Industrial Arts and Vocational Education, Vol. XVII, No. 9 (October, 1929), pp. 376-378.

3.	Quality	20 per cent
4.	Approach	18 per cent
5.	Attitude	15 per cent
6.	Tests	10 per cent

Clarence Robb[7] of Dunbar, West Virginia, suggests that we use the following factors for estimating the grade for pupil achievement:

1.	Skill	40 per cent
2.	Information	20 per cent
3.	Appreciation	10 per cent
4.	Attitude	30 per cent

Griffith does not mention the percentage that he thinks each factor should count but he says there are many. He writes,[8]

> "The only hope of constructing a workable set of standards and tests lies in the ability to discover correlations between factors such that the number may be reduced to a reasonable set. The factors most commonly considered are (1) speed, (2) accuracy, (3) neatness. Only in the most general and unscientific ways have standards been set up for any of these factors for various grades of various kinds of schools. Such personal elements as (1) attitude, (2) attention, and (3) industry are usually taken into account for grading a pupil for a month-they should not be considered in evaluating a given piece of work for neatness, speed and accuracy, attitude, attention, and industry, like neatness are subjective depending upon the ideals the individual teacher may have as to these matters."

Suggested grading system.- The writer however; does not agree with some of the writers as to the value that should be placed upon the factors that will

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[7]Clarence Robb, "Measurement", Industrial Arts and Vocational Education, Vol. XX, No. 6, (October, 1929), p. 281.

[8]Ira Samuel Griffith, Teaching Manual and Industrial Arts (Peoria, The Manual Arts Press, 1920), pp. 190-191.

be included in a final grade.

The writer suggests the following percentages for a tentative grading procedure:

Projects	40 per cent
Tests	30 per cent
Attitude	10 per cent
Use and Care of Tools	20 per cent

As one of the purposes in industrial arts is the making of projects, it would seem desirable to give a grade for projects based upon all of the operations involved in making the project instead of grading merely on quality or quantity of work.

Instead of giveing a grade to the very general terms of knowledge or information the writer thinks that a second factor on a final grade should be the test grade.

Although a pupil's attitude must be regarded as important, it is practically impossible to measure attitude objectively. For that reason a relatively small percentage should be assigned to that factor.

For the last factor in determining the final grade the writer suggests that use and care of tools be considered. By manipulative tests this factor may be measured quite objectively.

Work prepared for daily assignments will be treated as a requirement and credit will not be given.

Notebooks also will be treated as requirements for the course. Credit will be deducted if they are unsatisfactory or incomplete.

TABLE XVII

GRAPHIC RATING SCALE

Desirable Industrial Habits. Reliability-How well he carries out orders.	U Unreliable	S Usually Reliable	E Reliable
Accuracy-How precise his work is done.	Rejected	Few Errors	Outstanding in every detail No errors.
Safety-Use of safety devices; carefullness	Timid	Cautious	Always alert.
Interest-Active; Attentive to his work.	Lacks Interest	Attentive; Does not watch clock.	Absorbed in work.
Judgment-Deciding quickly and accurately.	Seldom	Momentarily	Quick to act.
Courtesy-Showing respect for others.	Disgruntled Hostile	Respect for fellow workers; for authority.	Pleasingly courteous.
Speed-Rate of Producing	Slow	Moderate	Fast
Conservative-How well he estimates value of materials.	Wastes material; Wastes time.	Plans work; Cares for tools and equipment.	Exceptionally well planned work and an outstanding evaluating of materials.
Cooperative-How well he works with others.	Disturbs others, Will not work with others-Selfish	Will help fellow workers. Shares tools and apparatus willingly.	Volunteers personal help.

NOTE: U---Unsatisfactory
S---Satisfactory
E---Excellent

CHAPTER X

MARKING BY THE LETTER GRADE

Newkirk and Greene[1] point out three reasons for discontinuing the use of percentages:

1. The percentage scale has for its only fixed points zero and one hundred. The former means no ability and the latter perfect mastery, yet the complete scale is never used in practice.

