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ACHIEVEMENT AND ATTITUDINAL CHANGE IN MATHEMATICS: BOZEMAN, MONTANA FIFTH-GRADE STUDENTS TAUGHT IN COMPETITIVE AND NONCOMPETITIVE SITUATIONS

by

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ABSTRACT

The problem of this study was to compare Bozeman, Montana fifth-grade students in competitive and noncompetitive situations regarding achievement in mathematics and the change of attitudes toward the learning of mathematics. Male and female students from two fifth- and two sixth-grade mathematics classes at Willson School were given a Metric Length Achievement pretest and a Mathematics Attitude Scale pretest. The two fifth-grade classes were chosen to take part in the study.

Both classes were instructed in the Metric System of Length for 7 days. Various instructional materials and methods were employed. The 23 students in the experimental group were evaluated on daily papers against a behavioral-objective format to indicate which objectives had been introduced, and which objectives each student had developed, satisfied, or mastered. The 22 students in the control group were evaluated on daily papers against a traditional absolute-grading scale, and each student was informed daily of his cumulative average. When formal instruction was completed, each group was given a Metric Length Achievement posttest and a Mathematics Attitude Scale posttest. Both posttests were identical to the pretests.

The results of the pretests and posttests were subjected to statistical analysis to determine the mean degree of improvement on the Metric Length Achievement test (posttest - pretest) and the mean positive change on the Mathematics Attitude Scale test (posttest - pretest). The $\underline{t}$-test was used to determine the significance of the difference between the two independent means in each case. The Level of Significance was set at $\alpha = .05$, employing a one-tailed test. The mean degree of improvement was significant for the experimental group on the Metric Length Achievement test, $\underline{t}(43) = + 2.24$, $\underline{p} < .05$. The mean positive change was nonsignificant on the Mathematics Attitude Scale, although the results favored the experimental group, $\underline{t}(43) = + .80$, $\underline{p} > .05$.

Both groups of students benefited from instruction in the Metric System of Length and it appeared to the researcher that students can and will learn in the absence of grade pressure. However, it is evident that some students learn better in a competitive situation, while others would benefit from a nongraded learning experience. Although there is widespread sentiment expressed to adopt a new system of student evaluation, a new system must be fairly accurate to consider replacing the traditional grading systems.

CHAPTER 1

Introduction

If one were to trace the course of mankind from its beginning to the present and predict into the future, he would discover a general theme which has persisted, now persists, and will persist: the never-ending quest for a better civilization. Man makes use of his special attributes--intelligence, reasoning, and motivation, to name a few--to give him direction and motion in making his lifetime more meaningful. However, he is not selfish in his pursuit. He learns from his elders and ancestors; he discovers anew and shares his knowledge and feelings with his peers; and, he passes his experience and recommendations on to his children and future generations. This has been the primary purpose of education.

It is often forgotten that this should be a two-way street. Man can also learn from his children and can teach his elders. The evaluation of a student's progress in formal education offers an excellent example:

The student demands that the instructor assign him a definite task and/or facilitate an atmosphere in which the student can work in a direction toward completion of a project. An evaluation seems appropriate as a periodic check on his progress toward completion.

Instructors employ various methods of evaluation. Among these are the pass/fail experience, criterion-referenced behavioral objectives, relative- and absolute-grading standards, written evaluations, and progress reports. Grading offers a convenient way of bringing order to the evaluative process and is intended to be a motivational spur to help the student in his continual striving to maintain and enhance himself.

Students demand to know whether they have passed or failed and how well they have done in order to plan for the future. Parents wish to know how their children are doing in school. Instructors and administrators demand feedback to strengthen the educational process. Colleges request transcripts for admission and placement purposes. Employers request transcripts for hiring and assigning personnel.

Grading is not harmful in itself. The harm lies in how it is erroneously used. Evaluation implies judgmentalism. The instructor must determine the cut-off point in the pass/fail experience. He decides which behavioral objectives must be met when using the criterion-referenced system. Children subjected to relative-grading standards learn how they stand in comparison to other children as if they were competing in a tournament to decide who is best. Instructors predetermine their own standards in absolute grading, such as 94-100% is an "A", 88-93% is a "B", etc. Written evaluations are subjective and bias is difficult to remedy. Furthermore, if a progress report employs letter grades, it is hard to explain that an "A" received during the first term and a "B" received for the second term indicates progress.

Grading means extra work for the instructor. Often creativity is sacrificed for the sake of conformity. Finally, the grade may become the end while the knowledge accumulated becomes the means to this end.

However, the gestalt of grading cannot become completed until it is made into a two-way street. Only the child knows what he really wants in life and he must be given the freedom to plan his future and enhance his self-concept. The grade must mean something to him personally. Instructors must attend to the feelings of their students regarding the effects that grading has upon them. Students should be given much of the responsibility of evaluating themselves. The logical consequences of self-evaluation will most likely follow.

Statement of the Problem

The problem of this study was to compare Bozeman, Montana fifth-grade students in competitive and noncompetitive situations regarding achievement in mathematics and the change of attitudes toward the learning of mathematics.

Purpose of the Study

School should be a good place--and is for the majority. Schools regularly graduate well-educated, well-adjusted, responsible citizens. Instructors are eternally encouraged to help all of their children to do better. Yet, many instructors (frequently under pressure) continue to employ evaluative systems such as the normal curve, in which only a few of the students can receive the best evaluations. Grade pressure fosters cheating and begets failures, dropouts, chronic disrupters, and emotionally-disturbed children. Does this indicate that the instructor has failed to teach his students to pass his course and keep trying in school? Rather, the researcher believes that educators must look for more effective ways of evaluating pupil progress.

