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The Development of an Industrial Arts Measurement Knowledge Test

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THE DEVELOPMENT OF AN INDUSTRIAL ARTS MEASUREMENT

KNOWLEDGE TEST

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

CHAPTER I

THE PROBLEM AND ITS LITERATURE

This study was an attempt to discover the different
levels of achievement in terms of measurable information
that junior high-school pupils possess at the beginning of
an industrial-arts exploratory course. The information
gained from the investigation is intended for use in individ-
ual and group guidance of pupils and for improving the quality
and the effectiveness of industrial-arts instruction.
Newkirk and Greene[1] express the idea that the diagnosis of
skill and knowledge of the individual industrial-arts pupil,
as well as that of the class, is of great value in promot-
ing instructional efficiency.

Teacher planning in industrial-arts is somewhat more
complicated than in some subject matter fields. This
situation is due in part to the confusion that exists in
the ranks of industrial-arts education; for leading indust-
rial-arts educators have expressed much indecision as to
the principles and practices of an industrial-arts program.
Thus, it is understandable that even more confusion must

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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. 22-27.

exist in the minds of administrators who are trying to fit an industrial-arts program into the school curriculum.[2] Moreover, there is a trend toward increasing the responsibility placed on the shoulders of the industrial-arts instructors; and many times this includes the development of the course of study as well as the individual course planning.[3]

The industrial-arts movement has undergone several great changes; the most important influence, perhaps, was the Smith-Hughes Act, which clearly defined vocational education. This act resulted in emphasis being placed on vocational education and only recently has industrial-arts began to assume importance on its own merits.[4]

Frank C. Moore[5] has defined industrial arts as one of the practical arts, a form of non-vocational education, which has for its purpose giving information about and experience in the use of tools, materials, and processes incident generally to the home and industry. This viewpoint

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[2] Edward L. Myers, "The Next Twenty Years in Industrial Arts, "Industrial Arts and Vocational Education, 40: 317, October, 1951.

[3] John F. Friese, Course Making in Industrial Education (Peoria, Ill.: Manual Arts Press, 1946), pp. 7-8.

[4] Myers, op. cit., pp. 317.

[5] Frank C. Moore, "Improving Instruction in Industrial Arts, "American Vocational Journal, 22:7, May, 1947.

illustrates the great change that has taken place from the turn of the century to the present. In the late twenties industrial-arts instruction emphasized the development of skills and fundamental tool processes; the main objective being to produce a skilled worker. The present day object-ives[6] such as: (1) interest in industry; (2) appreciation and use; (3) self-discipline and initiative; (4) cooperative attitudes; (5) health and safety; (6) interest and achieve-ment; (7) orderly performance; (8) drawing and design; and (9) shop skills and knowledge, tend to reverse the earlier objectives. The unfortunate result of this change of motives is that not all of the industrial-arts educators have accept-ed the new objectives.

The investigator hopes that this study will aid the industrial-arts instructor in solving one of his many problems; namely, improving the quality and effectiveness of industrial-arts instruction on both the individual and class level. This objective can be achieved through the location of achievement levels, in terms of measurable information that junior-high school pupils possess at the beginning of an exploratory industrial-arts course. With the location of this information the industrial-arts instructor may better adjust his planning to the actual needs of his class.

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[6] _Supra._ pp. 2-3.

I. THE PROBLEM

It was the purpose of this study to construct and use a paper and pencil test for discovering, in terms of measurement knowledge, the achievement level of junior-high school pupils at the start of an industrial-arts exploratory course.

The following definitions apply to terms frequently used in this study: Knowledge is considered as the acquaintance with facts and things; Measurement Knowledge is thought of as acquaintance with those facts and things that are capable of being computed, compared or represented by a standard, or porportioned by rule. Skill, as used by Selvidge and Fryklund,[7] is interpreted as applied knowledge.

It was recoganized that measurement knowledge was one of many industrial-arts readiness factors that was important and one that would lend itself to study, therefore, this investigation is limited to that one factor. Measurement knowledge was selected for investigation because of the investigator's belief that such knowledge is a prime factor if students are to make satisfactory progress in an industrial-arts program. Furthermore, under special abilities in the aims of education section, the Trade and Industry Education Service

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[7] R. W. Selvidge and Verne C. Fryklund, Principles of Trade and Industrial Teaching (Peoria, Ill.: Chas. A. Bennett Co. Inc., 1946), p. 170

of the Division of Vocational Education lists this factor in
the _Virginia Industrial Arts Handbook_.[8] Greene, Jorgensen,
and Gerberich [9] also believe that industrial-arts instruction
could be made more effective through the appraisal of pupil's
measurement knowledge.

The literature of the Industrial-Arts Education field
was explored for material pertinent to the problem, and no
directly related information concerning the problem was dis-
covered.

The need for an achievement test of measurement
knowledge was evident throughout the fourteen years of
industrial-arts teaching experinece of the investigator.
Actually the need for a device to measure the achievement
level of the individual and class measurement knowledge at
the beginning of an industrial-arts exploratory course had
always seemed to exist.[10] Measurement knowledge in indust-
rial —arts is similiar in all psychological aspects to know-
ledge in other school subjects that are now being measured
effectively with an objective-type examination. Data

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[8] _Virginia Industrial Arts Handbook_, 1948 (Richmond:
The Trade and Industrial Education Service of the Division
of Vocational Education State Board of Education, 1948),
Part I, pp. 13-14.

[9] Harry A. Greene, Albert N. Jorgensen, and J. R.
Gerberich, _Measurement and Evaluation in the Secondary
School_ (New York: Longmans, Greene, and Co.), P. 456.

[10] Newkirk and Greene, _op., cit._, p. 14

secured through the use of a measurement knowledge objective type test is much superior to the teacher's unaided judgement and should greatly improve shop instruction.[11] Selvidge and Fryklund[12] also state that a program of testing is most effective when it is used for diagnosing individual learning difficulties and individual needs. The development of achievement tests designed especially for this field should encourage shop instructors to determine the readiness of their pupils for the industrial-arts course.

The measurement knowledge test was constructed for use in junior-high school exploratory industrial-arts courses in the Portsmouth, Virginia Public Schools, and pupils in the sixth, seventh, and eighth grades for the school session of 1951-52 were selected as subjects for the study. No attempt was made through the use of the test to establish achievement levels and norms other than for use in the Public School System of Portsmouth, Virginia.

II. PROCEDURE

The primary step in the construction of the industrial-arts measurement knowledge test was the collection of data from which test items could be formulated. The questionnaire method was selected as the means to secure the necessary data.

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[11] Newkirk and Greene, op. cit., pp. 43-45.
[12] Selvidge and Fryklund, op. cit., p. 360.

In the construction of the questionnaire, suggestions revealed in the Research Bulletin, "The Questionnaire," developed by the National Educational Association,[13] were closely followed by the investigator. The measurement knowledge items[14] selected for inclusion in the questionnaire check lists were selected from the official Virginia elementary state course of study, elementary text books, and elementary source books. The items selected represented the measurement knowledge that should have been acquired by the pupils in previous elementary experiences.

Analogous measurement knowledge items were classified into fifteen different sections. The questionnaire recipients, all the white industrial-arts teachers in Virginia, were given instructions to place check marks by each item showing the amount of measurement skill and knowledge they believed a junior-high school pupil should possess as he enters an industrial-arts exploratory course. Check marks were placed in the columns labled None, Little, Much, and Mastery. The terms "skill" and "knowledge" were defined on the questionnaire for ease of interpretation. Spaces were provided in which additional items could be added by the industrial-arts instructors who answered the questionnaire.

