A STUDY OF GRADE DISTRIBUTION IN LARGE AND SMALL CLASS GROUPS, COVERING THE SAME STUDENTS AND THE SAME CLASSWORK

by

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INTRODUCTION

STATEMENT OF THE PROBLEM

In grading student accomplishment, it is desirable to maintain a high degree of validity and objectivity. It is the purpose of this study to determine how well this has been done on a given project assigned to the beginning sections of an elementary woodworking course at the Oregon State College.

SIGNIFICANCE OF THE PROBLEM

The normal curve system of grading (4:242)* used at the Oregon State College makes it possible to locate with a high degree of accuracy the position of individual student grades when the students are members of large classes. When the students are members of small classes, however, the curve system proves inadequate. For example, a class of twelve or thirteen students

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* This refers to number 4 of the bibliography, page 242.

would, under the curve system, include one A grade and one F grade. But it might easily happen that two or three outstanding students were enrolled in such a class. If the "Normal" distribution were rigidly applied, one of these students would receive an A grade, and the others would receive grades of B or less. Likewise one F would have to be given, under the distribution curve, even though the poorest students in the class might, if members of a large group, merit a grade of D or even a C. For the small class, then, an absolute adherence to the normal grade curve may often be inadequate and unfair.

METHOD OF PROCEDURE

In pursuing the problem presented in this thesis, 133 examples of a beginning woodworking project were secured and numbered, and a record was made of their original grades. These were then rearrenged in one group and graded according to the normal curve. Figures were then compiled to show the number of grades changed at each grade level. A measuring device was evolved which, the author believes, will assist in making the future grading of the project more accurate, more objective, and more just.

ORIGINAL PROJECTS IN SMALL GROUPS

SOURCE OF MATERIAL

Although the woodworking project selected serves the primary purpose of providing a means of applying the early instruction of the course, it is customarily used as a cutting board to protect the woodworking table during chiseling, gouging, or other operations that would deface the table top. Over a period of years, however, these boards, together with a complete record of the original grades recorded on each, have been collected. It is this collection that was used in the preparation of this study.

NUMBER OF INSTRUCTORS AND PROJECTS COMPLETED UNDER EACH

The following tabulation indicates the number and size of classes studied and the number of instructors involved.

Number of separate classes	7
Number of regular instructors	2
" " " guest " " "	1
" " " part-time " "	1
Total number of instructors	4

Number of Students Per Instructor

Instructor Number	Number of Students
1	94
2	20
3	16
4	3
Total No. Students	133

NUMBER OF PROJECTS AND WHEN USED

The number of the projects, together with the time when they were used, is indicated in the following:

TIME	PROJECTS
Fall 1929-1930*	26
Fall 1931-1932	49
Fall 1932-1933	10
Winter 1933-1934	20
Winter 1935-1936	18
Summer 1931	8
Summer 1933	2
Total No. of Projects	133

* Dates refer to the school year.

CONSTRUCTION OF THE PROJECT

In preparation for this beginning project in woodworking, white pine boards of 3/4" to 7/8" in thickness were cut to a width of 5½" and a length of 12". Care was taken to see that these were made of uniform clear, straight-grained wood. The two sides of these boards were planed parallel with each other, one edge being jointed square with the sides. The two ends were sawed square with the jointed edge. The second edge was saw-sized parallel to the jointed edge. The thickness was not considered in either the manual operations or the grading.

After a complete demonstration on the procedure to use in squaring this project, each student was given a board to use as his project material. He was told to select either side as a working face and to hand-joint either edge until he considered it was straight and square with the working face. This completed, he presented the project to the instructor for an inspection. If the edge met the standard required by the instructor, he initialed it, and the student continued with the next step. If it did not meet the standard, the student was required to try again. This edge was used as a working edge in the next two operations. It is to be noted that although the jointed edge was already straight and square with the working face, the student was required to use a hand plane on the surface for the purpose of removing all machine-tool marks.

After the jointed edge was completed, one end was planed square with the working edge and working face; next, the second end was likewise finished. The final operation was the jointing of the second edge square with the working face and parallel to the working edge.

When these four surfaces had been initialed by the instructor, an acceptable standard of accuracy was thus indicated, and the project was considered to be completed and ready for grading.

At some time early in each term and after all these projects had been completed, they were collected and graded. The primary consideration in the grading was the length and width measurement of each board. It is assumed that the instructor maintained a uniform standard in his checking of the various operations. It then becomes unnecessary for him to check further on the squareness of the project.

The student who has squared the project with the least loss of material is judged to have best followed instructions and to have exhibited the best craftsmanship in the class. In like manner, the student who planed away excessive material in length or in width or in both is considered a poorer craftsman, his standing in the class being determined by the relative amount of material he has used up in the process of finishing his project.

The longest of these boards, according to measurement indicated on a ruler, was given the highest grade on length, and the shortest board was given the lowest grade. Likewise, the widest board was given the highest grade on width, and the narrowest one, the lowest grade. A composite was made of the length and width grades, by the use of the "Equivalent-Grade-and Score Chart." The letter grades given for the length and width were transferred into a numerical value and added together. This sum was divided by two and the quotient was used to establish a new letter grade for the project as a whole.

As an example, let us assume that the letter grade for length was B plus and for the width was C. Upon referring to the "Equivalent-Grade-and-Score Chart," we find that B plus is the equivalent of four and that C is the equivalent of eight. The sum of four and eight divided by two is equal to six. Six transfers into B minus as a final grade on the finished project.

EQUIVALENT-GRADE-AND-SCORE CHART

Letter Grade	Equivalent Score
A Plus	1
A	2
A Minus	3
B Plus	4
B	5
B Minus	6
C Plus	7
C	8
C Minus	9
D Plus	10
D	11
D Minus	12
F Plus	13
F	15
F Minus	18

"NORMAL" CURVE GRADE DISTRIBUTION

The system used in regrading these 133 projects (See Figure I, Page 10) is as follows: The projects were arrenged on a straight, flat surface in such a manner that the longest board was on the right and the shortest on the left end of the completed group of 133 pieces. A straight edge was then placed on top of the projects, and those that held the straight edge above the others were moved toward the right. Those that were somewhat below the general level of the straight edge were moved to the left. This process was continued until there was a gradual drop from the longest on the right to the shortest on the left.