The purpose of this study was to discover if the motivation to learn can come from within the student. Educators must experiment to see if it is possible for the student to take part in assessing his personal and societal needs and progress, and act accordingly.

Contributions and Applications

The researcher hoped that this study would contribute to the field of education in the following ways:

1. The establishment of a progress report which reflects what each student has learned and how well he has improved. (If a student began a course with a low grade and finished with a high grade, he should be evaluated according to improvement rather than his performance average.)

2. An evaluation which would be less judgmental and would amount to a collaboration between the student and his instructor.

3. An opportunity for each child to work to the best of his ability.

This study would have application in that tests and other evaluations would be related learning opportunities and not isolated experiences. Educators would discover new methods of assigning tasks, facilitating learning opportunities, and checking the progress which has resulted. Emphasis would be on affective as well as cognitive learning, and self-awareness. School work would relate more directly to the child's present and future outside environments.

General Questions to be Answered

The general questions to be answered naturally follow from the statement of the problem:

1. When compared to students in competitive situations, will students subjected to noncompetitive situations demonstrate a significant mean degree of improvement in linear measurement using the International System of Units (SI), popularly known as the "Metric System"?

2. When compared to students in competitive situations, will students in noncompetitive situations demonstrate a significant mean positive change in attitudes toward the learning of mathematics, after learning the Metric System of Length in the absence of grades?

General Procedure

The researcher used the Metric System of Length as his medium for testing and teaching. Instruments included:

1. a Metric Length Achievement pretest and posttest (see Appendix A) designed by the researcher;

2. a Mathematics Attitude (Likert) Scale pretest and posttest (Aiken, 1976) (see Appendix B);

3. selected worksheets (see Appendix C) from a metric curriculum

book designed for grades K-6 (Ellingsen, Jones, Stearns, & Tigges, Note 1);

4. a behavioral-objective format (see Appendix D) derived from the metric curriculum book (Ellingsen et al., Note 1); and,

5. supplementary teaching materials (metre sticks, Cuisenaire rods, etc.).

The two pretests (Metric Length Achievement and Mathematics Attitude Scale) were administered to four classrooms of students (two fifth- and two sixth-grade classes) during April, 1976. On the basis of the pretests, the two fifth-grade classes were selected to take part in the study, since their results were more evenly matched.

The researcher taught the metric length concepts in the same manner to both groups for 7 days during their respective mathematics periods. Teaching methods included lectures, classroom and gymnasium activities, and class discussions. The 22 students in the control group were graded on daily papers against an absolute-grading scale. The 23 students in the experimental group were evaluated against a behavioral-objective format. Here, the researcher and each child collaborated daily to evaluate the objectives to which the student had been introduced, and which objectives he had developed, satisfied, or mastered. Each child in the experimental group was also given the opportunity to outline his own expectations, needs, and ideas for individual projects, hereafter referred to as "personal objectives". Both groups had access to optional worksheets which they wished to explore.

Formal instruction was completed in May. The researcher administered the two posttests (identical to the Metric Length Achievement and Mathematics Attitude Scale pretests) to both groups of students. Statistical analysis determined the degree of mathematical achievement and change of attitudes toward the learning of mathematics.

Limitations

Experimenter bias limited this study. The children were fifth-grade students and were able to display reasonable competency using the basic skills of mathematical measurement. The students demonstrated individuality in responding to the researcher-instructor, the evaluation systems, and education in general. The ultimate affective and cognitive learning which took place must stand the temporal test of time. This study was completed long before the ultimate learning can ever be measured.

Delimitations

The researcher used the Metric System of Length as his medium for teaching and evaluated the change of attitudes toward the learning of mathematics only. The researcher incorporated his own personality and style into his teaching. The study involved 45 students and was run for 7 mathematics periods in each of two classrooms during April and May, 1976 at Willson School in Bozeman, Montana.

Definition of Terms

Metre (m). The unit of metric length.

Centimetre (cm). Equivalent to 0.01 metres.

Millimetre (mm). Equivalent to 0.001 metres.

Kilometre (km). Equivalent to 1 000 metres.

Summary

Grading has been confusing for everyone involved with education. There is a lack of consensus as to how the evaluation process best fits into the educational experience. It was the hope of the researcher to give an objective appraisal of such a subjective matter, and to help educators understand more fully the cognitive and affective aspects of evaluation.

CHAPTER 2

Review of Literature

The method of organization of literature encompasses six general areas: (a) the historical development of grading practices, (b) concern for a more accurate system of evaluating pupil progress, (c) evaluation of traditional group-grading practices, (d) evaluation of the pass/fail experience, (e) the need for individual rather than group evaluations, and (f) the purpose for incorporating behavioral and personal objectives into the individual evaluations.

The Historical Development of Grading Practices

Grading systems were the product of European universities in the middle ages. There were no grading systems in the earliest universities. Rather, a student just kept attending until the faculty agreed that he should be granted a degree. As a result, there were no grades, no credits, and no standards for exams. Some students stayed for years and never graduated.

Students began to clamor for a system in which an instructor would assign a definite task and check on its completion. Faculty members tried to avoid it since it meant more work for them. They did not need such a system. Students insisted and eventually a rudimentary system of examinations and credits was forced upon faculties by student demand (Harrington, 1963).

Concern for a More Accurate System of Evaluating Pupil Progress

Throughout their educational experience, students become testconscious citizens in a test-oriented society. They feel the pressure to conform to the educational rat race, enhancing their chances of being admitted into the most suitable colleges (Ciampa, 1969).