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[13] "The Questionnaire," Research Bulletin of the National Education Association, Vol. VII, No. I (Washington: National Education Association, 1930), pp. 14-24.

[14] See Questionnaire. pp. 12-14

A preliminary try-out of the questionnaire was made using five industrial-arts instructors in the Portsmouth, Virginia city school system. Revision of the instrument was made in line with suggestions offered during this try-out. One major change was made, in the form of the column lay-out to facilitate easier reading and checking of items. A letter of transmittal[15] was developed explaining the purpose and stating sponsorship by the Virginia State Supervisor of Trade and Industry. Several questions were added to the general information section[16] of the questionnaire at the request of the Department of Trade and Industry. This general information section was included to secure background information about the recipients of the questionnaire.

The questionnaire was mailed to all white industrial-arts teachers in Virginia. The mailing list was supplied by the State Department of Trade and Industry and included the names of 187 white industrial-arts instructors. Two follow-up cards[17] were sent out; the first, ten days after the questionnaire was mailed; and the second, twenty days later. Replies were recieved from 127 of the 187 instructors, a 68 per cent return. The returns included four question-

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[15] See Appendix A. p. 55

[16] See Appendix A. p. 56

[17] See Appendix A. p. 57

naires which were marked unclaimed, three which were not completed because the addressees were in military service, and five which were marked incorrectly; therefore, a total of twelve returnes could not be used. The remaining 115 replies were employed in identifying which measurement knowledge items were to be included in the test.

CHAPTER II

THE DEVELOPMENT OF THE INDUSTRIAL-ARTS
MEASUREMENT KNOWLEDGE TEST

The measurement knowledge items checked by the in-
dustrial-arts instructors on the questionnaire were to serve
as the basis for construction of the measurement knowledge
test. After the test was constructed and following two re-
visions, the final form of the instrument was given to 221
junior-high school pupils taking exploratory industrial-arts
courses. The reliability of the test was checked statistically
and norms for Portsmouth, Virginia school system were
established.

I. QUESTIONNAIRE DATA

The industrial-arts measurement knowledge test was de-
signed as a pencil and paper type test,[18] so the _skill_ (perfor-
mance) factor was not included; only the _knowledge_ (of measure-
ment) factor was considered in this study. Inclusion or reject-
ion of measurement knowledge items for test items was deter-
mined by classifying the items checked by the respondents into
columns labled "_much_" and "_mastery_" as one category, and
columns "_little_" and "_none_" as another category. The

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[18] _Supra_. p. 5.

measurement knowledge items checked by a majority or over 50 per cent of the respondents in the columns "much" and "mastery" were selected for inclusion in the test.[19]

Common practice and experience in teaching are factors which may be relied upon to help define judgment concerning areas of knowledge about which pupils should know. The investigator selected the industrial-arts instructors of the state to help judge which measurement knowledge the test should be concerned with.

The general information section of the questionnaire showed that the average Virginia industrial-arts instructor had approximately ten years teaching experience in his field and represented twenty-six different fields of industrial-arts instruction, ranging from the fourth grade through college level. The heaviest concentration of experience was in the eighth grade through the eleventh grade; and furthermore, the school year 1950-51 found the majority of the industrial-arts instructors also teaching in those grades. Another interesting fact disclosed that a major number of the school systems represented by the 115 shop instructors began industrial-arts programs in the seventh or eight grades. Therefore, the investigator believes that the opinions expressed by the industrial-arts instructors who represent such a wide range of

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[19] See Questionnaire. p. 12-14.

MEASUREMENT QUESTIONNAIRE

Instructions:

Place ✓ marks in the columns showing the amount of measurement skill or knowledge that you believe a junior high school pupil should possess at the time of entering an industrial arts exploratory course. Please check both the skill (applied knowledge) and knowledge (acquaintance with facts and things) section of each item.

Blank spaces are for any additions you may wish to add.

Degree of skill (s) and knowledge (k) a junior high pupil should possess.

Liquid Measure

Item	MASTERY k	MASTERY s	MUCH k	MUCH s	LITTLE k	LITTLE s	NONE s	NONE k
Gallon	42	40	47	47	22	24	4	4
Quart	45	43	48	46	20	22	2	4
Pint	42	40	49	47	22	24	2	4
Half Pint	30	30	49	43	32	35	4	7
Cup	19	19	38	33	46	47	12	16
Ounce	16	16	46	37	47	47	12	15

Decimal Measure

Item	MASTERY k	MASTERY s	MUCH k	MUCH s	LITTLE k	LITTLE s	NONE s	NONE k
1. Whole Number	58	55	38	41	14	13	5	6
.1 Tenth	31	30	49	48	28	29	7	8
.01 Hundredth	23	21	41	40	41	39	10	15
.001 Thousandth	17	14	26	26	43	41	29	34
.0001 Ten Thousandth	5	5	21	18	38	35	31	57
.00001 Hundred "	2	2	15	11	34	31	64	71
.000001 Millionth	2	2	13	10	32	28	68	75

Angles

Item	MASTERY k	MASTERY s	MUCH k	MUCH s	LITTLE k	LITTLE s	NONE s	NONE k
360° Circle	33	32	45	43	31	33	6	7
180° Straight Line	30	29	45	45	33	31	7	10
90° Right Angle	29	29	50	56	32	30	4	6
60° Angle	14	15	39	35	49	48	13	17
45° Angle	22	22	41	38	36	35	16	20
30° Angle	16	15	35	33	45	43	19	24
Acute Angle	18	7	31	31	45	39	31	38
Obtuse Angle	8	7	30	30	46	40	31	38

Degree of skill (s) and knowledge (k) a junior high pupil should possess.

Linear Measure

Item	MASTERY k	MASTERY s	MUCH k	MUCH s	LITTLE k	LITTLE s	NONE k	NONE s
Yard	50	45	45	43	20	25	0	2
Foot	57	53	49	49	9	13	0	0
Inch	61	56	47	48	7	11	0	0
Half Inch	50	49	55	50	10	16	0	0
Quarter Inch	40	40	55	48	17	24	3	3
Eighth Inch	35	33	49	44	26	31	5	7
Sixteenth Inch	30	28	39	35	36	37	10	15

Metric Measure

Item	MASTERY k	MASTERY s	MUCH k	MUCH s	LITTLE k	LITTLE s	NONE k	NONE s
Meter	3	3	8	5	66	30	38	57
Decimeter	2	2	4	5	51	36	58	72
Centimeter	2	2	5	5	54	40	59	68
Millimeter	2	2	4	4	51	37	58	72
Kilometer	2	2	4	4	49	36	60	73
Kilowatt	3	3	11	7	61	47	40	58
Kilocycle	2	2	8	7	48	38	57	68

Symbols

Item	MASTERY k	MASTERY s	MUCH k	MUCH s	LITTLE k	LITTLE s	NONE k	NONE s
ℼ Pi	9	9	30	27	47	46	29	33
∠ Angle	15	14	32	29	60	56	8	16
° Degree	18	17	39	33	51	56	7	9
" Inch	46	43	41	42	26	26	2	4
' Foot	49	47	37	38	27	28	2	2
△ Triangle	17	15	31	31	56	51	11	18
% Per Cent	18	18	50	47	40	42	7	8
√ Square Root	7	7	22	20	53	48	33	40

Degree of skill (s) and knowledge (k) a junior high pupil should possess.

