The effects of acceleration on the attitudes toward and achievement in mathematics

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Abstract
This study examined the affects of participation in accelerated mathematics classes on the attitudes toward and the achievement in mathematics of thirty-five seventh, eighth, and ninth grade students and their parents. The respondents, from a small rural school district, completed a survey consisting of an open-form question and ten statements designed to elicit perceptions regarding their attitudes toward and achievement in mathematics.

Results indicated that parental attitudes were significantly more positive than students as a result of participation. Results also showed that participation produced no harmful effects and, in fact, many respondents expressed a desire to continue taking accelerated classes. While semester grades showed achievement to be above average for most students, respondents expressed ambivalence regarding the content and pacing. In general, the results support previously reported findings suggesting acceleration in mathematics does not harm and may even benefit participants.
THE EFFECTS OF ACCELERATION ON THE
ATTITUDES TOWARD AND ACHIEVEMENT
IN MATHEMATICS

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Abstract

This study examined the affects of participation in accelerated mathematics classes on the attitudes toward and the achievement in mathematics of thirty-five seventh, eighth, and ninth grade students and their parents. The respondents, from a small rural school district, completed a survey consisting of an open-form question and ten statements designed to elicit perceptions regarding their attitudes toward and achievement in mathematics. Results indicated that parental attitudes were significantly more positive than students as a result of participation. Results also showed that participation produced no harmful effects and, in fact, many respondents expressed a desire to continue taking accelerated classes. While semester grades showed achievement to be above average for most students, respondents expressed ambivalence regarding the content and pacing. In general, the results support previously reported findings suggesting acceleration in mathematics does not harm and may even benefit participants.
Chapter I

Introduction of the Problem

For those who are immersed in the process of educating a highly gifted child, it is inevitable that the question of acceleration will need to be addressed. Hundreds of research studies have been conducted and published on this topic. Whether the reference is to early entrance, grade skipping, continuous progress, or any of a number of other forms of acceleration, it is more than likely the single most recommended provision to be suggested when discussing ways to meet the needs of a highly gifted child. This is true especially when the area of giftedness is mathematical. VanTassel-Baska (1994) points out that a solid body of research has shown that mathematical talent can be developed most economically through a program of acceleration.

In spite of this seeming preponderance of supportive research, it is apparent that practitioners in the field have not embraced this provision. It appears that acceptability, not efficacy is the issue (Southern, Jones, and Fiscus, 1989). This is particularly true in rural schools. Southern and Jones (1992) report that gifted programs in some rural areas are not as well developed or as varied as their urban counterparts. As a result, acceleration is less likely to be offered as an option. It seems that teachers, especially, are not convinced of the benefits this provision offers; indeed, there is some concern among educators that it is actually harmful to gifted students. Parents in rural districts, tending toward the more conservative viewpoint, may be even less reluctant to challenge the status quo (Southern & Jones, 1992).

I have experienced this juxtaposition of viewpoints while attempting to meet the needs of highly mathematically gifted youngsters in a rural school
district. I coordinated the development of an accelerative program specifically aimed at providing students the opportunity to receive suitable instruction in mathematics at every level of their development on a continuous basis. Because the majority of research supports the use of acceleration in meeting the needs of students highly gifted in mathematics, this practice has formed the basis of this program (Fox, 1974b; Stanley, 1986; VanTassel Baska, 1994).

Previous to the development of the accelerative program, students took the first year of algebra in ninth grade. The second year of algebra and geometry needed to be taken in tenth grade, and math analysis in the junior year, in order to take Advanced Placement calculus as a senior. This sequence left students with virtually no opportunity to enroll in a college level mathematics course while still in high school. Therefore, the program envisioned two important goals: (a) To provide students with the opportunity to accelerate instruction in mathematics thereby eliminating the doubling up of courses in the sophomore year, and (b) to provide students with the opportunity to take additional college level mathematics courses if they so desired.

The development and implementation of the program was fraught with controversy. Many of the issues discussed in the literature review were dealt with during the year-long preparations. In January of 1995, the first group of students, sixth graders, began participating in a program that offered them two full years of acceleration in mathematics. The curriculum selected for use was essentially a combination of seventh and eighth grade level content designed to prepare students for the first year of algebra as seventh graders.

Statement of the Problem

The accelerative mathematics program is currently in its fourth year.
Students as young as second grade have entered the program and continue to be offered acceleration of subject matter. The initial group of students, now in ninth grade, is completing the second year of algebra. Year-end program evaluations have been conducted each year as part of the general gifted education program review. It is my belief that these evaluations do not perform an adequate job of assessing the degree to which this particular program meets the needs of the students enrolled. It is important to ascertain whether students are benefiting in any of the myriad ways suggested in the research.

I elected to survey the students and the parents of the students currently participating in the seventh, eighth, and ninth grade accelerative mathematics program in order to answer the following questions: (a) What are the effects of this program on student attitudes toward mathematics? (b) What are the effects of this program on student achievement in mathematics? and (c) What are the perceptions of parents regarding the effects of the accelerative mathematics program on the attitudes and achievement of their children?