2. The establishment of the limits of the scale fixes the intermediate values. Accordingly the difference between marks of seventy-five to seventy-six should be the same as the difference between marks of ninety-seven to ninety-eight. Common observation reaveals the absurdity of this assumption.

3. The use of the percentage scale presupposes that the teacher is able to distinguish as many as 101 minute differences in accomplishment. Experimental evidence[2] reveals that teachers are able to distinguish from five to seven levels of ability. To use a finer scale assumes an exactness of discrimination on the part of the teacher which does not exist.

4. The use of an arbitrarily selected percentage as a passing mark as is is very commonly done results in throwing the marks into a badly skewed distribution with too large a proportion of the marks piled up at or near the passing mark.

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[1] Louis V. Newkirk and Harry A. Greene, Test and Measurements in Industriel Education (New York, John Wiley and Sons, Inc., 1935), pp.235-236.

[2] C.W. Ruch, The Objective or New Type Examination (Chicago, Scott, Foresman and Co., 1929), pp. 370-374.

Friese[3] writes that it is futile to attempt to rate using a system of such fine distinction as there is in the percentage method. In marking out final grades it is not hard for the teacher to classify each pupil's achievement into one of five groups but it would be practically impossible to use a finer scale.

Definition of letter grades.- The following definitions by Hillbrand[4] are given as an illustration of the type of statements that should be prepared by the teacher and given to the pupil for the purpose of defining each of the letter steps in the five point scale. The definitions should be understood alike by teachers, administrators and pupils.

GRADE	DEFINITION
A	1. Consistently does more than is required. 2. Has a wide vocabulary at his command. 3. Is always alert; takes an active part in discussions. 4. Has unusual dependability in taking assignments. 5. Is prompt, neat, and thorough in all work, and is usually free from teachers' correction. 6. Knows how to select books and materials, and is a rapid worker. 7. Has initiative and originality in attacking problems.

[3] John F. Friese, Exploring the Manual Arts (New York, The Century Co., 1926), pp. 339-340.

[4] J. C. Hillbrand, "Measurement", School and Society, Vol. XXI (January 1925), p. 142.

8. Has ability to associate and rethink the problem and can adapt himself to new and changing situations.

9. Has enthusiasm for and interest in his work.

10. Has ability to apply ideas gained in study to everyday life.

B

1. Frequently does more than is required.

2. Has good vocabulary and speaks with conviction.

3. Is unusually alive to the situation at hand.

4. Is careful in complying with assignments.

5. Is eager to attack new problems; profits from criticism.

6. Is prompt, neat and unusually accurate in all work.

7. Has ability to apply general principles of the course.

C

1. Does what is required.

2. Possesses a moderate vocabulary.

3. Is willing to apply himself during class hour.

4. Does daily work with comparative freedom from carelessness.

5. Is attentive to assignments.

6. Has ability and willingness to comply with instructions and a cheerful response to a correction.

7. Is reasonably thorough and prompt in all work.

8. Has average neatness and accuracy in all work.

9. Has ability to retain collectively the general principles of the course.

D

1. Usually does what is required.

2. Attendance is often irregular.

3. Tools and equipment are sometimes lacking.

4. Frequently misunderstands assignments.

5. Is willing but slow in complying with instructions and corrections.

6. Is careless in preparation of work.

F

1. Usually does a little less than is required.

2. Is listless and inattentive in class.

3. Tools and equipment for work are often lacking.

4. Is always tardy with work.

5. Seldom knows anything outside the lesson.

6. Retains only fragments of the general principles of the course.

7. Is lacking in qualities of the first three groups so that he cannot or will not do good work.

How to tell a good student.- William S. Hill[5] has prepared a statement of qualities and types of activity which characterize a good student. They are as following.

A good student will:

1. Follow directions.

2. Master the facts in each lesson.

   a. Be able to repeat the facts accurately.

   b. Remember the exact working of quotations, definitions, theorems, scientific laws, formulas and the like.

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[5] William S. Hill, "Defining a Good Student" School Review, Vol. III, No. 8 (June 1926), p. 406.

3. Keep his work up to date.

   a. Hand in written work on time.

   b. Make up promptly work lost by absence.