Numbers

Degree	s/k	Fractions	Whole Numbers	Mixed Numbers	Multiplication	Subtraction	Addition	Division
MASTERY	k	30	57	37	57	60	63	57
MASTERY	s	28	55	33	55	59	63	56
MUCH	k	68	51	61	52	49	48	51
MUCH	s	68	54	65	54	51	49	52
LITTLE	k	16	7	17	6	6	4	7
LITTLE	s	18	6	17	6	5	3	7
NONE	k	1	0	0	0	0	0	0
NONE	s	1	0	0	0	0	0	0

Terms

Degree	s/k	Edge	End	Face	Thickness	Width	Length	Board Feet
MASTERY	k	25	27	24	29	31	30	11
MASTERY	s	24	24	24	27	29	27	12
MUCH	k	46	46	40	53	52	52	30
MUCH	s	40	41	35	47	47	47	28
LITTLE	k	29	29	34	24	24	25	38
LITTLE	s	33	33	35	29	28	36	31
NONE	k	15	13	17	9	8	8	36
NONE	s	18	17	21	12	11	11	49

Formulas

Degree	s/k	$A=S^2$	$A=WL$	$V=WLH$	$C=\pi D$	$D=2R$	$A=\tfrac{1}{2}bh$
MASTERY	k	6	9	8	6	9	5
MASTERY	s	5	9	7	5	8	4
MUCH	k	23	28	18	19	23	17
MUCH	s	23	26	15	17	21	18
LITTLE	k	45	46	48	48	30	50
LITTLE	s	41	45	48	47	47	42
NONE	k	41	32	41	42	33	43
NONE	s	46	35	45	46	39	51

Parts of Circle

Degree	s/k	Circumference	Diameter	Radius	Arc	Degree
MASTERY	k	23	30	29	13	15
MASTERY	s	21	27	26	11	12
MUCH	k	46	54	53	35	39
MUCH	s	44	46	43	29	34
LITTLE	k	35	29	30	35	49
LITTLE	s	44	38	41	56	32
NONE	k	11	2	3	12	12
NONE	s	6	4	5	19	17

Degree of skill (s) and knowledge (k) a junior high pupil should possess.

Instruments

Degree	s/k	Scale	Protractor	Compass	Caliper	Micrometer	Voltmeter	Ammeter	Divider
MASTERY	k	10	8	14	4	3	1	1	5
MASTERY	s	10	7	14	4	3	1	1	5
MUCH	k	31	27	54	25	9	10	11	24
MUCH	s	49	31	53	25	8	10	11	24
LITTLE	k	35	70	43	42	34	34	35	37
LITTLE	s	36	61	43	37	29	26	27	46
NONE	k	19	10	4	44	69	70	68	29
NONE	s	20	16	5	49	75	78	76	40

Figures

Degree	s/k	Rectangle	Square	Cube	Triangle	Circle	Cone	Cylinder	Hexagon	Octagon	Parallelogram	Trapezoid
MASTERY	k	29	34	26	19	28	8	10	8	7	6	3
MASTERY	s	29	32	19	18	26	8	9	8	7	5	3
MUCH	k	58	59	47	54	55	27	29	14	15	16	14
MUCH	s	53	56	46	48	53	24	27	14	15	14	11
LITTLE	k	24	22	39	37	32	49	54	66	62	52	47
LITTLE	s	31	27	39	43	36	48	50	57	49	50	43
NONE	k	4	0	9	5	0	31	22	27	31	41	51
NONE	s	2	0	11	6	0	35	29	36	44	46	58

Miscellaneous

Degree	s/k	Dozen	Ounce	Pound	Gross	Quire	Ream	Centigrade	Fahrenheit
MASTERY	k	30	33	51	15	8	8	6	8
MASTERY	s	28	31	50	15	8	8	6	8
MUCH	k	68	43	41	33	14	19	19	30
MUCH	s	68	42	41	30	16	18	18	26
LITTLE	k	16	32	20	35	52	49	52	52
LITTLE	s	18	31	20	53	44	43	48	54
NONE	k	1	7	3	12	41	39	38	25
NONE	s	1	11	4	17	47	46	43	27

Degree of skill (s) and knowledge (k) a junior high pupil should possess.		Square Yard	Square Foot	Square Inch
MASTERY	k	10	12	13
	s	10	12	12
MUCH	k	38	51	49
	s	31	44	44
LITTLE	k	38	45	45
	s	46	44	45
NONE	k	19	7	8
	s	28	15	14

Square Measure

Degree of skill (s) and knowledge (k) a junior high pupil should possess.		Cubic Yard	Cubic Foot	Cubic Inch
MASTERY	k	3	4	4
	s	3	4	4
MUCH	k	30	37	38
	s	25	32	33
LITTLE	k	51	51	50
	s	50	51	50
NONE	k	31	23	23
	s	37	28	28

Cubic Measure

experience and training, afford a valid basis for the con-
struction of questions in the junior-high school measurement
knowledge test.[20] The questionnaire tabulation indicated that
forty-nine items in thirteen sections should be included in
the measurement knowledge test.[21] The sections labled Metric
Measure, Cubic Measure, and Formulas, were checked "little"
or "none" by a large percentage of the industrial-arts in-
structors on the questionnaire. Therefore, test items "cup"
and "ounce" in the Liquid Measure Section, as well as "de-
gree" in the Symbol Section were also excluded as the basis
for test. Inch, foot, yard, and dozen were the only items,
out of over a hundred choices that the industrial-arts in-
structors selected for inclusion by nearly unaminous opinion.
All items in the Linear Measure Section were checked as im-
portant enough to be used as bases for test questions.
Thirty-four items out of the forty-nine selected by the shop
instructors for inclusion were chosen by more than a 2 to 1
majority, while thirty-four of the fifty-two items were ex-
cluded by the same ratio. The selection and rejection of items
to be included in the measurement knowledge test by the indust-
rial-arts teachers indicated a close agreement in a majority
of cases.

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[20] Newkirk and Greene, op. cit., p. 32.

[21] See Table I, pp. 16-18.

TABLE I

INDUSTRIAL-ARTS TEACHERS' CHOICES OF ITEMS FOR INCLUSION IN A MEASUREMENT KNOWLEDGE TEST

	VALUE			VALUE	
	NONE LITTLE	MUCH		NONE LITTLE	MUCH
Linear Measure			**Liquid Measure**		
Yard	20	95	Gallon	26	89
Foot	9	106	Quart	22	95
Inch	7	108	Pint	24	91
Half Inch	10	105	Half Pint	36	79
Quarter Inch	20	95	Cup	58	57
Eighth Inch	31	84	Ounce	59	56
Sixteenth Inch	46	69			
			Decimal Measure		
Metric Measure					
			1. Whole Number	19	96
Meter	104	11	.1 Tenth	35	80
Decimeter	109	6	.01 Hundredth	51	64
Centimeter	108	7	.001 Thousandth	72	43
Millimeter	109	6	.0001 Ten Thousandth	89	26
Kilometer	109	6	.00001 Hundred "	98	17
Kilowatt	101	14	.000001 Millionth	100	15
Kilocycle	106	10			
			Angles		
Symbols			360° Circle	37	78
			180° Straight Line	40	75
π Pi	76	39	90° Right Angle	36	79
∠ Angle	68	47	60° Angle	62	53
° Degree	58	57	45° Angle	52	63
" Inch	28	87	30° Angle	64	51
' Foot	29	86	Acute Angle	76	39
△ Triangle	67	48	Obtuse Angle	77	38
% Per Cent	47	68			
√ Square Root	86	29			

TABLE I (continued)

