SECTION D, SOCIAL SCIENCES

An Exploratory Study of Remedial Mathematics[1]

ROY GLADSTONE, ROY BRYAN DEAL, and JOHN E. DREVDAHL

Oklahoma State University, Stillwater

Mathematics is an important tool subject. It is therefore unfortunate that some bright students dislike or are fearful of mathematics and do poorly in the subject. This study was undertaken in an effort to help such students mitigate their negative attitudes and to help them achieve a somewhat higher level in mathematics.

The study had its forebearers, of course. Axline (1947) pioneered the use of psychotherapy as a remedy for academic difficulties. Her subjects were second graders who were having difficulties in reading. The children gained in reading achievement beyond expectancy despite the fact that no attempt was made to teach them reading during the therapy period. Dealing individually with bright college students who had a crippling fear of mathematics, Tulock (1957), a mathematician, helped the students overcome their fear by using simple problems, thus insuring success, and by encouragement. The students later went on to success in mathematics as well as in other areas.

For objective evidence concerning the efficacy of helping the remedial learner understand mathematics it is apparently necessary to turn to remedial arithmetic. Fernald (1943) achieved success with bright pupils in remedial arithmetic by objectifying the arithmetic symbols and processes in remedial classes. In normal classes attempts to produce more effective learning through an emphasis on understanding or "discovery" produce, at worst, no difference when compared with a traditionally taught class and, at best, both gains over control groups and evidence that the method is liked by both the student and the instructor. In a typical study Burkhard (1956) found that learning of the calculus in the experimental (understanding) group was superior to that of the control group.

Wolfe's study (1956) indicates that time since the last mathematics course was taken is a factor to be reckoned with in the interpretation of test results used to select high-ability, low-achievement groups.

In all, the literature indicates that it is reasonable to suppose students can be helped in the fashion proposed but it indicates little beyond this.

Design of the Experiment

All the subjects were above the 50th percentile on the ACE or SCAT, did poorly on a mathematics placement test, said they disliked or feared mathematics and were volunteers. Beyond this the subjects were matched in pairs on the college aptitude test and, where possible, on the mathematics aptitude test.[2]

One group composed a class in mathematics in which pressure was relaxed, understanding emphasized at the expense of time spent on rote memorizing and practicing rote memorized procedures, and with whom a clinical psychologist encouraged the ventilation of feelings toward mathe-

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[2] Two placement tests were used. Some of the matched pairs did not take the same examination making it impossible to match all the pairs on this variable.

matics, procedures in mathematics classes and mathematics instructors during class time. The other group was enrolled in regular mathematics classes.

Criteria of success were (1) changed attitudes as evidenced by responses to an attitude scale and by subsequent enrollment in mathematics and (2) achievement in mathematics as evidenced by before-and-after tests and by grades in subsequent courses.

Procedure

The group of students having negative attitudes toward mathematics was found by means of announcing the experiment in low level mathematics classes and by placing a flyer in the Freshman Orientation Bulletin. The students who responded were culled and matched. Pertinent characteristics of the matched pairs are given in Table I.

In the experimental group the instructor started the course with an explanation of the nature of mathematics followed by a consideration of set theory. Readings were substituted for a text. In lieu of the traditional problems, the students were asked to develop the fundamental axioms of the number system. The ideas the students had were given in class rather than in the form of written work. The instructor explained that the work was difficult, that the students were not expected to complete large numbers of problems, and that insights might be expected to occur as the course progressed.

At intervals the clinical psychologist encouraged the students to ask questions and to say what they thought of the course and related topics. It soon became evident that the students were rendered insecure by the departure from traditional procedures and that they wanted the security of assignments, graded problems, and tests. A good deal of worrying about grades was evidenced, the students wanting to know how they would be graded since the normal instruments of grades (problems and tests) were minimized. As a result, a text was assigned, arriving at the Bookstore about midsemester. Some problems were also assigned for homework.

At the end of the semester two tests were given, one on set theory, the other being one of the two placement tests. The control group was given neither of these tests because of difficulties in scheduling. An attitude scale, developed for the purpose and designed to detect changes in attitude toward mathematics, was given to both groups. In addition a check was made on the number of students of both groups who took mathematics the following semester and of their grades.