Following the uniform distribution of the projects, from the longest to the shortest, the various letter grade groups were selected on a percentage basis, in agreement with the modified normal distribution system recognized at Oregon State College. This distribution was as follows:

A	B	C	D	F
7%	24%	38%	24%	7%

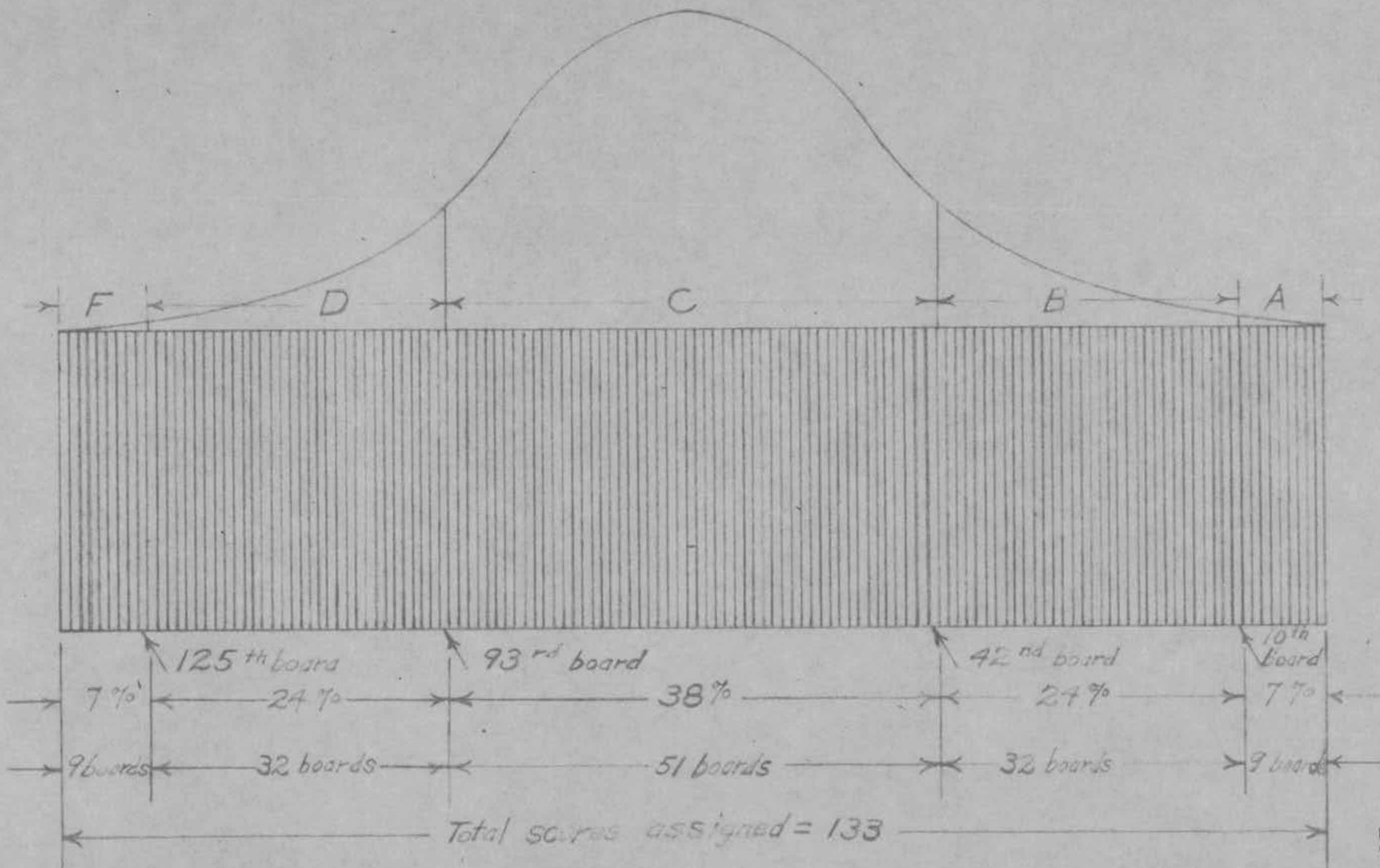

Figure 1. Graphical Representation of Re-scoring Original Projects

NUMBER OF GRADES IN EACH GROUP BY NORMAL CURVE

Applying these percentages to the 133 projects in the group, we have the following number of grades in each group:

A	B	C	D	F
9.31	31.92	50.54	31.92	9.31

It is obvious that these boards cannot be divided into fractions and still retain their usefulness; therefore an arbitrary adjustment in the number of the various grades was made in order to eliminate the fractions. It will be noted that such an adjustment would have to be made unless the total number of projects equalled 100 or some multiple thereof. This arrangement was as follows:

A	B	C	D	F
9	32	51	32	9

Since the original grades awarded in the small groups made use of plus and minus following the letter grades, as a further means of a finer differentiation (and of averaging the letter grades on a numerical basis, as explained on page 9) in the small groups, these distribtutions in the larger group (133 total) could be further compared as follows:

A Plus	3		
A	3	Total A grades	9
A Minus	3		
B Plus	11		
B	10	Total B grades	32
B Minus	11		
C Plus	17		
C	17	Total C grades	51
C Minus	17		
D Plus	11		
D	10	Total D grades	32
D Minus	11		
F Plus	3		
F	3	Total F grades	9
F Minus	3		

REDISTRIBUTING GRADES IN THE LARGE GROUP

A measuring device was prepared with which to record the length or width of the boards that separate the various grade groups established by the arrangement of the 133 boards. Two pieces of aluminum angle were cut and riveted together in such a manner that the shorter one made an angle of ninety degrees with and near the end of the longer one, making the whole similar to a "T" square.