INDUSTRIAL-ARTS TEACHERS CHOICES OF ITEMS FOR INCLUSION IN A MEASUREMENT KNOWLEDGE TEST

	VALUE			VALUE	
	NONE / LITTLE	MUCH		NONE / LITTLE	MUCH
Instruments			**Numbers**		
Scale	54	61	Fractions	17	91
Protractor	80	35	Whole Numbers	7	108
Compass	47	68	Mixed Numbers	17	98
Caliper	86	29	Multiplication	6	109
Micrometer	103	12	Subtraction	6	109
Voltmeter	104	11	Addition	4	111
Ammeter	103	12	Division	7	108
Divider	86	29			
			Terms		
Figures					
			Edge	44	71
Rectangle	28	87	End	42	73
Square	22	93	Face	51	64
Cube	48	67	Thickness	33	82
Triangle	42	73	Width	32	83
Circle	32	83	Length	33	82
Cone	80	35	Board Feet	74	41
Cylinder	76	39			
Hexagon	93	72	**Formulas**		
Octagon	93	72			
Parallelogram	93	72	$A = S$	86	29
			$A = WL$	78	37
Square Measure			$V = WLH$	89	26
			$C = \pi D$	90	25
Square Yard	67	48	$D = 2R$	83	32
Square Foot	52	63	$A = \tfrac{1}{2}bh$	93	22
Square Inch	53	62			

TABLE I(continued)

INDUSTRIAL-ARTS TEACHERS CHOICES OF ITEMS FOR
INCLUSION IN A MEASUREMENT KNOWLEDGE TEST

	VALUE			VALUE	
	NONE	LITTLE	MUCH		NONE	LITTLE	MUCH

	NONE / LITTLE	MUCH		NONE / LITTLE	MUCH
Miscellaneous			**Parts of Circle**		
Dozen	17	98	Circumference	46	69
Ounce	39	76	Diameter	31	84
Pound	23	92	Radius	33	82
Gross	67	48	Arc	67	48
Quire	93	22	Degree	61	54
Ream	88	27			
Centigrade	90	25			
Fahrenheit	77	38			
Cubic Measure					
Cubic Yard	82	33			
Cubic Foot	74	41			
Cubic Inch	73	42			

The following formula was used to approximate the number of test items that should be alloted to each section of the questionnaire.

$$\frac{\text{Number of questionnaire items in each section.}}{49} \quad X \quad 75 \text{ (The number of test items).}$$
(The number of questionnaire
items to be included from
all sections).

The number of test items representing each selected questionnaire item was developed by the use of the above formula. The test originally included more than seventy-five items, which incidently seemed suitable for a forty-five to fifty minute time limit. This number (seventy-five) was arrived at expermentially by giving a longer test to forty-nine junior-high school pupils and computing the average completion time.

One of the most satisfactory and reliable objective-test exercises in the measurement of industrial-education information is the multiple-response.[22] After study of authorities in the field of test construction, Lindquist in particular,[23] it was decided to use a consistent type of item, namely multiple-response, throughout the test. An attempt was also made to use as much non-verbal material as possible

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[22] Ibid., p. 109.

[23] E. F. Lindquist, Educational Measurement (Washington, D. C. : American Council of Education, 1951). p. 173.

in the development of the multiple-response items. The general suggestions for construction of objective test items listed in Greene, Jorgensen, and Gerberich[24] were closely followed in constructing the test.

The plan suggested by Remmers and Gage[25] was adhered to in the development of the directions for administering and scoring the test.[26] A separate answer sheet was devised on which the pupil recorded his answers.[27] A manual scoring key was also developed.[28]

II. TEST TRIALS AND REVISIONS

The test was given to a group of fifteen pupils-- five from each of the sixth, seventh, and eighth grades respectively. After study of the results, the test was revised and changes were made to eliminate items that were too difficult, too easy, and poorly stated. A record of all questions asked by pupils during administering of trial test, aided in making necessary revisions. The revised test had a total of eighty-five test items.

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[24] Greene, Jorgensen, and Gerberich, op. cit., pp. 187-196.

[25] H. H. Remmers and N. L. Gage, Educational Measurement and Evaluation (New York: Harpers & Bros., 1943). p. 197

[26] See Appendix B. p. 59.

[27] See Appendix B. pp. 60-61.

[28] See Appendix B. pp. 60-61.

The number of items in _Part A_, the _Numbers Section_, was doubled in order to reduce error. It was felt by the investigator that in this section, which involved arithmetic computation, that chance error might be introduced in single item presentation; thus, the number of items was doubled and in the scoring credit for the _Numbers Section_ was halved to keep the total possible score at seventy-five. The arrangement of items in the test booklet was changed to conform to the organization of items in the questionnaire. The decision to use the timed method for giving the test was also made at this time. These changes necessitated a new set of directions and a new answer sheet with a new scoring key.

The revised test was given to thirty-four sixth, seventh, and eighth grade pupils. The maximum time allotment for the individual sections of the test was established at the point where 90 per cent of the pupils completed the test.[29] This suggested time schedule is included in the instructions for administering the test.[30] Again the results were checked and minor revisions were made.

Following the second revision, the test was given,

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[29] G. M. Ruch, _The Objective or New-Type Examination._ (Chicago, Ill.: Scott, Foresman & Co., 1929). p. 154

[30] See Appendix B. p. 59

during the fall term of the school year 1951-52, to 21 sixth grade pupils, 55 seventh grade pupils, and 145 eighth grade pupils for a total of 221 pupils enrolled in exploratory industrial-arts courses.[31]

III. STATISTICAL PROCEDURE

The Pearson product-moment formula was used to compute the reliability coefficient of the two halves of the test by the split-half method using the odd and even numbered items. The reliability of one-half of the test was established, and following this, the Spearman-Brown prophecy formula was used in estimating the reliability for the whole test. The standard error of the coefficient of correlation was computed for all grades. Table No. II reveals the Numbers, Half Test Coefficients of Correlations, Whole Test Coefficients of Correlations, and The Standard Error of the Coefficients of Correlations.

TABLE NO. II

COEFFICIENTS OF CORRELATIONS AND THE STANDARD ERROR OF THE COEFFICIENTS FOR THE MEASUREMENT KNOWLEDGE TEST GIVEN TO THE SIXTH, SEVENTH, AND EIGHTH GRADE PUPILS

Grade	Number of Pupils	Coefficients of Correlations		Standard Error of Coefficients
		Half Test	Whole Test	
Sixth	21	.7869	.8807	.084
Seventh	55	.8012	.8895	.048
Eighth	145	.8477	.9176	.060

---

[31] See Test. pp. 25-47

Norms for Portsmouth, Virginia school system were developed for the investigator's own use.[32] The percentile curves show that the eighth grade runs rather consistently above the other two grades; however, about 18 per cent of the eighth grade fall below the medium of the sixth grade. the medium of the sixth and seventh grades vary but two points while the difference in medium of the seventh and eighth grades is four points. The Q_1 of the eighth grade is approximately the same as Q_3 of the seventh grade. Also the spread between the sixth and seventh grade in Q_1 is six points while between the seventh and eight grade it is only four points. In regards to Q_3 all three grades show approximately the same four point spread. The coefficient of variation between the sixth and seventh grade shows a variability of nearly 80 per cent on measurement knowledge. Between the seventh and eighth grade this coefficient is nearly 90 per cent. Also between the sixth and eighth grade the coefficient of variability runs nearly 91 per cent.

