Evaluating an accelerated mathematics program

A centre of inquiry approach

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Overview

Research reviews on the effects of acceleration (Daurio, 1979; Getzels & Dillon, 1973; Gold, 1965; Goldberg, 1958; Gowan & Demos, 1964) have been exceedingly positive. Daurio's (1979) review of the literature, for example, indicates that accelerated students often outperform control students on both academic and non-academic measures. Gold (1965) wrote, "No paradox is more striking than the inconsistency between research findings on acceleration and the failure of our society to reduce the time spent by superior students in formal education" (p. 238).

The smorgasbord of accelerative opportunities model pioneered by the Study of Mathematically Precocious Youth (SMPY) at The Johns Hopkins University provides much evidence for the effectiveness of accelerative practices. After using a talent search approach (Stanley, 1976; 1977, 1979; Stanley & Benbow, 1986) to identify superior mathematical reasoners, SMPY encourages students to take advantage of numerous accelerative opportunities. Accelerative possibilities are limited only by the ability and motivation of the identified students. The more capable and motivated a student is, the more "radical" the accelerative possibilities. SMPY has pioneered the use of fast-paced mathematics classes, whereby students learn several years of mathematics in one year (Bartkovich & George, 1980; George & Denham, 1976). Benbow, Perkins and Stanley (1983) reported that participants in SMPY's first two fast-paced mathematics classes scored significantly higher in mathematics portion of the Scholastic Aptitude Tests (SAT-M), expressed greater interest in mathematics and science, and accelerated their education much more than nonparticipants. Fast-paced classes can be geared to Advanced Placement exams (Mezynski, Stanley, & McCoart, 1983).

SMPY has also pioneered the Diagnostic Testing-Prescriptive Instruction (DT-PI) approach to accelerate students (Stanley, 1978, 1986). This instructional approach, which can be used in both individual and group settings, involves: using standardized tests, analyzing content of items missed on a given test to determine educational needs, designing and implementing an instructional program to address these needs, retesting on a parallel form of the initial test to determine mastery, and proceeding to the next content level using the same approach (Benbow, 1986).

Brody and Benbow (1987) have examined the effectiveness of the smorgasbord of opportunities model. Students who made use of accelerative options had higher college GPAs, won more honors, attended more selective colleges, and had higher career aspirations than students who decided to make use of these accelerative options.

Despite the positive research results, accelerative practices are underutilized in North America. There is only one accelerated mathematics program at the junior high school level in the entire province of Alberta, Canada. The present report describes on-going research at that junior high school, F. E. Osborne Junior High School in Calgary. Two aspects of the study are unique. First, an integrated or unified approach to the teaching of mathematics is used in Alberta. This report provides insights regarding the effectiveness of mathematics acceleration in this integrated context. Second, the results available for this evaluation are due to a unique collaborative venture called a centre of inquiry, in which partnerships are formed between university faculty and personnel for the purpose of conducting joint research and evaluation projects.

Description of the Alberta Curriculum

The mathematics curriculum at the junior high school level consists of six strands: problem solving; number systems and operations; ratio and proportion, measurement and geometry, data management and algebra. These strands are taught each year as components of the three-year junior high school mathematics curriculum (Alberta Education, 1988). At the senior high school level, the main mathematics curriculum is a sequence of three courses. Each course consists of concepts in Algebra, geometry, trigonometry, and statistics. Students aspiring to post-secondary education take a sequence labelled Math 10, Math 20, and Math 30. Concepts in calculus are taught in an optional course, entitled Math 31 (Alberta Education, 1992).

Description of the Accelerated Mathematics Program at F. E. Osborne Junior High School

F. E. Osborne Junior High School has a school population of approximately 500 students dispersed among Grades 7, 8, and 9. Since 1987, about 30 students enroll each year in an accelerated mathematics program, designed to teach the three-year junior high school mathematics curriculum and Math 10 while enrolled in junior high school. Acceleration is accomplished by teaching Grade 7 and Grade 8 Mathematics courses, while students are in Grade 7; Grade 9 Mathematics while students are in Grade 8; and Math 10 while students are in Grade 9. These students have been selected on the basis on standardized achievement performance in elementary, student interest, teacher recommendations, and parental permission. The program also has a flexible entrance policy to accommodate transfer and regular students, who demonstrate mathematics achievement.

Evaluation Methodology

Available data regarding end-of-the year achievement for various cohorts, beginning in 1987 were analyzed in terms of success in particular courses, correlates of achievement, and performance of accelerated students and older students on common examinations. Data were available for four cohorts of students (1987-1988, 1988-1989, 1989-1990, and 1990-1991).

Table 1: Percentage Success in Accelerated Mathematics Classes by Cohort

Cohort	Math 7/8	Math 9	Math 10	Math 20	Math 30
1987-1988			82%	78%	95%
1988-1989	100%	100%	82%	87%	
1989-1990	97%	100%	82%		
1990-1991	94%	100%			

Results of Longitudinal Follow-Ups

Using a final grade of 70% or better as a criterion for success in a given course, the success rates of students in various cohorts are shown in Table 1. Students were especially successful in Grade 9 mathematics, with all students in three cohorts, surpassing the criterion. Results appear reasonably consistent across cohorts.

Results of Path Analysis

A path analysis model was developed to predict success for each math course. This simple effects model proposes that achievement in each course in the mathematics sequence has only direct effects for the next course. Path coefficients predicting achievement in math courses for the four cohorts are shown in Figure 1. Results are strongly supportive of the proposed model. Since the path coefficients for this particular madel are simply the bivariate correlation coefficients, squaring the coefficients provides an index of the variance accounted for by each predictor. For the eight predictors of mathematics achievement over the four cohorts, the median variance accounted for was 56 percent.

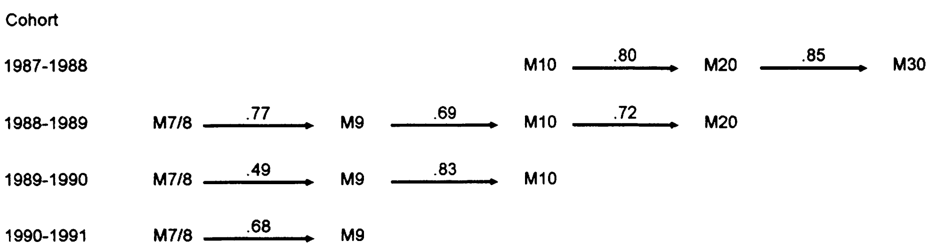

Figure 1: Path coefficients for predicting mathematics achievement

Performance on Common Examinations

Common mid-term examinations were administered to students in the accelerated mathematics program and students in the regular mathematics program to determine if there were skill differentials between accelerated and older regular program students. Analysis of variance results indicated no statistically significant differences between accelerated and older regular program students.

Summary/Future Directions

The evaluation data collected to this point generally supports the effectiveness of the accelerated mathematics program at F. E. Osborne Junior High School. These results provide evidence that accelerated programs do work even when an integrated approach to the mathematics curriculum is used. The progress of all cohorts are being continually monitored. Several pilot studies on the use of teacher-made tests and teacher rating forms as possible identification tools are currently being implemented.

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