In reality, the grading process is a personal involvement between each instructor and his respective students (Winkler, 1969). The real motivation to learn is the satisfaction a student enjoys in discovering something new to himself (McGuire, 1969).

The National Council of Teachers of English (NCTE) issued a statement expressing the concern for a more accurate system of evaluating pupil progress: "Reporting a child's progress in the early grades should be done through methods other than the assignment of a letter or numerical grade" (Brodinski, 1972, p. 5).

The Department of Planning and Evaluation for the Vancouver (British Columbia, Canada) Board of School Trustees sent out a questionnaire to 600 families of students in grades 3-6. Of the 393 replies, 32.1% of the families preferred symbols for reporting pupil progress and 21.6% favored using letter grades. Other preferences were teacher comments, percentages, and satisfactory/unsatisfactory. However, 55.7% of the families wanted each child's achievement to be evaluated in relation to his own ability. Only 24.4% felt that children should meet prescribed standards of achievement while only 12.2% preferred that progress be reported in comparison to the progress of other children (Gilbert & Ellis, 1972).

Ciampa (1969) felt that students are intelligently aware, but are in need of a revival of genuine academic purpose. Every student in every classroom should know what will be expected of him and how he is doing (Brodinski, 1972). Consequently, instructors must provide for a self-motivating and mentally healthy environment where students will be motivated to learn in the absence of competing for grades (Bailey, 1973).

Evaluation of Traditional Group-Grading Practices

Traditionally, grading has been based upon absolute or relative systems of measurement. Absolute grading refers to a fixed scale using raw scores or percentages while relative grading reveals an individual's relative standing within his norm-referenced group ("Relative Grading Methods", 1967).

Advocates of the traditional grading practices held that grading brings orderliness to the evaluative procedure and is a convenient way of communicating pupil progress. Grades are characteristic of life: The injustices of grading are realistic with the injustices of life in general. By removing grades, there is no motivation to learn (McGuire, 1969).

Critics of traditional grading practices argued that the emphasis is on competition rather than appreciation, valuing conformity and memory over creativity. Grading hinders teaching, fosters cheating, and inconsistency results since different instructors employ different standards for grading (Pedrini & Pedrini, 1972).

Brodinski (1972) found that "the mark--which should be a means of analysis and a spur to improvement--often becomes an end in itself" (p. 6). McGuire (1969) elaborated that grading forces the students to concentrate on earning the grade instead of learning for the sake of learning. In a speech to fellow colleagues attending a Phi Beta Kappa dinner at the University of California (Berkeley) in 1968, he stated, "My single-minded pursuit of high grades in college had not been worth it. The grade-point game had distracted me from the real goal of education--the development of myself as a person" (p. 32). Thus, if the real purpose of education is toward self-awareness, McGuire felt that grading often detracts from this direction.

Poli (1970) sensed that if instructors continue to evaluate students by group averages, they must be aware of the ensuing personal and emotional consequences. Brodinski (1972) stated that competition among the group has undesirable effects upon the child's mental health. Bailey (1973) felt that grades are psychologically damaging to the majority of the students because only a few students are able to achieve the highest marks. This results in a breakdown of the relationship between the instructor and many of his students. McGuire (1969) rationalized that "a good student looks good because he is being supported by comparison with the mediocrity of poorer students" (p. 33). Summarily, the traditional letter-grading system is more discouraging to learning than encouraging.

Winkler (1969) noted that absolute grading practices neglect the individuality of each child and the circumstances which have influenced the person that he is. McGuire (1969) noted that these practices are no more effective than relative grading. The knowledge needed for tests is reduced to quanta. Any knowledge without point value is not worth internalizing. As a result, "learning gets lost in a maze of points, minuses, and pluses" (p. 34).

According to Brodinski (1972), "the single mark does not convey information effectively" (p. 6). Pedrini and Pedrini (1972) reported that any system based on grades measures performance rather than learning. Ciampa (1969) added that the material learned is stored in the mind to be transferred later to a test and left there!

Consequently, if the purpose of traditional grading practices "is to motivate the student toward intensive learning--grading often doesn't work well at all" (Brodinski, 1972, p. 9). Rather than being used as an evaluative procedure, Bailey (1973) stated that grades are conventionally conceived as the end of the educational endeavor, and therefore are failing the educational system. He concluded by remarking, "Throw away grades--they fail; and college admissions are no longer an excuse for failing to act!" (p. 8).

Evaluation of the Pass/Fail Experience

The pass/fail experience de-emphasizes the instructor's judgment of progress in favor of discovering the educational value of a course. The students have the freedom to pursue education through self-motivation, with relatively little emphasis on measuring achievement (Brodinski, 1972).

The critics argued that the pass/fail experience deprives the students of the incentive to do their best and deprives the instructors of maintaining the academic standards necessary to promote high levels of student effort. This system is unrealistic since students will face competition throughout life. Although it relieves pressure, the pass/fail experience fosters mediocrity since students will seek credit for a course and prevent being penalized by receiving a low passing grade (Pedrini & Pedrini, 1972). To minimize this possibility, McGuire (1969) recommended that the pass/fail experience should be supplemented with the instructor's written analysis of the student, the student's evaluation of his own progress, and the use of standardized national exams to support the progress each student had made.

The Need for Individual rather than Group Evaluations

The Education USA Survey recognized that it is important to judge the student in relation to his own work and progress rather than to gauge his ranking in a group. To quote, "The best way to evaluate students is in terms of specific skills and knowledge being acquired, and in terms of what the student can actually do, not in terms of student-student comparisons" (Brodinski, 1972, p. 60). Bailey (1973) felt that emphasis should be focused upon what the students have learned rather than upon what they have not learned in relation to the other students. A more positive approach to evaluation must be devised which stresses a criterion-referenced system instead of a norm-referenced system. The students should compete with the course objectives rather than with themselves.