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[32] See Figure 1. p.24

SCORE	SIXTH GRADE			SEVENTH GRADE			EIGHTH GRADE			PERCENTILE SCORE
	f	CUM f	%	f	CUM f	%	f	CUM f	%	0 10 20 30 40 50 60 70 80 90 100
37.5	0	21	100	0	55	100	6	145	100	
35.5	0	21	100	0	55	100	7	139	96	
33.5	1	21	100	4	55	100	18	132	91	
31.5	0	21	95	3	51	93	18	114	79	
29.5	1	20	95	4	48	81	14	96	66	
27.5	0	19	90	11	44	80	28	82	57	
25.5	2	19	90	7	33	60	26	54	37	
23.3	3	17	81	9	26	47	8	28	19	
21.5	4	14	67	7	17	31	7	20	14	
19.5	2	10	48	4	10	18	2	13	9	
17.5	2	8	38	3	6	11	2	11	8	
15.5	2	6	29	3	3	5	3	9	6	
13.5	2	4	19	0	0	0	3	6	4	
11.5	1	2	10	0	0	0	2	3	2	
9.5	1	1	4	0	0	0	1	1	1	

FIGURE 1

PERCENTILE CURVE REPRESENTING THE DISTRIBUTION
OF SCORES OF SIXTH, SEVENTH, AND EIGHTH GRADE
PUPILS, ON THE INDUSTRIAL ARTS MEASUREMENT
KNOWLEDGE TEST

INDUSTRIAL ARTS TEST

MEASUREMENT KNOWLEDGE

DIRECTIONS:

This is a test of your achievement, in the elementary grades, of Measurement Knowledge.

The test is made up of 12 parts. Each part will be timed.

There are 85 questions in the test.

You are to start and stop working at Teacher's Command.

Try to answer all questions.

There are several answers suggested for these questions. Select the answer which you think is correct. Place an X through the letter of that answer on the answer sheet.

Do Not Mark Test Booklet. All answers must be on the answer sheet.

Following is a sample question to show you how to mark your answers.

Sample

1. Gasoline is sold in what way?   Answer

   a. pound
   b. gallon   1. a. X c. d.
   c. cup
   d. ounce

Fill in the space provided for name, school, age, and grade, at the top of the answer sheet.

DO NOT TURN PAGE UNTIL COMMAND IS GIVEN:

INDUSTRIAL ARTS TEST

PART I

1. The picture below represents which one of the following measures?
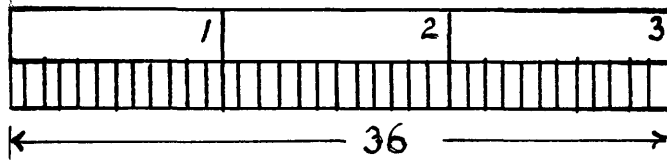
    a. rod
    b. inch
    c. foot
    d. yard
    e. meter

2. The picture below represents which on of the following measures?
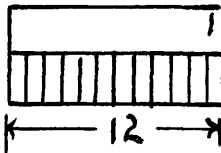
    a. yard
    b. foot
    c. meter
    d. rod
    e. inch

3. The picture below represents which one of the following measures?
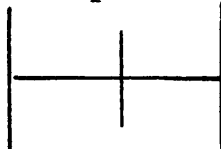
    a. eighth inches
    b. sixteenth inches
    c. half inches
    d. quarter inches
    e. inch

4. The picture below represents which one of the following measures?
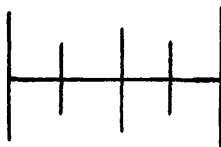
    a. sixteenth inches
    b. eighth inches
    c. quarter inches
    d. half inches
    e. inch

5. The picture below represents which one of the following measures?
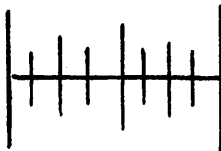
    a. quarter inches
    b. half inches
    c. sixteenth inches
    d. inch
    e. eighth inches

PART I

6. The picture below represents which one of the following measures?

    a. eighth inches
    b. sixteenth inches
    c. quarter inches
    d. half inches
    e. inch

7. The picture below represents which one of the following measures?

    a. sixteenth inches
    b. quarter inches
    c. half inches
    d. inch
    e. eighth inches

8. If an inch is divided into halves which one of the answers below would be the correct number of parts in the inch?

    a. four
    b. sixteen
    c. two
    d. eight

9. Which answer listed below would be the smallest part of an inch?

    a. half
    b. sixteenth
    c. quarter
    d. eighth

10. Which answer listed below would be the largest part of an inch?

    a. sixteenth
    b. half
    c. eighth
    d. quarter

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INDUSTRIAL ARTS TEST

PART II

1. The sign ($''$) is the same as which one of the following answers?

    a. foot sign
    b. dollar sign
    c. per cent sign
    d. inch sign
    e. degree sign

2. This sign ($\%$) is the same as which one of the following answers?

    a. dollar sign
    b. foot sign
    c. inch sign
    d. degree sign
    e. per cent sign

3. This sign ($'$) is the same as which one of the following answers?

    a. foot sign
    b. degree sign
    c. inch sign
    d. per cent sign
    e. dollar sign

4. If John wishes to order a 28 inch bike from a catalogue, which answer below shows the correct way to write this?

    a. 28'
    b. 28''
    c. 28%
    d. 28°

5. John also wishes to order a 12 foot boat, which measure below shows the correct way to write this?

    a. 12°
    b. 12''
    c. 12%
    d. 12'

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INDUSTRIAL ARTS TEST

PART III
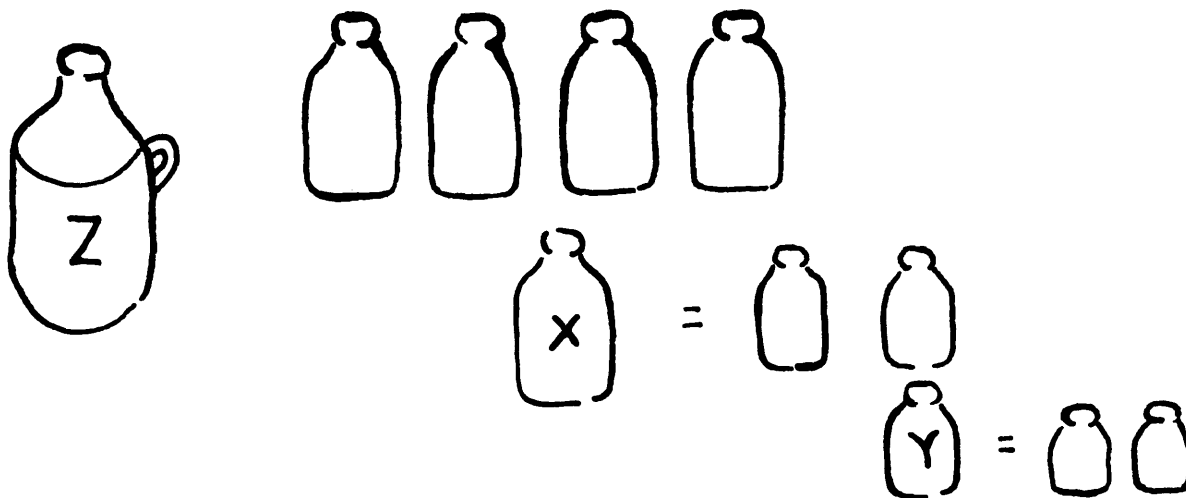
1. Which answer below is the correct name for bottle Z in the above picture?

    a. quart
    b. pint
    c. gallon
    d. half pint

2. Which answer below is the correct name for bottle X in the picture?

    a. pint
    b. gallon
    c. quart
    d. half pint

3. Which answer below is correct for bottle Y in the picture?

    a. gallon
    b. quart
    c. half pint
    d. pint

4. Eight boys buy a gallon of ice cream and divide it evenly, which answer below shows the amount each would receive?

    a. quart   c. half pint
    b. pint   d. half gallon

INDUSTRIAL ARTS TEST

PART III

5. If each boy receives a half pint of milk, how many boys will a gallon serve?

    a. 8
    b. 4
    c. 16
    d. 32

6. Four boys wish to drink a quart of chocolate milk, if each receives the same amount which answer below is correct?

    a. gallon
    b. pint
    c. half pint
    d. half quart

(DO NOT TURN PAGE)