LENGTH FOR EACH GRADE

At this point, the entire 133 boards were divided into sections,the size of which had been determined in accordance with the standard grade distribution curve used at Oregon State College.

Since there were to be nine boards in the A-grade group, the tenth board (from the right end of the line) was selected as a measure of the limit between the A and B groups and was placed on the measuring device with one end against the base and its side against the upright. A sharp, thin scriber point was used to cut a narrow line across the upright aluminum angle, the end of the board serving as a guide. This line marked the lower limit for boards in the A group, and the upper limit for those in the B group.

Any board that covered more of this line than did the tenth board was to be an A grade in length; any board that did not partially cover this line was worthy of only a B grade, or less, in length, according to the standards set by the 133 cases of this study. The tenth board was used for this measurement because the line had to be drawn outside the end of the board. If the ninth board had been used, the line would have been off the end of the board and would thus have left the ninth board in the B group, and only eight A grades would have been allowed.

Adding nine boards in the A group to the thirty-two in the B group gave the forty-first board as the shortest one in the B group. The next, or forty-second board, was the longest in the C group and was, therefore, removed and used as a measure for determining the line separating the B and C sections.

Adding nine, thirty-two, and fifty-one, the number of boards in the A, B, and C groups respectively, showed the ninety-second board to be the shortest one in the C section and the ninety-third board to be the longest one in the D group. This was used to establish the dividing line between the C and D sections.

In a like manner, the sum of nine, thirty-two, fifty-one, and thirty-two showed the-one-hundred-twenty fourth board to be the shortest in the D group and the one hundred and twenty-fifth to be the longest in the F group. nThis, therefore, was the board to be used in setting a dividing line between the D and the F grades.

The 133 boards were given a letter grade for length in accordance with the divisions as indicated on page 12, and a record of these was made in column 3 on pages 18 to 27 inclusive.

WIDTH FOR EACH GRADE

The next procedure was to rearrange the boards so that the widest was at the extreme right and the narrowest was at the extreme left. The boards marking the dividing lines between the various grades, for width, were selected in the same manner as were those establishing corresponding lines for length.

Each board was in turn placed on the measuring device, with one side against the base. The other side was used as a gague to strike a line on the upright. This line was, in each case, the dividing point between the two grades under consideration. In grading for width, these four lines are to serve as will the other four for length.

A regrading of these 133 projects for width was then conducted in the same manner as was employed in the regrading for length. The grades were recorded by letters placed in column 5 on pages 18 to 27 inclusive. The "Equivalent-Grade-and-Score Chart" on page 8 was used in the calculation of the scores for columns 4 and 6. The total equivalent score was found by adding the scores in columns 4 and 6. The average equivalent score for column 8 was found by dividing the total score in column 7 by two. The "Equivalent-Grade-and-Score Chart" was used to convert the average equivalent score into a letter grade in column 9.

For example, student number six had a letter grade of B on length, as recorded in column 3. Upon reference to the "Equivalent-Grade-and-Score Chart" we found the B was valued at five points, and so recorded it in column 4. Likewise a C Plus (column 5) in the width of the board gave a score of seven in column 6. The sum of the equivalent scores of four and six was recorded in column 7. The average equivalent score was placed in column 8. This average of six was the equivalent of a re-evaluated grade (column 9). When the job was completed, the student had received a grade of B Minus; in his case, therefore, the grade was changed but little by the revaluation.

Let us now consider the scores on student number fourteen. The length grade was D Minus and the width grade C Plus, producing a total equivalent score of nineteen. The average was nine point five (9.5), or just slightly higher than C Minus. In this study, the half point on the average equivalent score has been consistently omitted because it was never of sufficient value to raise the grade to the next level.

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	1	B-	A	2	C	8	10	5.0	B
	2	A-	B-	4	C+	7	11	5.5	B
	3	C-	D	12	C+	7	19	9.5	C-
	4	B	C-	9	C+	7	16	8.0	C
	5	B-	C+	7	C	8	15	7.5	C+
	6	B-	B	5	C+	7	12	6.0	B
	7	D	F	15	D-	12	27	13.5	F+
	8	A-	B	5	C+	7	12	6.0	B-
	9	B-	C+	7	C	8	15	7.5	C+
	10	B+	C	8	D+	10	18	9.0	C-
	11	A	B-	6	A+	1	7	3.5	A-
	12	C-	A	2	C+	7	9	4.5	B+
	13	B	B-	6	C	8	14	7.0	C+
	14	B-	D-	12	C+	7	19	9.5	C-

COLUMN	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	15	C	F-	16	C+	7	23	11.5	D
	16	D+	D-	12	F	15	27	13.5	F+
	17	A	A	2	B	5	7.0	3.5	A
	18	D	F+	13	F	15	28	9.0	C-
	19	B-	B	5	B	5	10	5.0	B
	20	C-	D+	10	C+	7	17	8.5	C
	21	C-	D	11	B	5	16	8.0	C
	22	C	C+	7	C-	9	16	8.0	C
	23	C	C+	9	B-	6	15	7.5	C+
	24	D+	D+	10	C-	9	19	9.5	C-
	25	C	B+	4	C-	9	13	6.5	B-
	26	C+	A+	1	C-	7	8	4.0	B+
	27	B+	B	5	A-	3	8	4.0	B+
	28	B-	A-	3	C	8	11	5.5	B-

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	29	B	A+	1	B+	4	5	2.5	A
	30	A	B+	4	A+	1	5	2.5	A
	31	D+	D-	12	D+	10	22	11.0	D
	32	B	B-	6	C+	7	13	6.5	B-
	33	C	C+	7	C-	9	16	8.0	C
	34	C	C	8	B-	6	14	7.0	C+
	35	D	F+	13	D	11	24	12.0	D-
	36	A-	B+	4	A-	3	7	3.5	A-
	37	D+	C-	9	D-	12	23	11.5	D
	38	B+	A-	3	C+	7	10	5.0	B
	39	B+	B-	6	B+	4	10	5.0	B
	40	C-	C	8	C-	9	17	8.5	C
	41	A	B+	4	B+	4	8	4.0	B+
	42	C-	C-	9	C-	9	18	9.0	C-