The Purpose for Incorporating Behavioral and Personal Objectives into the Individual Evaluations

Growth should be measured toward specifically stated goals. The behavioral objective is based on the premise that "everything a student learns, or does not learn, may be observed, recorded, and reported" (Brodinski, 1972, p. 60).

The Concord High School System of Wilmington, Delaware uses a criterion-referenced evaluation. Each class is focused upon carefully written performance objectives. Students learn at their own rates and achieve the goals of the class when they master either of two levels. If the students meet the basic requirements they have achieved the sufficiency level. The level of proficiency is reserved for students who demonstrate special skills and interests, and who profess the motivation to distinguish themselves. In October, 1972, 172 colleges responded to a Concord High School survey which asked the question: What effect will our new evaluation scale have on the chances of our students being accepted to your college? (Bailey, 1973, pp. 7-8).

Only 10% of the colleges felt that the criterion-referenced evaluation system would have harmful effects, whereas 60% of the colleges could foresee no effect (Bailey, 1973).

Behavioral objectives can be incorporated into the student evaluation process in such a way that failure can be avoided. Either an objective is met or it is not met. Winkler (1969) suggested that failing a student requires no particular skill on the part of the instructor. Failure must be constructive in that it must demonstrate to the student the need for achievement and responsibility. However, the instructor must be realistically fair, and ensure that he is not being foolish, philanthropic, or overly compassionate. Simultaneously, the instructor must compel academic compliance and avoid failure on the part of the student.

In 1958, Rogers (1961) stated to participants in a workshop at Goddard College (Plainfield, Vermont) that "the natural place of evaluation in life is as a ticket of entrance, not as a club over the recalcitrant" (p. 291). The student must discover that he cannot enter engineering school without learning so much mathematics; he cannot get a job in a certain corporation unless he earns a college diploma; and, he cannot obtain a valid driver's license unless he passes an examination concerning the rules of the road (pp. 290-291).

Summary

Ciampa (1969) observed that many school systems have taken positive steps in developing more accurate systems for evaluating each student. However, he felt that this is not good enough: There is a need for national reform of evaluative procedures. Winkler (1969) noted that impersonal group measurement, though convenient, is academically unjust.

CHAPTER 3

Procedures

The problem of this study was to compare students in competitive (graded) and noncompetitive situations regarding achievement in mathematics and the change of attitudes toward the learning of mathematics. This chapter was organized and presented in the following manner: (a) population description and sampling procedure, (b) treatments, (c) methods of collecting data, (d) methods of organizing data, (e) statistical hypotheses, (f) analysis of data, and (g) precautions taken for accuracy.

Population Description and Sampling Procedure

The population consisted of all fifth- and sixth-grade students enrolled at Willson School in Bozeman, Montana during April and May, 1976. The researcher administered two pretests (Metric Length Achievement and Mathematics Attitude Scale) to the homeroom mathematics classes of the two fifth- and two sixth-grade mathematics teachers at Willson School. The Metric Length Achievement test (see Appendix A) covered the 17 behavioral objectives (see Appendix D) taught during the study. The questions on the Metric Length Achievement test were assigned equal weight (1 point apiece), resulting in a maximum score of 30. The questions were designed by the researcher. The Mathematics Attitude Scale consisted of 20 items measuring attitudes toward the learning of mathematics (see Appendix B). The researcher used an adaptation of the Mathematics Attitude Scale designed by Aiken and Dreger (in Aiken, 1963, 1976). Several words were changed slightly to clarify the vocabulary for the students. The reliability and validity of the Mathematics Attitude Scale were established by Aiken and Dreger (1961):

> Preliminary investigation using this scale attested to its reliability (r = .94 for test-retest). In addition, a test of independence between the scores on the attitude scale and scores on four items designed to measure attitudes toward academic subjects in general suggested that attitudes specific to mathematics were being measured (χ^2 = .80, df = 1). (p. 20)

Ten of the items (numbers 1, 2, 6, 7, 8, 10, 12, 13, 16, and 17) on the Mathematics Attitude Scale connote negative attitudes and 10 items (numbers 3, 4, 5, 9, 11, 14, 15, 18, 19, and 20) connote positive attitudes toward mathematics (Aiken & Dreger, 1961). Following the Likert procedure, each item was scored with integers from 0 to 4 in the direction of "dislike-like mathematics" (i.e., item number 16 was scored as 3 for Disagree (D) or 1 for Agree (A); item number 19 was scored as 0 for Strongly Disagree (SD) or 4 for Strongly Agree (SA); Undecided (U) was scored as 2 for each item.). The scores for each item were added, resulting in a maximum "like" score of 80 (Aiken, 1963).

The results of the pretests appear in Table 1. The researcher selected the two fifth-grade classes (5A and 5B) for the study, since these students seemed more evenly matched on the basis of the pretests. The researcher collaborated with the mathematics teachers and decided

Table 1

Mean Scores on Pretests to Determine

Sampling Distribution for the Study

Group	Number	Mean Score
Metric Length Achievement[a]		
5A	22	11.59
5B	23	10.04
6A	20	16.90
6B	24	10.71
Mathematics Attitude Scale[b]		
5A	22	53.14
5B	23	52.91
6A	20	57.05
6B	24	46.33

[a]Maximum score = 30

[b]Maximum score = 80

that 5B ($\underline{n}$ = 23) would serve as the experimental group and 5A ($\underline{n}$ = 22) would serve as the control group.