4. Be orderly and neat in written work.

   a. Write legibly.

   b. Arrange material in an orderly manner.

   c. Keep papers and notebook clean and neat.

5. Understand the meaning of each lesson.

   a. Be able to answer questions relating to the facts.

   b. Be able to apply principles and give illustrations.

6. Remember what he has learned.

   a. Be able to make use of previous lesson at any time.

   b. Be able to pass examinations.

7. Cooperate with teacher and class.

   a. Take an interest in his work and give class attention.

   b. Volunteer information and answers when desirable.

   c. Take part in class discussions.

   d. Profit by criticisms and suggestions.

8. Work independently.

   a. Take up new topics after necessary explanations are given, and do the work on the first assignment.

   b. Get along without prompting and proding by the teacher.

   c. Be able and ready to go ahead on his won responsibility.

   d. Show some originality in ideas and methods.

CONCLUSION

1. Teachers' marks are variable and inconsistant.

2. There is a lack of agreement among teachers as to the weight to be assigned to the various measurable factors in industrial arts.

3. There is a need for furthering the development of student rating cards.

4. There is a need for further study in regard to means that will make grading more objective and efficient.

5. An attempt should be made to apply some grading procedures used in the academic fields to industrial arts.

6. The grading system has for one of its chief values its psychological effect upon the students.

7. Teachers of industrial arts do not use a uniform system of grading.

8. Grading methods are in the need for a complete revision.

9. Objectives should be kept in mind in marking students.

10. Accurate and valid measurements will have a direct bearing on the future of industrial arts.

11. In the selection of objective tests and the marking of teacher made tests, validity, reliability, and objectivity should be considered.

APPENDIX A

The appendix presents a selected list of distributors and publishers of test materials likely to be of interest to industrial education students, teachers, and supervisors. Obviously this list does not include many of the important distributors and publishers of test of more general interest.

Bruce Publishing Company, Milwaukee, Wisconsin.

Bureau of Educational Research and Service, University of Iowa, Iowa City, Iowa.

Educational Test Bureau, Minneapolis, Minnesota.

Ginn and Company, Boston, Massachusetts.

Manual Arts Press, Peoria, Illinois.

Marietta Apparatus Company, Marietta, Ohio.

Public School Publishing Company, Bloomington, Illinois.

Scott, Foresman, and Company, Chicago, Illinois.

Smith, Turner E., Atlanta, Georgia.

Stanford University Press, Stanford University, California.

Stoelting Company, C. H., Chicago, Illinois.

Teachers College, Bureau of Publications, Columbia University, New York.

World Book Company, Yonkers, New York.

Louis V. Newkirk and Harry A. Greene (New York, John Wiley and Sons Inc., 1935), p. 243.

APPENDIX -- B

This appendix presents a selected list of tests that are now available in the field of Industrial Arts.

1. Achievement Test in Mechanical Drawing. High School and College; Harry M. Wright; Bloomington, Public School Publishing Co.
2. Drawing Aptitude Test. Weston W. Mitchell; Bloomington, Ill., McKnight and McKnight.
3. Mechanical Drawing. High School; Charles Schoonover, C. L. Jackson, and H. E. Schrammel; Emporia Kan. Bureau of Educational Measurements, Kansas State Teachers College.
4. Mechanical Drawing, High School; Charles Leinlar Jr. Peoria, Ill., The Manual Arts Press.
5. Mechanical Drawing Performance Test. High School; Ernest W. Baxter; Milwaukee, Wis., Bruce Publishing Co.
6. Mechanical Drawing Tests, High School; A. P. Fischer; Milwaukee, Wis. Bruce Publishing Co.
7. Electrical Shop. High School; William L. Hunter; Peoria, Ill., The Manual Arts Press.
8. Home Mechanics Test. Grades 7 - 9; Louis V. Newkirk and George D. Stoddard; Iowa City, Iowa: Bureau of Educational Research and Service, The State University of Iowa.
9. Industrial Arts Tests, Woodwork. High School, Harry D. Nash; Milwaukee, Wis.: Bruce Publishing Co.
10. Printing. George A. Wells; Peoria, Ill. The Manual Arts Press.