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	43	C+	C+	7	B+	4	11	5.5	B
	44	C+	B	5	A-	3	8	4.0	B+
	45	A-	B+	4	B+	4	8	4.0	B+
	46	C	D+	10	B	5	15	7.5	C-
	47	C	C	8	B+	4	12	6.0	B-
	48	C	C+	7	C	8	15	7.5	C+
	49	B	B+	4	C-	9	13	6.5	B-
	50	B	B	8	B+	4	12	6.0	B-
	51	D	D-	12	D-	12	24	12	D-
	52	C+	C+	7	C-	9	16	8.0	C
	53	C	C+	7	D-	12	19	9.5	C-
	54	B-	B+	4	C	8	12	6.0	B-
	55	D	C	8	F-	18	26	13	F+
	56	C+	C	7	B-	6	13	6.5	B-

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN	1	2	3	4	5	6	7	8	9
	57	B-	C-	9	B+	4	13	6.5	B-
	58	D	D	11	F	15	26	13	F+
	59	B	B	5	B+	4	9	4.5	B+
	60	D	D-	12	D+	10	22	11	D
	61	C-	C-	7	F+	13	20	10	D+
	62	B	B+	4	C	8	12	6.0	B-
	63	B-	B	5	C	8	13	6.5	B-
	64	C	C	8	C+	7	15	7.5	C+
	65	C	C	8	B-	6	14	7.0	C+
	66	C	C+	7	C	8	15	7.5	C+
	67	B-	B+	4	D-	12	16	8.0	C
	68	C+	C-	9	D	11	20	10	D+
	69	D+	C-	9	D	11	20	10	D+
	70	A-	C	8	B	5	13	6.5	B-

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	71	B-	C	8	D	11	19	9.5	C-
	72	A	C-	9	B+	4	13	6.5	B-
	73	C+	C-	9	B	5	14	7.0	C+
	74	A-	C	8	A-	3	11	5.5	B
	75	C+	B+	4	D-	12	16	8.0	C
	76	C+	C	8	F	15	23	11.5	D
	77	B	C-	9	B-	6	15	7.5	C+
	78	B+	D+	10	B-	6	16	8.0	C
	79	C+	C-	9	C	8	17	8.5	C
	80	C-	C+	7	C-	9	16	8.0	C
	81	B	D+	10	B+	4	14	7.0	C-
	82	C+	D-	12	F-	18	26	13	F+
	83	B-	B-	6	C+	7	13	6.5	B-
	84	A-	A-	3	C-	9	12	6.0	B-

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	85	A	B-	6	B+	4	10	5.0	B
	86	A	B-	6	C+	7	13	6.5	B-
	87	B	C+	7	C	8	15	7.5	C+
	88	D	F+	13	D+	10	23	11.5	D
	89	C	D	10	C+	7	17	8.5	C
	90	D	D-	12	F+	13	25	12.5	D-
	91	D	D	11	F-	18	29	14.5	F+
	92	B	C-	9	C-	9	20	10	C-
	93	A	B+	4	B	5	9	4.5	B+
	94	B	C-	9	C-	9	18	9	C-
	95	D	F-	18	D	11	29	14.5	F+
	96	C	C-	9	D+	10	19	9.5	C-
	97	B	B-	6	C	8	14	7.5	C+
	98	A	C+	7	C-	9	16	8.0	C

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN	1	2	3	4	5	6	7	8	9
	99	B-	C-	9	C	10	19	8.5	C
	100	C	D+	10	D	11	21	10.5	D+
	101	C+	D-	12	D	11	23	11.5	D
	102	D-	D-	12	D-	12	24	12	D-
	103	C+	C-	9	D+	10	19	9.5	C-
	104	B+	C-	9	B+	4	13	6.5	B-
	105	B-	D	11	B-	6	17	8.5	C
	106	D	F-	18	C	8	26	13	F
	107	D+	D	11	D+	10	21	10.5	D+
	108	B	D	10	C+	7	17	8.5	C
	109	D	F	15	C-	9	24	12	D-
	110	C	D-	12	C	8	20	10	D+
	111	C	C-	9	C	10	19	9.5	C-
	112	C	D	11	C	8	19	9.5	C-

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	113	C	D+	10	C-	9	19	9.5	C-
	114	D	F	15	D-	12	27	13.5	F+
	115	C-	D+	10	D+	10	20	10	D+
	116	D	D+	10	D+	10	20	10	D+
	117	C	C	8	C	8	16	8	C
	118	C	B	5	B	5	10	5	B
	119	C	C	8	B-	6	14	7	C+
	120	A	A+	1	A	2	3	1.5	A+
	121	C-	C+	7	C-	9	16	8.0	C
	122	B	B	5	B	5	10	5.0	B
	123	C	C	8	B-	6	14	7.0	C+
	124	D	D-	12	D+	10	22	11	D
	125	C	C+	7	A	2	9	4.5	B+
	126	C	B-	6	B-	6	12	6	B-

	Student Number	Grade on Original Project	New Grade on Length of Board	Equivalent Score on Length of Board	New Grade on Width of Board	Equivalent Score on Width of Board	Total Equivalent Score	Average Equivalent Score	New Grade Score
COLUMN:	1	2	3	4	5	6	7	8	9
	127	A	A	2	A	2	4	2	A
	128	C	B-	6	C+	7	13	6.5	B-
	129	D	C-	9	D	11	20	10	D+
	130	B	B-	6	B-	6	12	6	B-
	131	D	D	11	C	8	19	9.5	C-
	132	D	C-	9	D+	10	19	9.5	C-
	133	B	B	5	A+	1	6	3	A-

NUMBER OF GRADES CHANGED BY THE REDISTRIBUTION

Grade	No. Changed Downward	No. Changed Upward
A to F	0	0
A to D	0	0
A to C	1	0
A to B	11	0
B to F	0	0
B to D	0	0
B to C	18	0
B to A	0	2
C to F	1	0
C to D	8	0
C to B	0	11
C to A	0	0
D to F	8	0
D to C	0	4
D to B	0	0
D to A	0	0
	Total 47	Total 17

SUMMARY OF GRADES CHANGED BY THE REDISTRIBUTION

Total grades changed	47 + 17	64
Per Cent of Total grades changed		48.12
Per Cent of Total grades lowered		35.34
Per Cent of Total grades raised		12.78

It will be noted that approximately three times as many grades were lowered as were raised.

