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Mathematics Training for the Exceptional Student

By FRED ROBERTSON

In general the instruction in the college and university is designed for the student of average ability. The others who are unable to meet this requirement pose a problem that cannot be ignored. The problem of special training to meet the needs of the gifted student is not too pressing. The usual reaction is that something should be done and there the problem rests. In the past whenever such programs have been initiated they usually have had a short life. The twin phases, overcontent and down grading, have been fatal.

The preceding discussion applies particularly to the large institutions. The small ones have their own informal but successful method to care for the exceptional student.

This paper is a report on a training program for gifted students at the Iowa State College which was initiated in 1946 and has continued with variations to the present. The aim of this program is unique as such programs go. It may be stated thus: The aim is for the gifted student to attain a satisfactory performance level in a period of time shorter than the normal. In general the programming called for combining algebra and trigonometry in one quarter. Thus the time spent to complete the calculus is five quarters instead of the normal six.

The selection procedure to obtain the personnel of the accelerated sections varied somewhat. A complete explanation for the fall of 1952 is given in, "Bulletin of the Kansas Association of Teachers of Mathematics," vol. 28—February 1954, No. 3, pp. 18-21, under the title, "Algebra and Trigonometry for the Gifted Student at the Iowa State College," by this author. Any significant variation in the procedure will be explained.

The procedure for each year will be presented and then tables coordinating the entire program will be given.

For many years there has been a testing out procedure in mathematics at the Iowa State College. From the test papers thus obtained in algebra and trigonometry it is evident that many students are on the threshold of a satisfactory level of achievement in these subjects. Thus it seemed logical a combined course in algebra and trigonometry would remove their slight deficiency.

In September 1946 an annex to the Iowa State College was activated at Camp Dodge near Des Moines where about 500 freshmen

in engineering and science were enrolled. The author activated the first class in the accelerated program there. During the Christmas vacation in 1946 plans were made to test out some students in trigonometry. At the beginning of the winter quarter, in January 1947, nineteen tested out and accepted a chance to advance their mathematical training one quarter. They were assembled in one class under an excellent teacher of many years experience. The class remained intact in both analytics and the first quarter of calculus. The results were excellent when measured by any normal educational standards.

The procedure was varied in 1947 and 1948 at the Iowa State College Campus. Those students who were selected and elected the accelerated course took a combined course in algebra and trigonometry for one quarter. They enrolled in analytics in the winter quarter. The results were excellent.

The year 1949-50 marked an abrupt change in the selection procedure. Those entering students whose transcripts showed credits for a fourth semester of high school algebra and/or trigonometry were permitted to enroll in the next sequential course in mathematics. Thus some students by-passed college algebra, others trigonometry, and some both subjects.

The instructors preferred to maintain the performance level of the past. Since many of our students were participating in mathematical experiences one, two or even three quarters less than the normal six required to complete the calculus, this standard proved impossible to attain. It was unanimously agreed to modify the procedure so that the change from former years was less abrupt.

In 1950-51 account was taken of the time spent on fourth semester algebra and trigonometry. The time allotted to these subjects was increased from the preceding year, but was less than the usual amount. Again the performance level was disappointing.

The years 1951-53 marked an extension of the tendency in the preceding year. The complexity of administration of the freshmen courses was astounding. One member discovered there were fifteen different combinations for freshmen in the fall quarter in mathematics. A report of this program was published in the periodical mentioned in the first part of this paper.

An unpublished report contains a table showing that in the fall quarter of 1952 approximately 25 per cent of the freshmen made normal progress in their selected course. The decision was reached to return to approximately the pre-1949 procedure with the proviso

that as many students as were capable would be advanced in mathematics.

From the fall of 1953 this speeded up procedure has been done by a testing out and an accelerated class program. The selection procedure for the personnel of the accelerated sections was essentially as in 1952. These students were expected to shorten their collegiate mathematical experience by one quarter and maintain a satisfactory performance level.

The following table gives the number accepted and the number completing the specified course for each year. From this data the mortality from course to course is easily computed.

Table 1
Attendance (computed at end of each course)

Year	First Quarter Drops	Number Accepted	101 Algebra	102 Trigonometry	103 Analytics	211 Calculus I	212 Calculus II	213 Calculus III	Other Courses
1946	0	19			19	19	18	15	10
1947	0	44	44	38	41	38	36	34	20
1948	4	66	62	62	59	56	51	47	35
1949									
1950									
1951									
1952	2	125	123	123	115	104	87	62	
1953	0	90	90	89	70	60	53	49	28
1954	0	81	81	72	62	59	51	47	12
1955	25 + 5	131	106	101	80	73			
1956	5	78	78	73					
1957									

The table shows for the year 1946, nineteen were accepted for the accelerated course. All nineteen received satisfactory grades in analytics and Calculus I. Eighteen did well in Calculus II and fifteen completed the Calculus. Ten of the original nineteen took other courses in mathematics.

The year 1955 showed an abnormal number of drops in the first half of the accelerated course.

The following table shows the academic success of the members of the accelerated sections.

In table 2 normal progress is defined as a grade of A or B or C. Those are the grades needed if a student at Iowa State College is to make normal progress toward graduation.

Table 2 is read as follows: In the year 1946 there was 1 accelerated section of 19 members. This was 4 percent of the freshmen enrolled in college algebra. Ninety-five percent of those taking analytics made a grade of C or better in Analytics; the same for first

Table 2
Normal Progress %

Year	Drops	Sections	Number Advanced	Percent Advanced	Algebra	Trigonometry	Analytics	Calculus I	Calculus II	Calculus III	Other Courses	% A or B Calculus	A in All Math
1946	0	1	19	4			95	95	72	80	92	42	5
1947	0	2	44	5	100	100	96	93	90	91	33	47	2
1948	4	5	66	3	100	100	90	85	87	96	88	46	4
1949													
1950													
1951													
1952	2	6	125	12	100	100	85	89	77	92	91	39	13
1953	0	4	90	9	100	100	88	82	82	76	82	41	6
1954	0	3	81	8	100	94	97	77	66	82	91	22	3
1955	25	5	131	12	98	91	98	87					
1956	5	3	78	7	100	100							
1957													

quarter calculus; 72 in calculus II; and 80 percent in calculus III; while 92 percent did equally well in other mathematics courses. Forty-two percent of the original 19 made an A or B grade in all their mathematics through the calculus and 5 of the 19 made a straight A in mathematics through the first two years of college.

Conclusion: Elements of weakness and strength are shown in the study. The effectiveness of the program decreased rapidly with increasing class size. Possibly the maximum class size should be no more than 20. There was not always uniformity in the course objectives as visualized by the instructors.

During the winter quarter the personnel of the accelerated sections was placed in the usual analytics sections. The normal personnel of these sections consists in large degree of non-regulars. The combination of these groups did not constitute an ideal situation. Many problems arose. There was little agreement on a satisfactory alternative. The reorientation of these students into the usual program is always difficult.

Some elements of strength in the program are the saving of class room time, the meeting of challenging situations early in their college experience, exposure to new, useful and valuable mathematical techniques as well as early association with future leaders.

When class size was kept low and much work, thought and study was given to this program the results were excellent. However, it is very difficult to maintain these exceptionally high standards over the years. There is factual evidence that some participants in the program did not benefit.

Whether such a program can be maintained successfully over a long period of time has not been demonstrated.

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