Treatments

Both groups of students were taught the Metric System of Length during their regularly scheduled mathematics classes. The researcher presented the same lessons to both groups daily for 7 days each. He used selected worksheets from Think & Teach METRIC (Ellingsen et al., Note 1), a metric curriculum book designed for grades K-6. A sample of the 27 worksheets used in this study is presented in Appendix C. Only linear measurement, area, basic relationships, symbols, and basic units (kilometre, metre, centimetre, and millimetre) were studied. Decimal conversions, hectares, and other units (hectometres, decametres, and decimetres) were not included.

The researcher used various teaching methods to present the metric length concepts, including lectures, individual and group activities, and class discussions. Materials included metre sticks, centimetre rulers, trundle wheels, metric tapes, and Cuisenaire rods. Optional worksheets were available and were used at the students' discretion to enhance learning. Daily papers were corrected and scored by the researcher.

Experimental group. The experimental group ($\underline{n}$ = 23) students were in a noncompetitive situation and were evaluated on daily papers against a behavioral-objective format (see Appendix D). The researcher collaborated with each student daily to evaluate which objectives had been introduced (I), and which objectives the student was developing (D), had satisfied (S), and had mastered (M). The format consisted of 17 behavioral objectives and space was allowed for the student to indicate his personal objectives (expectations, needs, and ideas for individual projects).

Control group. The control group ($\underline{n}$ = 22) students were in a competitive situation and were evaluated against a traditional (absolute-grading) scale. The researcher used the following percentages in determining grades on daily papers: (a) 94-100% = A, (b) 87-93% = B, (c) 80-86% = C, (d) 70-79% = D, (e) 50-69% = D^-, and (f) 0-49% = F. Because the Metric System was relatively new to the students, the researcher made provisions for avoiding failure (and psychological effects of failure) by giving an F only if a student scored less than 50% on a daily paper. A score of 70% or above was considered a passing grade. The researcher suspended judgment if a child scored between 50-69%. Each student was informed of his cumulative average daily.

Methods of Collecting Data

During formal instruction, the researcher graded the daily papers of the control group and recorded the percentages and grades in a grade book. He used the behavioral-objective format (see Appendix D) in determining the progress of each student in the experimental group. The Metric Length Achievement test (see Appendix A) and the daily worksheets (see sample in Appendix C) were both designed from the behavioral-objective format.

When formal instruction ended, the researcher administered the posttests (Metric Length Achievement and Mathematics Attitude Scale) to both groups of students. The posttests were identical to the pretests.

No special training, directions, or methods of correcting were used in this study. Only a familiarity with the Metric System and experience in scoring and grading papers were necessary.

Methods of Organizing Data

Neither the daily averages of the control group nor the behavioral-objective format used with the experimental group were used as data in analyzing the results of this study. Only the results of the pretests and posttests (Metric Length Achievement and Mathematics Attitude Scale) were subjected to statistical analysis to determine the degree of mathematical achievement and the change of attitudes toward the learning of mathematics.

Statistical Hypotheses

The statistical hypotheses were designed from the general questions to be answered, found in Chapter 1 (see p. 5). The following hypotheses were tested:

1. Metric Length Achievement: H_o: $\bar{\Delta}_E = \bar{\Delta}_C$

$\bar{\Delta}_E$ refers to the mean degree of improvement achieved by the experimental group (posttest - pretest). $\bar{\Delta}_C$ refers to the mean degree of improvement achieved by the control group (posttest - pretest).

2. Mathematics Attitude Scale: H_o: $\bar{\Delta}_E = \bar{\Delta}_C$

$\bar{\Delta}_E$ refers to the mean positive change achieved by the experimental group (posttest - pretest). $\bar{\Delta}_C$ refers to the mean positive change achieved by the control group (posttest - pretest).

Analysis of Data

To test both hypotheses, the _t_-test for two independent means was used to determine the significance of the difference between the experimental group ($\bar{\Delta}_E$) and the control group ($\bar{\Delta}_C$). The Level of Significance was set at $\alpha = .05$, employing a one-tailed test.

Precautions Taken for Accuracy

The researcher used an electronic calculator to compute the statistics involved in this study.

Summary

It was the hope of the researcher that the results of the statistical hypotheses would enable him to make recommendations concerning the directions future researchers might wish to pursue regarding affective and cognitive learning processes in the field of education.

CHAPTER 4

Results

Metric Length Achievement

The data for the Metric Length Achievement pretest and posttest is presented in Table 2. $\bar{\Delta}_E$ refers to the mean degree of improvement achieved by the experimental group (posttest - pretest). $\bar{\Delta}_C$ refers to the mean degree of improvement achieved by the control group (post-test - pretest). It follows from the results in Table 4 that the experimental group students (in noncompetitive situations) demonstrated a significant mean degree of improvement when compared to the control group students (in competitive situations) in linear measurement using the Metric System of Length, $t(43) = + 2.24$, $p < .05$.

Mathematics Attitude Scale

The data for the Mathematics Attitude Scale pretest and posttest is presented in Table 3. $\bar{\Delta}_E$ refers to the mean positive change achieved by the experimental group (posttest - pretest). $\bar{\Delta}_C$ refers to the mean positive change achieved by the control group (posttest - pretest). It follows from the results in Table 4 that the experimental group students (in noncompetitive situations) did not demonstrate a significant mean positive change when compared to the control group students (in competitive situations) in attitudes toward the learning of mathematics, after learning the Metric System of Length in the absence of grades, $t(43) = + .80$, $p > .05$.