CORRELATION BY SPEARMAN'S METHOD OF RANK DIFFERENCES

The correlation of the beginning grade in woodworking with the final grade in the course is found by use of the data given on pages 32 to 38 inclusive. The students were arranged in descending order according to the grades received on the first project. A rank, equal to the average from the top, was given for each student. (See second column, page 36). The third column shows the rank positions of the students when they were arranged in descending order according to the final grade in the course. The D column shows the individual differences between the ranks in the beginning and in the final grades. The last column (D^2) is the square of the difference in each case.

SPEARMAN FORMULA FOR ATTAINING CORRELATIONS

$$\rho = 1 - \frac{6 \Sigma D^2}{N(N^2-1)}$$

$$= 1 - \frac{6 \times 242,223,75}{2,352,504}$$

$$= 1 - (.618) = .382$$

Referring to Garrett "Statistics in Psychology and Education", page 192, Table XX, we find that the value of .382 for ρ gives a value of .40 for r. Thus there is shown to be a positive correlation of.40. This is not regarded high by most authorities. It is usual to consider that values up to .20 are useless for showing systematic relationship.

Although correlations up to plus or minus .20 are considered valueless by most writers on the subject, the present positive .40 does show that the exercise has some predicative value.

GRADES IN WOODWORKING CLASS

Student No.	First Grade	Final Grade	Student No.	First Grade	Final Grade
1	B-	C	21	C-	B-
2	A-	C+	22	C	B
3	C-	C	23	C	B-
4	B	B	24	D+	C
5	B-	C+	25	C	C
6	B-	D+	26	C+	C+
7	D	D	27	B+	C+
8	A-	C+	28	B-	B-
9	B-	C+	29	B	C
10	B+	B-	30	A	B
11	A	B-	31	D+	B
12	C-	B+	32	B	A-
13	B	B+	33	C	D
14	B-	C-	34	C	B
15	C	C-	35	D	C
16	D+	D	36	A-	A-
17	A	B	37	D+	C+
18	D-	D	38	B+	B+
19	B-	C+	39	B+	A-
20	C-	C+	40	C-	B

Student No.	First Grade	Final Grade	Student No.	First Grade	Final Grade
41	A	B-	61	C-	C-
42	C-	C	62	B	C
43	C+	C	63	B-	A
44	C+	C+	64	C	D
45	A-	B+	65	C	C+
46	C	B-	66	C	D
47	C	A	67	B-	D
48	C	F	68	C+	B
49	B	C	69	D+	C-
50	B	C+	70	A-	B
51	D	F	71	B-	B
52	C+	C	72	A	C-
53	C	B	73	C+	B
54	B-	B	74	A-	B-
55	D	F	75	C+	D
56	C+	B	76	C+	C
57	B-	C+	77	B	A
58	D	F	78	B+	B
59	B	A	79	C+	C
60	D	B+	80	C-	C

Student No.	First Grade	Final Grade	Student NO.	First Grade	Final Grade
81	B	C+	101	C-	C
82	C+	C+	102	D-	C-
83	B-	C-	103	C+	D
84	A-	B	104	B+	C-
85	A	B	105	B-	A
86	A	A-	106	D	C
87	B	A	107	D+	C
88	D	C	108	B	C
89	C	B	109	D	B
90	D	C	110	C	A
91	D	F	111	C	D
92	B	D	112	C	C
93	A	A	113	C	C
94	B	F	114	D	C
95	D	D	115	C+	D+
96	C	C+	116	D	B-
97	B	D	117	C	C-
98	A	A	118	C	A
99	B-	C	119	C	B
100	C	C	120	A	C-

Student No.	First Grade	Final Grade	Student No.	First Grade	Final Grade
121	C-	D	128	C	C-
122	B	A	129	D	C-
123	C-	C-	130	B	B-
124	D	C	131	D	B
125	C	C-	132	D	C
126	C	A	133	B	C
127	A	C-			

SPEARMAN METHOD OF RANK DIFFERENCE

APPLIED TO

GRADES IN WOODWORKING CLASS

Student No.	First Rank	Final Rank	D	D^2
120	6	105	-99	9801
127	6	105	-99	9801
98	6	6.5	.5	.25
85	6	32	26	676
86	6	14.5	8.5	72.25
93	6	6.5	.5	.25
72	6	60.5	54.5	2970.25
17	6	32	26	676
11	6	47	41	1681
30	6	32	26	676
41	6	47	41	1681
8	15	60.5	45.5	2070.25
36	15	14.5	.5	.25
45	15	19	4	16
70	15	32	17	289
74	15	47	32	1024
84	15	32	17	289
2	15	60.5	45.5	2070.25
104	21.5	60.5	39	1521
78	21.5	32	10.5	110.25

Student.No.	First Rank	Final Rank	D	D^2
27	21.5	60.5	39	1521
38	21.5	19	2.5	6.25
39	21.5	14.5	7	49
10	21.5	47	25.5	650.25
133	33.5	83	49.5	2450.25
122	33.5	6.5	27	729
130	33.5	47	13.5	182.25
97	33.5	120	86.5	7482.25
108	33.5	83	49.5	2450.25
87	33.5	6.5	27	729
92	33.5	120	86.5	7482.25
94	33.5	130.5	97	9409
77	33.5	6.5	27	729
81	33.5	60.5	27	729
49	33.5	83	49.5	2450.25
50	33.5	60.5	27	729
59	33.5	6.5	27	729
32	33.5	14.5	19	361
4	33.5	32	1.5	2.25
13	33.5	19	14.5	210.25
62	33.5	83	49.5	2450.25
29	33.5	83	49.5	2450.25