INDUSTRIAL ARTS TEST

PART IV

1. This number (75.) is the same as which one of the following answers?

    a. tenth
    b. whole number
    c. hundredth
    d. thousandth

2. This number (.9) is the same as which one of the following answers?

    a. whole number
    b. thousandth
    c. hundredth
    d. tenth

3. This number (.58) is the same as which one of the following answers?

    a. thousandth
    b. hundredth
    c. whole number
    d. tenth

4. Which answer below is a tenth?

    a.   .742
    b.   .05
    c. 7.
    d.   .8

5. Which answer below is a hundredth?

    a. 9.
    b.   .74
    c.   .894
    d.   .7

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INDUSTRIAL ARTS TEST

PART V

1. The picture below represents which one of the following answers?
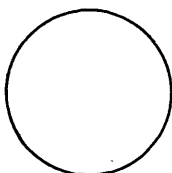
    a. 45 degree angle
    b. 90 degree angle
    c. 180 degree angle
    d. 360 degree angle
    e. 75 degree angle

2. The picture below represents which one of the following answers?

    a. 75 degree angle
    b. 90 degree angle
    c. 180 degree angle
    d. 360 degree angle
    e. 45 degree angle

3. The picture below represents which one of the following answers?
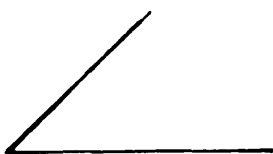
    a. 180 degree angle
    b. 45 degree angle
    c. **90 degree angle**
    d. 360 degree angle
    e. 75 degree angle

4. The picture below represents which one of the following answers?

    a. 360 degree angle
    b. 180 degree angle
    c. 45 degree angle
    d. 75 degree angle
    e. 90 degree angle

5. A 90 degree angle is the same as which one of the answers below?

    a. circle
    b. straight line
    c. half a right angle
    d. right angle

INDUSTRIAL ARTS TEST

PART V

6. A 45 degree angle is the same as which one of the answers below?

   a. right angle
   b. half a right angle
   c. circle
   d. straight line

(<u>DO</u> <u>NOT</u> <u>TURN</u> <u>PAGE</u>)

INDUSTRIAL ARTS TEST

PART VI

1. The picture below represents which one of the following answers?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
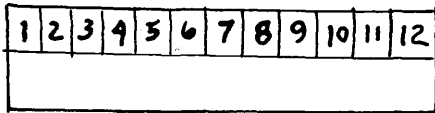
    a. scale (rule)
    b. compass
    c. yard stick
    d. divider

2. The picture below represents which one of the following answers?

    a. yard stick
    b. divider
    c. compass
    d. scale (rule)

5. Which one of the instruments below would you need to draw a straight line?

    a. compass
    b. scale (rule)
    c. divider
    d. protractor

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INDUSTRIAL ARTS TEST

PART VII

1. This picture represents which one of the answers below?
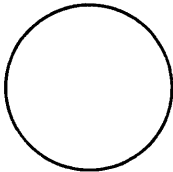
    a. square
    b. triangle
    c. circle
    d. rectangle
    e. octagon

2. This picture represents which one of the answers below?
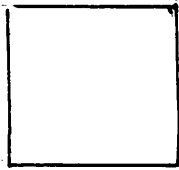
    a. rectangle
    b. cone
    c. square
    d. triangle
    e. circle

3. This picture represents which one of the answers below?
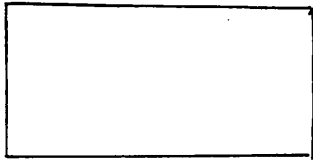
    a. square
    b. cube
    c. triangle
    d. circle
    e. rectangle

4. This picture represents which one of the answers below?
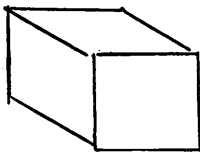
    a. rectangle
    b. cube
    c. circle
    d. triangle
    e. hexagon

5. Which figure in the list below is most like a pancake?

    a. square
    b. rectangle
    c. circle
    d. triangle

INDUSTRIAL ARTS TEST

PART VII

6. Which figure in the list below is most like a pat of butter?

> a. rectangle
> b. circle
> c. square
> d. triangle

7. Which figure in the list below is most like a dollar bill?

> a. circle
> b. square
> c. rectangle
> d. triangle

8. This picture represents which one of the answers below?

> a. square
> b. rectangle
> c. triangle
> d. circle
> e. trapezoid

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INDUSTRIAL ARTS TEST

PART VIII

1. A dozen apples could be evenly divided among how many boys?

    a. 8
    b. 6
    c. 15
    d. 18

2. Eggs are usually sold by which one of the following ways?

    a. bushel
    b. ounce
    c. pound
    d. dozen

3. John's mother brought home 24 oranges, how many dozen was this?

    a. 6
    b. 8
    c. 4
    d. 2

4. A pound of candy was divided between 8 boys, how many ounces did each receive?

    a. 8
    b. 2
    c. 6
    d. 4

5. Mary's mother spilled half of a pound of sugar, how many ounces remained?

    a. 32
    b. 8
    c. 16
    d. 4

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INDUSTRIAL ARTS TEST

PART IX

1. Which one of the answers below describe this number $(\frac{1}{2})$?

      a. decimal
      b. whole number
      c. mixed number
      d. fraction

2. Which one of the answers below describe this number $(4\frac{1}{2})$?

      a. fraction
      b. decimal
      c. whole number
      d. mixed number

3. Which one of the answers below describe this example (7x10)?

      a. division
      b. subtraction
      c. addition
      d. multiplication

4. Which of the answers below describe this example (8÷2)?

      a. addition
      b. division
      c. subtraction
      d. multiplication

5. Add (Work on scratch paper, mark answer on answer sheet)

      387
    42715
       86

    a. 47188
    b. 49189
    c. 43188
    d. 43178

6. Add

    $4\frac{1}{4}$
    $5\frac{1}{4}$
    $6\frac{1}{2}$

    a. $15\frac{1}{2}$
    b. $15\frac{1}{4}$
    c. 16
    d. $16\frac{1}{2}$

INDUSTRIAL ARTS TEST

PART IX

7. Add

$5 \frac{3}{8}$
$7 4/5$

    a. 13 $\frac{7}{8}$
    b. 14 7/40
    c. 13 7/5
    d. 13 7/40

8. Add

2 ft. 3 in.
4 ft. 9 in.

    a. 6 ft. 11 in.
    b. 7 ft. 1 in.
    c. 7 ft.
    d. 6 ft. 6 in.

9. Add

4 lb. 9 oz.
1 lb. 8 oz.

    a. 5 lb. 1 oz.
    b. 6 lb. 3 oz.
    c. 6 lb. 1 oz.
    d. 3 lb. 1 oz.

10. Subtract

5945
4672

    a. 1264
    b. 1273
    c. 1274
    d. 1275

11. Subtract

$5 \frac{1}{2}$
$3 1/7$

    a. 2 1/7
    b. 2 5/14
    c. 2 1/5
    d. 2 1/2

12. Subtract

$91 \frac{1}{4}$
$50 \frac{5}{8}$

    a. 39 $\frac{1}{2}$
    b. 40 5/8
    c. 41 5/32
    d. 40 1/2

INDUSTRIAL ARTS TEST

PART IX

13. Subtract

$$\begin{array}{r} 7 \text{ lb. } 7 \text{ oz.} \\ 5 \text{ lb. } 12 \text{ oz.} \end{array}$$

    a. 2 lb. 5 oz.
    b. 1 lb. 11 oz.
    c. 13 lb. 6 oz.
    d. 1 lb. 19 oz.