Table 2

Results of Metric Length Achievement

Pretest and Posttest

Experimental Group ($\underline{n}$ = 23)				Control Group ($\underline{n}$ = 22)			
Student	Posttest	Pretest	$\bar{\Delta}_E$	Student	Posttest	Pretest	$\bar{\Delta}_C$
1	30	7	23	1	30	5	25
2	25	2	23	2	28	4	24
3	30	8	22	3	24	6	18
4	28	6	22	4	26	9	17
5	29	8	21	5	29	13	16
6	30	10	20	6	29	13	16
7	28	9	19	7	28	13	15
8	22	3	19	8	19	4	15
9	30	12	18	9	26	12	14
10	29	12	17	10	25	11	14
11	23	6	17	11	29	16	13
12	25	9	16	12	21	8	13
13	24	8	16	13	28	16	12
14	30	15	15	14	27	15	12
15	28	14	14	15	27	15	12
16	28	14	14	16	28	17	11
17	26	12	14	17	27	16	11
18	22	8	14	18	29	19	10
19	20	6	14	19	27	17	10
20	30	17	13	20	23	13	10
21	30	19	11	21	19	9	10
22	28	17	11	22	14	4	10
23	20	9	11				
Totals:	615	231	384	Totals:	563	255	308
	$\bar{\Delta}_E$ = 16.70				$\bar{\Delta}_C$ = 14.00		

Note. Maximum score = 30.

Table 3

Results of Mathematics Attitude Scale

Pretest and Posttest

Experimental Group ($\underline{n}$ = 23)				Control Group ($\underline{n}$ = 22)			
Student	Posttest	Pretest	$\bar{\Delta}_E$	Student	Posttest	Pretest	$\bar{\Delta}_C$
1	33	31	+ 2	1	39	50	- 11
2	23	63	- 40	2	48	50	- 2
3	80	69	+ 11	3	56	59	- 3
4	51	45	+ 6	4	46	59	- 13
5	72	69	+ 3	5	68	78	- 10
6	77	76	+ 1	6	57	46	+ 11
7	74	71	+ 3	7	68	63	+ 5
8	66	61	+ 5	8	21	8	+ 13
9	78	77	+ 1	9	51	49	+ 2
10	53	45	+ 8	10	50	56	- 6
11	52	26	+ 26	11	44	49	- 5
12	66	61	+ 5	12	70	63	+ 7
13	76	76	0	13	56	59	- 3
14	62	62	0	14	63	65	- 2
15	54	44	+ 10	15	64	58	+ 6
16	45	32	+ 13	16	59	57	+ 2
17	53	65	- 12	17	43	48	- 5
18	50	28	+ 22	18	52	57	- 5
19	14	20	- 6	19	55	46	+ 9
20	54	54	0	20	73	61	+ 12
21	63	55	+ 8	21	57	52	+ 5
22	74	70	+ 4	22	42	36	+ 6
23	17	17	0				
Totals:	1,287	1,217	+ 70	Totals:	1,182	1,169	+ 13
	$\bar{\Delta}_E$ = + 3.04				$\bar{\Delta}_C$ = + .59		

<u>Note</u>. Maximum score = 80.

Table 4

Analysis of Data

	Metric Length Achievement	Mathematics Attitude Scale
H_o:	$\bar{\Delta}_E = \bar{\Delta}_C$	$\bar{\Delta}_E = \bar{\Delta}_C$
$\underline{p}$ level:[a]	$\alpha = .05$	$\alpha = .05$
$\underline{df}$:	43	43
Results:	$16.70 > 14.00$	$+3.04 > +.59$
$\underline{t}$:[b]	$+2.24^{*}$	$+.80^{**}$
Decision:	Reject H_o	Retain H_o

[a]The Level of Significance ($\underline{p}$ level) was set at .05, employing a one-tailed test.

[b]The $\underline{t}$-test for two independent means was used to determine the significance of the difference between $\bar{\Delta}_E$ and $\bar{\Delta}_C$.

$^{*}\underline{p} < .05$

$^{**}\underline{p} > .05$

CHAPTER 5

Summary, Conclusions, and Recommendations

Summary

Grading has been confusing for everyone involved with education. There is a lack of consensus as to how the evaluation process best fits into the educational experience. The problem of this study was to compare Bozeman, Montana fifth-grade students in competitive and noncompetitive situations regarding achievement in mathematics and the change of attitudes toward the learning of mathematics. The researcher attempted to determine whether or not students subjected to noncompetitive (ungraded) situations would demonstrate a significant mean degree of improvement (when compared to students in competitive situations) in linear measurement using the International System of Units (SI), popularly known as the Metric System. Furthermore, the researcher attempted to determine whether or not students in noncompetitive situations would experience a significant mean positive change (when compared to students in competitive situations) in attitudes toward the learning of mathematics, after learning the Metric System of Length in the absence of grades.

Male and female students from two fifth- and two sixth-grade mathematics classes at Willson School were given a Metric Length Achievement pretest and a Mathematics Attitude Scale pretest. The two fifth-grade classes were chosen to take part in the study.

Both classes were instructed in the Metric System of Length for

7 days. Various instructional materials and methods were employed. The 23 students in the experimental group were evaluated on daily papers against a behavioral-objective format to indicate which objectives had been introduced, and which objectives each student had developed, satisfied, or mastered. The 22 students in the control group were evaluated on daily papers against a traditional absolute-grading scale, and each student was informed daily of his cumulative average. When formal instruction was completed, each group was given a Metric Length Achievement posttest and a Mathematics Attitude Scale posttest. Both posttests were identical to the pretests.