Student No.	First Rank	Final Rank	D	D^2
99	50	83	33	1089
105	50	6.5	43.5	1982.25
1	50	83	33	1089
6	50	112	62	3844
9	50	60.5	10.5	110.25
14	50	105	55	3025
19	50	60.5	10.5	110.25
28	50	60.5	10.5	110.25
54	50	32	18	324
57	50	60.5	10.5	110.25
63	50	6.5	43.5	1892.25
67	50	120	60	3600
5	50	60.5	10.5	110.25
71	50	32	18	324
83	50	105	55	3025
75	64.5	120	55.5	3080.25
73	64.5	32	32.5	1056.25
68	64.5	32	32.5	1056.25
44	64.5	60.5	4	16
43	64.5	83	18.5	342.25
101	64.5	83	18.5	342.25
103	64.5	120	55.5	3080.25

Student No.	First Rank	Final Rank	D	D^2
115	64.5	120	55.5	3080.25
76	64.5	83	18.5	342.25
79	64.5	83	18.5	342.25
82	64.5	60.5	4	16
52	64.5	83	18.5	342.25
56	64.5	32	32.5	1056.25
26	64.5	83	18.5	342.25
117	84.5	105	20.5	420.25
118	84.5	6.5	78	6084
119	84.5	32	52.5	2756.25
125	84.5	105	20.5	420.25
126	84.5	6.5	78	6084
128	84.5	105	20.5	420.25
96	84.5	60.5	24	576
100	84.5	83	1.5	2.25
110	84.5	6.5	78	6084
111	84.5	120	35.5	1260.25
112	84.5	83	1.5	2.25
113	84.5	83	1.5	2.25
89	84.5	32	52.5	2756.25
47	84.5	6.5	78	6084
48	84.5	130.5	46	2116

Student No.	First Rank	Final Rank	D	D^2
53	84.5	32	52.5	2756.25
64	84.5	120	35.5	1260.25
65	84.5	60.5	24	576
15	84.5	105	20.5	420.25
22	84.5	32	52.5	2756.25
23	84.5	47	37.5	1406.25
25	84.5	83	1.5	2.25
33	84.5	120	35.5	1260.25
34	84.5	32	52.5	2756.25
46	84.5	47	37.5	1406.25
66	84.5	120	35.5	1260.25
3	102.5	83	19.5	380.25
12	102.5	19	83.5	6972.25
20	102.5	60.5	42	1764
21	102.5	47	55.5	3080.25
40	102.5	32	70.5	4970.25
42	102.5	83	19.5	380.25
61	102.5	105	2.5	6.25
80	102.5	83	19.5	380.25
121	102.5	120	17.5	306.25
123	102.5	105	2.5	6.25
107	110.5	83	27.5	756.25

Student No.	First Rank	Final Rank	D	D^2
16	110.5	120	9.5	90.25
24	110.5	83	27.5	756.25
31	110.5	32	78.5	6162.25
37	110.5	60.5	50	2500
69	110.5	105	5.5	30.25
88	122.5	83	39.5	1560.25
7	122.5	120	2.5	6.25
25	122.5	83	39.5	1560.25
58	122.5	130.5	8	64
60	122.5	19	103.5	10712.25
51	122.5	130.5	8	64
55	122.5	130.5	8	64
90	122.5	83	39.5	1560.25
91	122.5	130.5	8	64
95	122.5	120	2.5	6.25
109	122.5	32	90.5	8190.25
114	122.5	83	39.5	1560.25
124	122.5	83	39.5	1560.25
129	122.5	105	17.5	306.25
131	122.5	32	90.5	8190.25
132	122.5	83	39.5	1560.25
106	122.5	83	39.5	1560.25

Student No.	First Rank	Final Rank	D	D^2
116	122.5	47	75.5	5700.25
102	132.5	105	27.5	756.25
18	132.5	120	12.5	156.25