APPENDIX - B (Continued)

11. Related Subjects. William L. Hunter; Peoria, Ill. The Manual Arts Press.

12. Shop Tests, William L. Hunter; Peoria, Ill. The Manual Arts Press.

13. Woodworking Tests. William L. Hunter; Peoria, Ill. The Manual Arts Press.

BIBLIOGRAPHY

1. AYRES, L.P. The Ayres Handwriting Scale (New York, Russell Sage Foundation, 1912).

2. _____, History and the Present Status of Educational Measurement, Part II Seventeenth Yearbook, National Society for the Study of Education. Bloomington, Public School Publishing Co., 1926.

3. BARR, A.S., BURTON, WILLIAM H., and BRUECKNER, LEO J. Supervision, New York, D. Appleton Century Co.,(1938).

4. BELTING, PAUL E., The Community and Its High School, New York, D.C. Heath and Co., 1923.

5. BONSER, L.C. and MASSMAN, L.C. Industrial Arts for Elementary Schools, New York, The Macmillan Co., 1927.

6. CALVIN, STEPHEN S. "Marking System as an Incentive to Study," Education Magazine, Vol. XXXII, No. 6 (May, 1912), pp. 569-572.

7. CAVENY, C.C. and WEICHELT, "Reliability of Shop Grades", Industrial Arts and Vocational Education, Vol. XXXIII, No. 6 (June, 1945), p. 235.

8. COOPER, ALLEN A. "Grading the Industrial Art Student", Industrial Arts and Vocational Education, Vol. XXVII, No. 9 (February, 1938), p. 184.

9. CRAM, FRED D., and GREENE, H.A., "The Iowa Grammar Information Test," Bureau of Educational Research and Service, Extension Division, University of Iowa, Iowa City (1935).

10. ERICSON, EMANUEL E. "Grading Shop Projects", Industrial Education, Vol. XXVIII, No. 6 (January, 1907), p. 227.

11. _____, Teaching Problems in Industrial Arts, Peoria, The Manual Arts Press, 1930.

12. FREEMAN, F.N. "Chart for Diagnosing Faults in Handwriting", Boston, Houghton Mifflin, 1914.

13. FRIESE, JOHN F. Exploring the Manual Arts, New York, The Century Co., 1926.

14. GREENE, HARRY A., and JORGENSEN, ALBERT N. The Use and Interpretation of Elementary School Tests, New York, Longsmons, Green & Co., 1935.

15. GREENE, HARRY A., JORGENSEN, ALBERT N., and GERBERICH, J. RAYMOND, Measurement and Evaluation in the Secondary School, New York, Longmons Grier and Co., 1943.

16. GREEN, M.A., JORGENSEN, A.N. and KELLEY, V.H. "Iowa Silent Reading Test, Advanced", Yonkers World Book, 1931.

17. GRIFFITH, IRA SAMUEL, Teaching Manual and Industrial Arts, Peoria, The Manual Arts Press, 1920, pp. 190-191.

18. HAMER, CARL J. "A systematic Method of Grading Shop Projects", Industrial Arts and Vocational Education, Vol. XVIII, No. 10, October, 1929, pp. 376-378.

19. HAGGERTY, M.E. and HAGGERTY, LAURA C. "Reading Examination, Sigma 3", Yonkers, World Book Co., 1920.

20. HAGGERTY, MELVIN E., Usec of Measurement in Situations of School Problems, Part II, Seventeenth Yearbook, National Society for the Study of Education (Bloomington, Public School Publishing Co., 1926), pp. 25-40.

21. HAWKES, HERBERT E., LINDQUIST, E.F., and MANN, C.R. The Construction and Use of Achievement Examinations, New York, Houghton, Mifflin and Co., 1936.

22. HILL, WILLIAM C. "Defining a Good Student", School Review, Vol. III, No. 8, (June, 1926), p. 406.

23. HILLBRAND, J.C. "Measurement", School and Society, Vol. XXV, No. 6, (January 31, 1925), pp. 339-340.

24. HUDELSON, EARL, STETSON, T.L. and WOODYARD, ELLA, "Sixteen Spelling Scales for Secondary Schools", Bureau of Publication, Teacher's College, Columbia University, New York (1920).