The results of the pretests and posttests were subjected to statistical analysis to determine the mean degree of improvement on the Metric Length Achievement test (posttest - pretest) and the mean positive change on the Mathematics Attitude Scale test (posttest - pretest). The t-test was used to determine the significance of the difference between the two independent means in each case. The Level of Significance was set at $\alpha = .05$, employing a one-tailed test. The mean degree of improvement was significant for the experimental group on the Metric Length Achievement test, $t(43) = +2.24$, $p < .05$. The mean positive change was nonsignificant on the Mathematics Attitude Scale, although the results favored the experimental group, $t(43) = +.80$, $p > .05$.

Conclusions

The purpose of this study was to discover if the motivation to learn can come from within the student. The results of this study clearly demonstrated that both groups (experimental and control) of students benefited from instruction in the Metric System of Length. Consequently, seven students in the experimental group and one student in the control group achieved perfect scores (30) on the Metric Length Achievement posttest (see Table 2). It appeared to the researcher that students can and will learn in the absence of pressure from grades.

It is noteworthy that 16 students in the experimental group exhibited a positive change on the Mathematics Attitude Scale posttest, while only 3 students in the experimental group exhibited a negative change (see Table 3). On the other hand, 11 students in the control group demonstrated a positive change and 11 control group students demonstrated a negative change on the Mathematics Attitude Scale posttest. Furthermore, the results of the Mathematics Attitude Scale would be significant if the data for Student 2 of the experimental group were eliminated, $\underline{t}(42) = + 1.84$, $\underline{p} < .05$. It appeared to the researcher that some students learn better in a competitive situation, while others would benefit from a nongraded learning experience.

In light of the results of this study, plus the fact that there is widespread sentiment expressed (see Chapter 2, Review of Literature) to adopt a new system of student evaluation, a new system must be fairly accurate to consider replacing the traditional grading systems.

Recommendations

Educators must continue to experiment to determine if it is possible for a student to take part in assessing his personal and societal needs and progress, and act accordingly. The researcher recommends that behavioral and personal objectives should be incorporated into an integrated educational curriculum, where each objective will become an important part of a meaningful whole. This will enable the student to make plans for attaining the goals he sets for his own educational experience and, consequently, to assist him in discovering his goals in life.

Because of the unpredictability of human behavior and the infinite possibilities in which individuals may respond in various situations, many questions concerning achievement and evaluation remain unanswered. Directions future researchers might wish to pursue in regard to affective and cognitive learning processes in education are subsequently posed in the form of questions:

1. Can students be responsible judges for determining much of the direction in which they should move throughout their educational experience?

2. Is it possible to establish a progress report which enables a student to see where he was, where he is now, and where he is going?

3. Will the progress report be instrumental in bringing about

significant learning on the part of the student?

4. Will such a "grading system" bring order and convenience to evaluation?

5. Can affective learning coincide harmoniously with cognitive learning?

6. Do human feelings have an important place in education?

7. Will an instructor be able to establish better rapport with his students, their parents, and society in general by being less judgmental?

8. Can a progress report enhance a student's self-concept and self-awareness?

Answers to questions such as these would perhaps give educators a new perspective on evaluating a student's progress.

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APPENDICES

APPENDIX A

METRIC LENGTH ACHIEVEMENT

PRETEST AND POSTTEST

1. The unit of length in the Metric System is the:

   a. litre (Circle your answer.)
   b. Celsius
   c. gram
   d. metre
   e. hectare

2. Measure line segment A in centimetres. Line segment A is _____ centimetres long.

   A

3. The symbol for centimetres is _____.

4. Draw a line 12 centimetres long starting from dot B.

   B •

5. Measure line segment C and write the answer using the correct symbol. Line segment C is _____ _____ long.

   C

6. There are _____ centimetres in one metre.

7. The symbol for metre is _____.

8. If a table is 300 centimetres long it is also _____ metres long.

9. A short name for metre is _____.

10. There are _____ metres in one kilometre.

11. 2 000 metres equal _____ kilometres.

12. The symbol for kilometres is _____.

13. The distance from Bozeman to Billings is about 225:

    a. millimetres (Circle your answer.)
    b. kilograms
    c. kilometres
    d. centimetres
    e. millilitres

14. There are _____ millimetres in one metre.

15. There are _____ millimetres in one centimetre.

16. 1 000 millimetres = _____ centimetres = _____ metre(s).

17. Draw a line 20 millimetres long starting from dot D.

    D •

18. The symbol for millimetre(s) is _____.

19. Measure line segment E in centimetres and millimetres. Line segment E is _____ centimetres _____ millimetres long.

    E ▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬

20. Line segment F is 7 _______________ long.

    F ▬▬▬

21. The metre is used to measure:

    a. weight (Circle your answer.)
    b. temperature
    c. area
    d. length
    e. volume

22. You would measure your height in:

    a. metres and centimetres (Circle your answer.)
    b. kilometres and millimetres
    c. grams and kilograms
    d. litres and millilitres
    e. metres and kilometres

23. A door is about ____________________ high.

a. 26 centimetres 9 millimetres (Circle your answer.)
b. 535 metres 72 millimetres
c. 2 metres 5 centimetres
d. 1 kilometre 200 metres

24. The distance from Bozeman to Livingston is about 48 __________ and could be shortened to 48 _____.

25. To record the area of a notebook we would use:

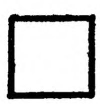
a. ms (Circle your answer.)
b. gm$_3$
c. hm3
d. dm^3
e. cm^2