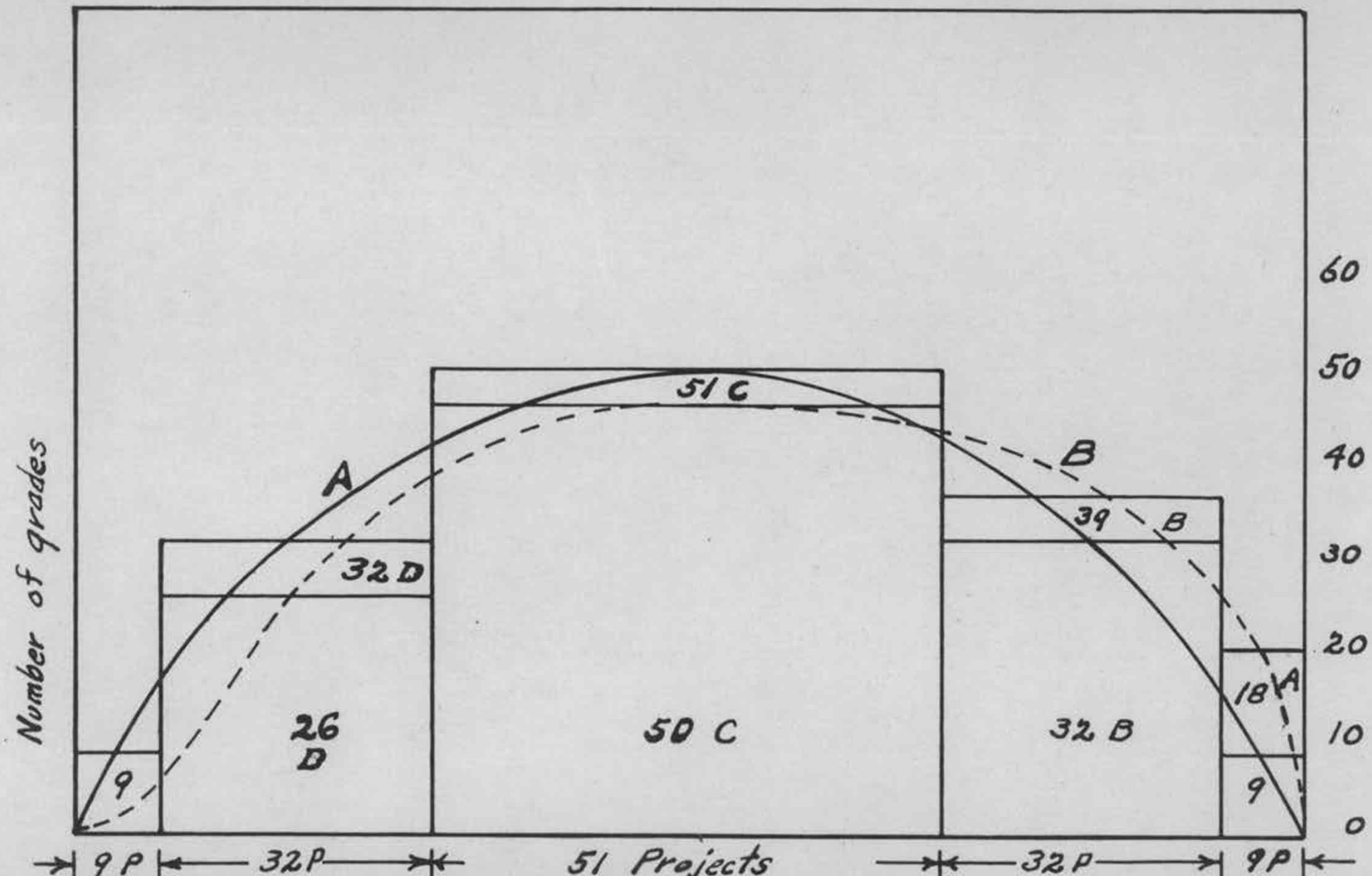

Figure 2. Curve A represents grades according to modified curve. Curve B represents grades as originally assigned.

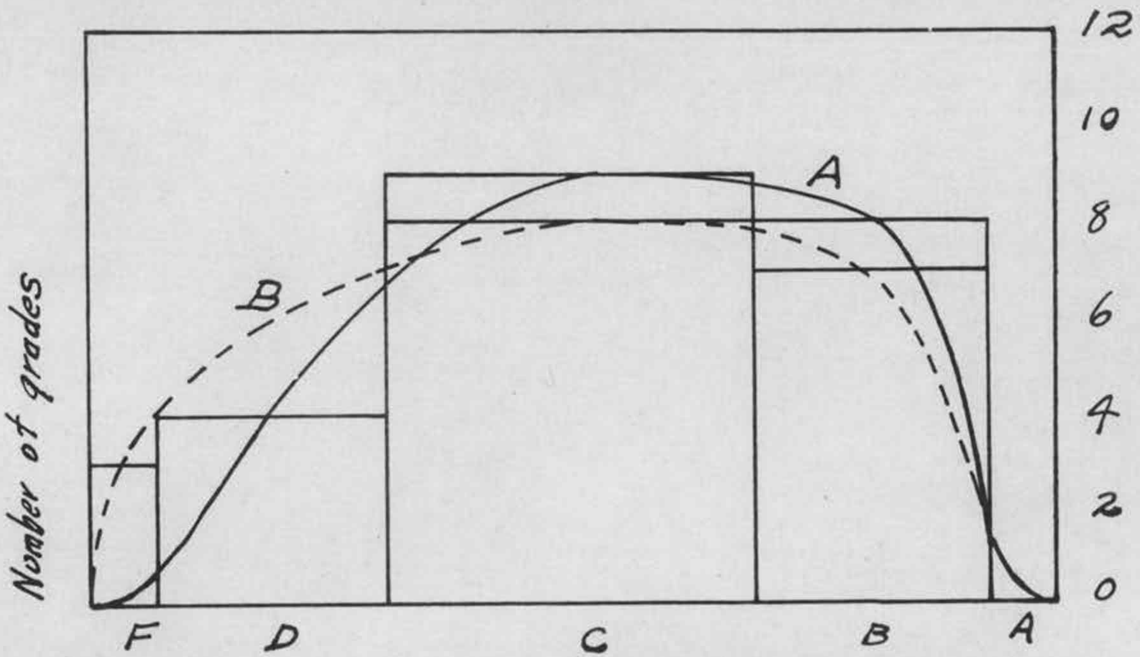

Figure 3. Curve A represents grades given to 21 students for a first project done in fall 1931-32. Curve B represents grades given for the same projects graded in a larger group.