14. Multiplication

$$\frac{2}{5} \times \frac{3}{5}$$

    a. $5/25$
    b. $6/25$
    c. 5
    d. $5/10$

15. Multiplication

$$4\frac{1}{2} \times 8\frac{3}{4}$$

    a. $12 \frac{4}{6}$
    b. $39 \frac{3}{8}$
    c. $32 \frac{3}{8}$
    d. $37 \frac{1}{8}$

16. Multiplication

$$9\frac{3}{8} \times \frac{1}{5}$$

    a. $9 \frac{3}{40}$
    b. $1 \frac{7}{8}$
    c. $9 \frac{2}{3}$
    d. $9 \frac{8}{15}$

17. Division

$$92 \overline{)1564}$$

    a. 25
    b. 17
    c. 15
    d. 19

18. Division

$$\frac{1}{2} \div \frac{1}{4}$$

    a. $\frac{1}{8}$
    b. 8
    c. 2
    d. $\frac{1}{2}$

INDUSTRIAL ARTS TEST

PART IX

19. Division

$144\overline{\smash{\big)}\,1584}$

a. 110
b. 11
c. 10
d. 12

20. Division

$\frac{7}{8} \div \frac{1}{2}$

a. ½
b. 1 ¾
c. 7/16
d. 8/16

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INDUSTRIAL ARTS TEST
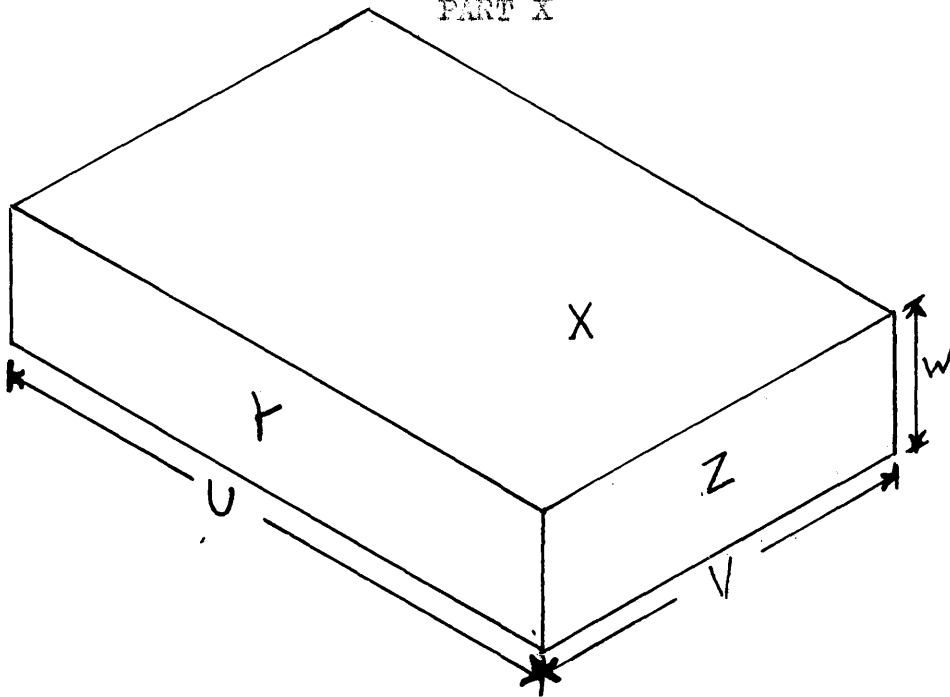
PART X

1. Which answer below is the same as part X in the picture?

    a. end
    b. edge
    c. face
    d. side

2. Which answer below is the same as part Y in the picture?

    a. end
    b. top
    c. edge
    d. bottom

3. Which answer below is the same as part Z in the picture?

    a. top
    b. end
    c. edge
    d. face

(TURN PAGE)

INDUSTRIAL ARTS TEST

PART X

4. Which answer below is the same as part U in the picture?

    a. width
    b. thickness
    c. length
    d. heighth

5. Which of the answers below is the same as part V in the picture?

    a. length
    b. thickness
    c. depth
    d. width

6. Which of the answers below is the same as part W in the picture?

    a. thickness
    b. width
    c. length
    d. depth

7. A block of wood similar to the above picture, would have how many surfaces?

    a. 3
    b. 4
    c. 5
    d. 6

8. A block of wood similar to the above picture, would have how many edges?

    a. 1
    b. 2
    c. 4
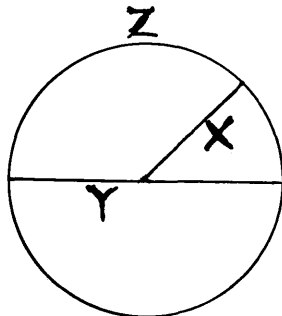   d. 6

INDUSTRIAL ARTS TEST

PART X

9. A block of wood similar to the above picture, would have how many ends?

    a. 6
    b. 4
    c. 2
    d. 1

(DO NOT TURN PAGE)

INDUSTRIAL ARTS TEST

PART XI

1. Which answer below is the name of part X in the above picture?

    a. circumference
    b. radius
    c. diameter
    d. degree

2. Which answer below is the name of part Y in the above picture?

    a. diameter
    b. radius
    c. arc
    d. circumference

3. Which answer below is the name of part Z in the above picture?

    a. circumference
    b. diameter
    c. degree
    d. radius

4. The diameter of a circle is the same as how many radii?

    a. 4
    b. 6
    c. 2
    d. 8

INDUSTRIAL ARTS TEST

PART XI

5. Which of the parts below is the longest part of a circle?

    a. diameter
    b. radius
    c. arc
    d. circumference

(DO NOT TURN PAGE)

INDUSTRIAL ARTS TEST

PART XII

1. Mrs. Jones' kitchen measures 12 ft. by 15 ft., how many
   square feet of linoleum would she need to completely
   cover the floor?

        a. 27 sq. ft.
        b. 45 sq. ft.
        c. 180 sq. ft.
        d. 90 sq. ft.

2. Mr. Brown wishes to paint his bedroom floor which
   measures 15 ft. by 20 ft. If a gallon of paint will
   cover 200 sq. ft. which answer shows the correct amount
   of paint needed?

        a. 1 gal.
        b. 1½ gal.
        c. 2 gal.
        d. 2½ gal.

3. A square foot is made up of how many square inches?

        a. 12 sq. in.
        b. 36 sq. in.
        c. 72 sq. in.
        d. 144 sq. in.

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CHAPTER III

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

This study accomplished its avowed purpose to construct a pencil and paper test for discovering, in terms of measurement knowledge, the achievement level of junior-high school pupils at the start of an industrial-arts exploratory course. Using such sources as elementary text books, elementary source books, and the official Virginia slementary state course of study, items were identified for inclusion in a questionnaire which was designed to reveal what should be asked on a measurement knowledge test. The questionnaire was distributed to all white industrial-arts instructors in Virginia.

Of the 101 items listed in the questionnaire forty-nine were selected for inclusion in the test. The forty-nine items were classified in the following categories: Linear Measure, Symbols, Angles, Decimal Measure, Liquid Measure, Instruments, Numbers, Figures, Terms, Parts of Circle, Square Measure, and Miscellaneous. Metric Measure, Cubic Measure, and Formulas were not selected as suitable for test items.

Since the items for the questionnaire were identified from standard text books, courses of study and the like, and since 115 industrial-arts instructors selected particular items

from the list, it is believed that the test had curricular
validity.

After the test was given to 221 sixth, seventh, and
eighth grade pupils the reliability of the test was computed
using the split-half method. The "whole test" coefficient of
correlation for each grade was .88, .89, .92, respectively.
It was also discovered that certain specific items such as,
item number 6, Part VII, item numbers 2, 3, 4, and 5, Part IV,
and item 1, Part I show the need for revision in order to make
the test more effective.