The Attitude Scale

The scale asked the student to compare his reactions to mathematics at the beginning of the semester with his reactions to other academic subjects at that same time and for similar end-of-the-semester comparisons. Five of the questions dealt with feelings, the sixth with an intellectual factor. The items dealt with liking (for mathematics vs. liking for other academic subjects such as English, Chemistry, and History), fear of the subjects, willingness to take the subjects, concern about grades, confidence in ability to deal with the subjects, and understanding of the way in which the subjects are used outside of the classroom.

Each question had five alternatives representing favorable to unfavorable attitude toward mathematics as compared with other academic sub-

TABLE I

MATCHING DATA

Pairs	Academic Aptitude Test ACE or SCAT Total Percentile		Mathematics Placement Test Scaled Score	
	Experimental Group Subject	Control Group Subject	Experimental Group Subject	Control Group Subject
1	86	76	54	59
2	81	82	*	*
3	84	89	58	62
4	54	54	56	50
5	72	74	*	*
6	94	97	48	65
7	56	56	*	*
8	82	76	69	72
9	67	72	59	66
10	84	78	54	51
11	57	54	*	*
12	59	62	58	53
M	73.0	72.5	57.0	59.8

*Tests used not the same for the two matched students.

jects. Each question was repeated twice, once with the beginning of the semester, once with the end of the semester. The questions varied in having the most favorable or least favorable alternative first. Weights were arbitrarily assigned to the alternatives, the most favorable being weighted five, the least favorable being weighted one. Beginning-of-semester scores were then subtracted from end-of-semester scores, a positive score indicating a change in attitude in the favorable direction.

The beginning-of-semester data were subjected to a cluster analysis (Fruchter, 1954) which indicated that the question dealing with knowledge about the use of mathematics was independent of the other factors, that the question dealing with liking for mathematics was only moderately related to the remaining questions, and that the remaining questions could be treated as a cluster. Table II gives the correlation matrix.

TABLE II

INTERCORRELATIONS OF THE QUESTIONS

QUESTION	2	3	4	5	6
1	.32	.60	.33	.46	.07
2		.78	.78	.67	-.25
3			.66	.73	-.16
4				.63	-.35
5					-.26

Results

The mathematics tests indicated little growth in mathematics ability in the experimental group. Comparable data are not available for the control group. It is possible that understandings were developed in the experimental group which were not tapped by the tests used.

The questionnaire data were treated by testing the difference between the mean changes in attitude of the two groups. The experimental group changed more in a positive direction than did the control group on all questions. However, considering the data derived from the two independent questions and the cluster, the only significant difference between the groups was on the question referring to liking for mathematics. The experimental subjects grew significantly more in their liking for mathematics than did the control group.

A check on the mathematics courses taken during the next semester revealed that four of the experimental group took another course, getting two D's and two F's, while five of the control group took another course, getting two F's, one D, one C and one B. Two of the control group dropped mathematics the first semester while none of the experimental group withdrew. Thus, there was more pressure on the control group to take mathematics the second semester than there was on the experimental group since one course in mathematics is required.

Discussion and Conclusions

It seems necessary to assume that the experimental subjects learned little of the mathematics measured by traditional tests but did change in their liking for the subject more than did the control group. Since the N was so small it is worthwhile noting that the difference on all the questions favored the experimental group.

The cluster analysis indicates, interestingly enough, that liking for mathematics and other attitudes toward mathematics are relatively independent in these bright students. This is interpreted to mean that such students will tend to avoid courses in which they feel they may get a low

grade even if they like the subject. The cluster analysis also indicates that these students fear a subject and are unwilling to take it when they believe they may get low grades in that subject. The clusters and the conclusions derived through the use of the questionnaire should be cross validated.

In addition to the material presented above, some hunches deserve mention. It is believed that the classroom ventilation of the feelings of the students was helpful if only because it revealed their reactions to the ongoing program. In future experimentation it is considered important to have texts, problems and tests. Easy problems and reassurance should be used liberally, and, finally, understandings should be stressed for such bright groups.

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