25. HUNTER, WILLIAM L., "Socializing Tests and Measurement", Industrial Arts and Vocational Education, Vol. VI, No. 2 (June 1938), p. 406.

26. KIRBY, THOMAS J. "The Kirby Grammar Tests," Bureau of Educational Research and Service, Extension Division," University of Iowa, Iowa City (1929).

27. MANUAL ARTS CONFERENCE, Industrial Arts in Modern Education, Peoria, The Manual Arts Press, 1934.

28. MATTINGLY, E.F., and SCHOGEN, T.C. Applied Drawing and Design, New York, McCormick, Mathers, and Co., 1940.

29. McCALL, WILLIAM A., How to Measure in Education, (New York, The Macmillan Co., 1922), P. 14.

30. _____, Measurement, (New York, The Macmillan Co., 1939).

31. MICHELL, WILLIAM J., and HAINES, E.RAY, "Construction of Written Achievement Tests", Industrial Arts and Vocational Education, Vol. XXXII, No. 6 (June, 1943), p. 270.

32. MONROE, WALTER S., An Introduction to the Theory of Educational Measurement, New York, Houghton, Mifflins and Co., 1923.

33. NEWKIRK, LOUIS V., and GREENE, HARRY V. Tests and Measurements in Industrial Arts, New York, John Wiley and Sons, 1935.

34. ODELL, CHARLES W. Traditional Examinations and New Type Tests, New York, The Century Co., 1928.

35. OTIS, A. S., "Scale for Rating Tests", Test Service Bulletin No. 13, Yonkers World Book Co.

36. PAYNE, ARTHUR F. Methods of Teaching Industrial Subjects, (New York, McGraw-Hill Book Co., 1926).

37. PRESSEY, LUELLA C. "Technical Vocabularies of the Public School Subjects" Bloomington, Public School Publishing Co., 1923.

38. RADFORD, STANLEY S. "Methods of Testing in Mechanical Drawing", Industrial Arts and Vocational Education, Vol. XXI, No. 1 (1942) P.6.

39. REPORT OF COMMITTEE ON STANDARD OF ATTAINMENT IN INDUSTRIAL ARTS, Bulletin of the American Vocational Association, Industrial Arts Section (December, 1923).

40. RASS, CLARENCE, "Measurement", Industrial Arts and Vocational Education, Vol. XX, No. 8, (October, 1923), p. 261.

41. ROCK, T.W. The Objective or New Type Examination, Chicago, Scott Foresman Co., 1928.

42. SCHMELZENBACH, DEAN M. Industrial Arts in Education, Peoria, The Manual Arts Press, 1933.

43. SELVIDGE, R.W. and THURSTON, VERNE O. Principles of Trade and Industrial Teaching, Peoria, The Manual Arts Press, 1930.

44. STEVENS, FAUNEST P. and ENGLE, T.L. "A Standard High School Spelling Scale" Atlanta, Turner E. Smith and Co., 1928.

45. SMITH, [illegible] J. "Objective Measurement in Industrial Education", Industrial Education Magazine, Vol. XXII, No. 4 (January, 1934), p. 852.

46. STARCH, DANIEL and ELLIOTT, EDWARD C. "Reliability of Grading", School Review, Vol. XXI (April, 1913), pp. 254-259.

47. STRUCK, F. TRUESDELL, Creative Teaching, New York, Longsmans, Green and Co., 1938.

48. THORNDYKE, E. L., "Measurement", Journal of Educational Psychology, Vol. IV, No. 2, (May 1913) p. 351.

49. WARNER, WILLIAM E., Policies of Industrial Arts Education, Columbus, Ohio, State University, Studies 1928.

50. WERNER, PAUL R. "A Student Rating Sheet", Industrial Arts and Vocational Education, Vol. XXXIV, No. 6, (1945), p. 373.

51. WILSON, G.M. "Wilson Language Error Tests", Yonkers, World Book Co., 1928.