The percentile curves for the three grades show each to
be approximately the same variability in measurement knowledge.

I. CONCLUSIONS

On the basis of the foregoing data, the following con-
clusions seem to be justified:

1. The test was reliable statistically.

2. The test was valid. The test seemingly had curri-
cular validity.

3. On the basis of the results it is concluded that the
test has value, when used as an achievement test, in locating
individual differences on the individual as well as the class
level in industrial-arts measurement knowledge.

4. The test needs revision before it may be given effectively to additional groups.

II. RECOMMENDATIONS

In view of the above conclusions the following recommendations are made:

1. A further study of industrial-arts readiness to determine the factors necessary for inclusion in an industrial-arts test should materially aid in the development of this type of testing.

2. The development of a skill factor test of measurement would be another worthwhile addition to supplement the measurement knowledge test.

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APPENDIX A.

4 Lawrence Circle
                                        Portsmouth, Va.

                                        May 16, 1951

Dear Sir:

        Dr. B. H. Van Oot, State Supervisor of Trade and
Industrial Education in Virginia, has given me permission
to send questionnaires to the Industrial Arts Instructors
of the State, in order that I may secure information for
use in the construction of a diagnostic industrial arts
test of measurement skill and knowledge. This test to be
designed for use on the junior high level.

        It is hoped that the study, of which the test is to
be a part, will be of value to industrial arts instructors
as an aid in improving course planning in the light of
individual differences of pupils.

        All information you submit will be treated confident-
ially and impersonally. Names and places will not be used
in the study.

        Your immediate attention will be greatly appreciated,
a copy of the completed test will be sent on request.

                                Sincerely yours,

                                Chester H. Gutzler

GENERAL INFORMATION

NAME _____

ADDRESS _____

SCHOOL ADDRESS _____

TOTAL YEARS TEACHING EXPERIENCE IN INDUSTRIAL ARTS _____

CIRCLE THE GRADE OR GRADES YOU ARE NOW TEACHING INDUSTRIAL ARTS

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, adult

CIRCLE THE GRADE OR GRADES YOU HAVE TAUGHT INDUSTRIAL ARTS

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, adult

CIRCLE THE STARTING GRADE FOR INDUSTRIAL ARTS IN YOUR SCHOOL

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,

CHECK TYPE OF SHOP ORGANIZATION IN YOUR SCHOOL

Comprehensive General Shop _____
Unit Shop _____
Other (explain) _____

PLEASE LIST THE INDUSTRIAL ARTS FIELDS IN WHICH YOUR ARE TEACHING, OR HAVE TAUGHT

1. _____   5. _____   9. _____

2. _____   6. _____   10. _____

3. _____   7. _____   11. _____

4. _____   8. _____   12. _____

IF YOU WOULD LIKE A COPY OF TEST, PLEASE CHECK _____

PLEASE FEEL FREE TO COMMENT ON ANY PHASE OF THIS QUESTIONNAIRE, OR ON INDUSTRIAL ARTS MEASUREMENT. ANY EXPRESSION OF OPINION WILL BE AP-PRECIATED.

FOLLOW-UP-CARD
(COPY)

5/23/51

Dear Sir:
Thank you for your prompt response to my questionnaire. If you have so requested, a copy of test will be sent you upon its completion.

In case you have not, as yet, completed the questionnaire, please do so at your earliest convience, as your reply is necessary for the construction of this test.

Sincerely,

Chester H. Gutzler

APPENDIX B

DIRECTIONS FOR ADMINISTERING
AND
SCORING TEST

There is a total of seventy five possible points on this test. The arithmethic section (Part IX) is scored one half point for each correct answer. Provide scrap paper for working this section. Apply rules of good testing when administering this test. When scoring count only correct answers.

SUGGESTED TIME SCHEDULE

Part I   5 minutes

Part II   2 minutes

Part III   3 minutes

Part IV   2 minutes

Part V   3 minutes

Part VI   2 minutes

Part VII   3 minutes

Part VIII   2 minutes

Part IX   15 minutes

Part X   4 minutes

Part XI   2 minutes

Part XII   2 minutes

TOTAL TIME 45 MINUTES

MEASUREMENT KNOWLEDGE TEST
ANSWER SHEET
KEY

NAME _____   SCORE _____   AGE _____

SCHOOL _____   GRADE LEVEL _____

DIRECTIONS: Place an X through the letter corresponding
to the choice of correct answer.

PART I

1. a. b. c. (d) e.
2. a. (b) c. d. e.
3. a. b. (c) d. e.
4. a. b. (c) d. e.
5. a. b. c. d. (e)
6. a. b. c. d. (e)
7. (a) b. c. d. e.
8. a. b. (c) d. e.
9. a. (b) c. d. e.
10. a. (b) c. d. e.

PART II

1. a. b. c. (d) e.
2. a. b. c. d. (e)
3. (a) b. c. d. e.
4. a. (b) c. d. e.
5. a. b. c. (d) e.

PART III

1. a. b. (c) d. e.
2. a. b. (c) d. e.
3. a. b. c. (d) e.
4. a. (b) c. d. e.
5. a. b. (c) d. e.
6. a. b. (c) d. e.

PART IV

1. a. (b) c. d. e.
2. a. b. c. (d) e.
3. a. (b) c. d. e.
4. a. b. c. (d) e.
5. a. (b) c. d. e.

PART V

1. a. b. c. (d) e.
2. a. (b) c. d. e.
3. a. (b) c. d. e.
4. a. (b) c. d. e.
5. a. b. c. (d) e.
6. a. (b) c. d. e.

PART VI

1. (a) b. c. d. e.
2. a. b. (c) d. e.
3. a. (b) c. d. e.

PART VII

1. a. b. (c) d. e.
2. a. b. (c) d. e.
3. a. b. c. d. (e)
4. a. (b) c. d. e.
5. a. b. (c) d. e.
6. a. b. (c) d. e.
7. a. b. (c) d. e.
8. a. b. (c) d. e.

PART VIII

1. a. (b) c. d. e.
2. a. b. c. (d) e.
3. a. b. c. (d) e.
4. a. (b) c. d. e.
5. a. (b) c. d. e.

PART IX

1. a. b. c. (d) e.
2. a. b. c. (d) e.
3. a. b. c. (d) e.
4. a. (b) c. d. e.
5. a. b. (c) d. e.
6. a. b. (c) d. e.
7. a. b. c. (d) e.
8. a. b. (c) d. e.
9. a. b. (c) d. e.
10. a. (b) c. d. e.
11. a. (b) c. d. e.
12. a. (b) c. d. e.
13. a. (b) c. d. e.
14. a. (b) c. d. e.
15. a. (b) c. d. e.
16. a. (b) c. d. (e)
17. a. (b) c. d. e.
18. a. b. (c) d. e.
19. a. (b) c. d. e.
20. a. (b) c. d. e.

PART X

1. a. b. (c) d. e.
2. a. b. (c) d. e.
3. a. (b) c. d. e.
4. a. b. (c) d. e.
5. a. b. c. (d) e.
6. (a) b. c. d. e.
7. a. b. c. (d) e.
8. a. (b) c. d. e.
9. a. b. (c) d. e.

MEASUREMENT KNOWLEDGE TEST
ANSWER SHEET
KEY (continued)

PART XI

1. a. (b) c. d. e.
2. (a) b. c. d. e.
3. (a) b. c. d. e.
4. a. b. (c) d. e.
5. a. b. c. (d) e.

PART XII

1. a. b. (c) d. e.
2. a. (b) c. d. e.
3. a. b. c. (d) e.