26. Measure line segment G. Line segment G is _____ centimetres _____ millimetres long.

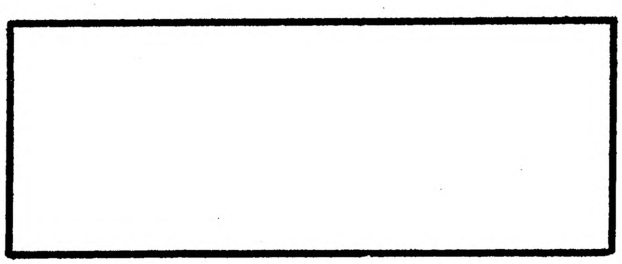
G

27. The symbol for square metres is _____.

28. The area of this square is 1 _____ or one square centimetre.



29. The area of this rectangle is 24 _____.



30. Draw a rectangle that is 5 centimetres long and 5 millimetres wide.

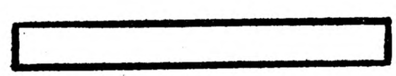
Answer Key

1. d. metre
2. 9 (nearest centimetre)
3. cm (no plural nor period)
4. see below (accept 11.9-12.1 cm)
5. 6 cm (no plural nor period)
6. 100
7. m (no period)
8. 3
9. m (no period)
10. 1 000 (accept 1,000)
11. 2
12. km (no plural nor period)
13. c. kilometres
14. 1 000 (accept 1,000)
15. 10
16. 100, 1
17. see below (accept 19-21 mm)
18. mm (no plural nor period)
19. 4, 8 (accept 4, 7 or 4, 9)
20. millimetres or mm (no plural nor period)
21. d. length
22. a. metres and centimetres
23. c. 2 metres 5 centimetres
24. kilometres, km (no plural nor period)
25. e. cm^2
26. 2, 4(accept 2, 3 or 2, 5)
27. m^2 (no plural nor period)
28. cm^2 (no plural nor period)
29. cm^2 (no plural nor period)
30. see below (accept 4.9-5.1 cm and 4-6 mm)

Maximum score = 30

4.

17.

30. 

APPENDIX B

MATHEMATICS ATTITUDE SCALE

PRETEST AND POSTTEST

<u>Directions</u>: Each of the statements on this page expresses a feeling that someone might have toward mathematics. After reading each statement, circle the answer which best describes how YOU feel about that statement. The letters stand for the following answers: SD--Strongly Disagree D--Disagree U--Undecided A--Agree SA--Strongly Agree.

1.	I am always under a terrible stress in a math class.	SD	D	U	A	SA
2.	I do not like mathematics, and it scares me to have to take it.	SD	D	U	A	SA
3.	Mathematics is very interesting to me, and I enjoy math courses.	SD	D	U	A	SA
4.	Mathematics is exciting and fun.	SD	D	U	A	SA
5.	Mathematics makes me feel confident, and at the same time it is exciting.	SD	D	U	A	SA
6.	My mind goes blank, and I am unable to think clearly when working math.	SD	D	U	A	SA
7.	I feel a little scared and shaky when trying to do mathematics problems.	SD	D	U	A	SA
8.	Mathematics makes me feel uncomfortable, restless, a little angry, and impatient.	SD	D	U	A	SA
9.	The feeling that I have toward mathematics is a good feeling.	SD	D	U	A	SA
10.	Mathematics makes me feel as though I'm lost in a jungle of numbers and can't find my way out of this jungle.	SD	D	U	A	SA

SD--Strongly Disagree	D--Disagree	U--Undecided	A--Agree	SA--Strongly Agree

11.	Mathematics is something which I enjoy a great deal.	SD	D	U	A	SA
12.	When I hear the word math, I have a feeling of dislike.	SD	D	U	A	SA
13.	I approach math with a feeling of hesitation, resulting from a fear of not being able to do math.	SD	D	U	A	SA
14.	I really like mathematics.	SD	D	U	A	SA
15.	Mathematics is a course in school which I have always enjoyed studying.	SD	D	U	A	SA
16.	It makes me nervous to even think about having to do a math problem.	SD	D	U	A	SA
17.	I have never liked math, and it is my most feared subject.	SD	D	U	A	SA
18.	I am happier in a math class than in any other class.	SD	D	U	A	SA
19.	I feel at ease in mathematics, and I like it very much.	SD	D	U	A	SA
20.	I feel a very good reaction to mathematics; it's enjoyable.	SD	D	U	A	SA

APPENDIX C

A SAMPLE WORKSHEET OF THE 27-PAGE INSTRUMENT USED IN TEACHING THE METRIC SYSTEM OF LENGTH

Draw lines the following lengths:

1. 1 centimetre (cm)

2. 4 centimetres (cm)

3. 7 cm

4. 12 cm

5. 10 cm

6. 3 cm

7. 2 cm

8. 5 cm

9. 8 cm

10. 15 centimetres

APPENDIX D

BEHAVIORAL-OBJECTIVE FORMAT USED

WITH THE EXPERIMENTAL GROUP

Behavioral Objectives--Metric Length	I	D	S	M
1. Measure length in centimetres				
2. Use cm as the symbol for centimetres				
3. Draw lines in centimetres				
4. Identify metre as the unit of length				
5. 1 metre = 100 centimetres				
6. Measure in metres and centimetres				
7. Use m as the symbol for metres				
8. 1 kilometre = 1 000 metres				
9. Measure in kilometres				
10. Use km as the symbol for kilometres				
11. 1 metre = 1 000 millimetres				
12. 10 millimetres = 1 centimetre				
13. Draw lines in millimetres				
14. Measure in centimetres and millimetres				
15. Use mm as the symbol for millimetres				
16. Know units for area: cm^2 and m^2				
17. Compute cm^2 and m^2 from linear units				
Personal Objectives 1.				
2.				
3.				