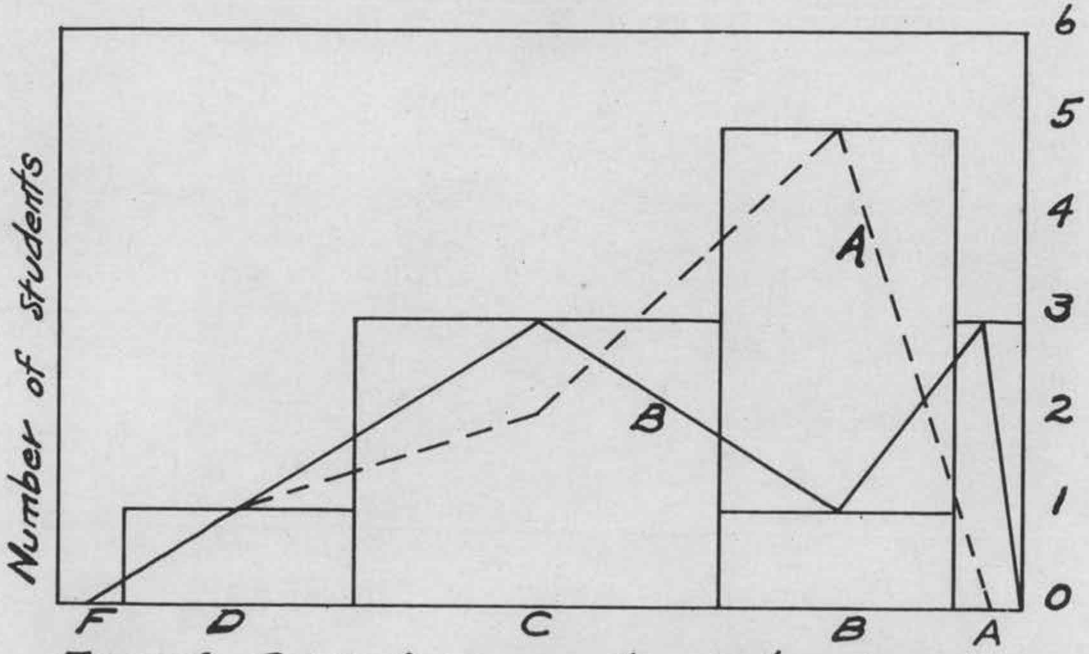

Figure 4. Curve A represents grades given to eight students for a first project done in fall 1929-30. Curve B represents grades given for the same projects graded in a larger group.

SUMMARY

This study was made to determine the relationship between grades given in small groups and those given for the same work to students of the same class in a large group, and, in addition, to set up a standard measuring device which will assist in grading the beginning wood-working project covered by the study.

For several years a uniform beginning project has been required in the first course of woodworking given by the Industrial Arts Department of the Oregon State College. Examples of this project and the grades originally assigned to them had been collected since 1929. The examples were arranged in a large group and the grades redistributed by application of the modified normal curve, as it is used by the College in its grading system.

After the student had witnessed a demonstration of the procedure in doing the work on this project, he was given a piece of board that had previously been cut to the standard size (5½" x 12"). The student did his work in such a way that the grading of the project required only the taking of the length and width measurements and the evaluating of them in terms of letter grades. The small size of the classes frequently made it very difficult to grade these projects objectively and in accordance with the normal curve.

A system was devised whereby 133 examples of this project were arranged, first according to length and second according to width. They were then graded in the larger group. New grades, to accord with the normal grade curve, were then assigned to the rearranged examples. These new values were transferred into composite letter grades by means of an equivalent-grade-and-score chart. A chart was then prepared to show the relationship between the grades originally given in the small groups and the reassigned grades in the larger group.

A measuring device was made by riveting two pieces of aluminum angle together in such a manner that the shorter piece made an angle of ninety degrees across the end of the longer piece. Boards representing the dividing points between the various grade levels, in both length and width, were selected and used as measuring devices in establishing standard grade-limit lines on this upright angle. Any project made in the future may be more easily graded objectively by testing it for length and width on this standardized measuring device, and, by the use of the "Equivalent-Grade and-Score Chart", evaluating this length and width into a composite letter score.

In this new distribution, grades were changed from the original as follows:

Total grades changed out of 133	64
Per cent of total grades changed	48.12
Per cent of grades lowered	35.34
Per cent of grades raised	12.78

This study shows how unlikely it is that a normal curve can be followed in grading unless a standardized device is available for use as a check. The device here presented not only makes it possible to follow the normal curve, regardless of the size of the class, but also gives to the measurements a higher degree of objectivity by indicating the position of a particular project with reference to a standard established from a large number of examples of such a project.

The study also shows the correlation between the grades given for the first project in woodworking and those for the final grade. This is done by means of the Spearman Rank Difference Method of calculation.

CONCLUSION

Although there is a considerable variation in the grading of the examples during the years indicated in the table formulated on page 4 of this study, this should not be taken as casting any reflection on the ability of any instructor, or instructors. It is commonly recognized that considerable variation is inevitable whenever examples of a project of this type are graded in a small group and without the aid of a standardized device with which to ascertain the grades in comparison with those of a larger group.

Through the checking of 133 finished examples of a project, the writer has developed a standardized device which is herewith presented as a part of this study. By checking such a large number of finished examples, it has been possible to establish grade levels which are indicated by lines drawn on an aluminum tee. These lines designate the upper and lower limits of grades, in length and in width, for each major grade division. A finished article done by a member of a small group may, therefore, be checked by means of this device to give it a rating comparable with the average rating of a large group. Although the change in the rank of the original projects when graded in the larger group is not great, it is hoped that the use of this measuring device will assist in smoothing out some of the irregularities in grading that have heretofore existed.

In grading an exercise of this type in junior or senior high school,classes, the device could also be used with but slight modification. The lines that indicate the various grade levels for a college group would naturally require changing to apply to boys of the high school age. In fact, because of difference of ability found in groups of junior and senior high school age, it would probably be necessary to determine two sets of lines for grade indicators.

Establishment of various grade levels for junior and senior high school pupils would become accurate only as a large number of examples of a project were accumulated to give the weight of numbers. It is probable that a higher degree of accuracy could be secured from the younger groups, since their ability would show a greater variation than that of the senior high school groups, and a greater distance would, therefore exist between the various grade divisions.

RECOMMENDATIONS

It is recommended that the device herewith submitted be used as a supplementary measuring stick in the future grading of the project considered in this study.

In view of the difficulty involved in measuring the length grades of A, B, and C, even with the present standardized device - the three lines separating these grades being so close together - it is further recommended that a change be made in this project by cutting one end of each board at an angle of five degrees in such a manner that one side of the board is slightly longer than the other. The student will be required to hand plane the angled end of the board, as well as the squared end, until they are both square with the working face and the working edge. The test of the quality of workmanship will still be the measuring of the product for length and width. This increase in difficulty of the operation will, it is expected, increase the variation in length of the boards and thus make it easier to separate the students into the grade levels.

A new set of lines with which to test the length of the finished projects will be needed on the measuring device. These can be accurately established only after a large number of projects are collected with which to determine what can be expected for each grade level.

It is further recommended that, if the necessary data are available, a study be made to correlate the grades given to the first three projects of the course under consideration with the final grade in that course.

If such data are not available, it is recommended that future records of this course be kept in such a manner that the grades on the cutting board and on the two projects immediately following will be readily obtainable.

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