Definition of Terms

Acceleration.

The process of acceleration can be accomplished through a wide range of practices. In its earliest form, it simply meant putting students ahead in grade placement. Later definitions of acceleration introduced the criteria of achievement and an ability to learn the material at a faster pace than the norm. These criteria eventually led to accelerative options that vary in the degree or extent of differentiation and in the major objective one is trying to achieve through the practice (Jones & Southern, 1991).

The accelerative option being discussed in this research study is a
combination of two types; subject matter acceleration or advanced level courses and concurrent or dual enrollment. Subject-matter acceleration or advanced level courses is defined as the practice of students receiving content in a particular subject area normally taught at a higher grade level. This acceleration is provided without actual assignment to the higher grade. For example, sixth graders take a pre-algebra class for seventh graders but remain a member of the sixth grade class. The students I surveyed receive high school credit for the successful completion of algebra one at the end of eighth grade. This option is defined as concurrent or dual enrollment.

ELP.

ELP refers to the name of the gifted and talented program in this district. It stands for Extended Learning Program.

Delimitations of the Study

I have narrowed the focus of my literature review in two ways: (a) To studies completed in the last twenty-five years, and (b) to studies dealing with acceleration in mathematics. Information was located through the University of Northern Iowa's Donald O. Rod Library using UNISTAR and through the Grant Wood Education Agency's information search of computer databases. The majority of my information resulted from reviewing references of selected research and working backwards.

A second delimitation of my study concerns the subjects I surveyed. The initial sample size was small. Thirty-five students participated in the accelerated mathematics courses offered at the district's middle school. Participants were predominantly middle class and no minorities were represented. Students from the ninth grade were not represented in the survey data. The overall return rate
on the surveys was less than 40% for each group, the student participants and the parents. A final delimitation of my study is the use of self-reporting data by the respondents.
A review of the literature related to acceleration clearly demonstrates a plethora of researchers who advocate acceleration as the single most effective tool in meeting the academic needs of gifted students. Clark (1983) suggests that while it should never be the total plan for a gifted program, a gifted individual's ability to learn at a pace faster than more typical learners dictates the need for some form of acceleration being present at all levels of schooling. Gallagher (1975) points to the attractiveness of this method in moderately shortening the educational career of gifted individuals. Stanley and Benbow (1986) suggest that the various forms of enrichment, often provided in lieu of acceleration, may actually harm the mathematically brilliant student.

Researchers voicing opposition to acceleration caution us about the potential harm that may result from the employment of this process. In general terms, the potentially harmful effects include social and or emotional maladjustment, reduced or even harmful academic productivity and achievement, and reduced opportunity for extracurricular participation.

An investigation of acceleration, in the broadest sense of the word, highlights two obvious questions: (a) What are the benefits that argue for the employment of this process? (b) What potentially harmful effects will result from the employment of this process? I have, for purposes of this study, elected to limit the focus of my research to studies that have been completed within the last twenty-five years. Of those, I have selected studies that discuss the benefits or the potentially harmful effects of acceleration with regards to the field of mathematics.
The Benefits of the Accelerative Process

Advocates of acceleration in the field of mathematics believe the process to be an essential tool in the quest to provide highly gifted students an education that is commensurate to their ability level (Stanley, 1979; VanTassel Baska, 1994). Potential benefits resulting from the employment of the accelerative process can be grouped in the following categories: (a) The effectiveness and the efficiency of matching the curriculum to the needs of the students, (b) recognition of student accomplishment, (c) increased productivity, (d) opportunity for advanced work in the talent areas, and (e) exposure to an intellectual peer group (Southern & Jones, 1991).

Effectiveness and Efficiency of the Accelerative Process

Research directed toward determining the benefits of acceleration in mathematics often point to the economical feasibility of developing mathematical talent using this process (VanTassel Baska, 1994). Primarily, though, it is the assurance of continuous progress at a pace appropriate to the learner that is the major benefit of employing the accelerative process to the study of mathematics (Stanley, 1986).

When a new learning task is at the right level of student readiness, the content is learned well and more effectively remembered. The new content is also more readily generalized to other relevant situations (Proctor, & Black, Feldhusen, 1986). This match between curriculum and student readiness ensures the greatest efficiency in learning. Mathematical instruction that falls below the student's current level of achievement is repetitious, causes boredom, and is inefficient from the prospective of both teaching and learning (Benbow, 1991; Davis & Rimm, 1985).

Csikszentmihalyi & Robinson (1986) and Feldman (1986) approached
this issue from the theoretical perspective based on developmental and cognitive psychology. Their studies suggest that the domains of knowledge (e.g., mathematics) have specific stages and levels that often coincide with the student's own inclinations. Acceleration allows students to improve their knowledge base, which in turn results in the learning and adoption of more efficient cognitive strategies (Benbow, 1991).

A large portion of the research dealing with acceleration in mathematics comes directly from the Study of Mathematically Precocious Youth (SMPY) founded by Julian Stanley at Johns Hopkins University. The program, over twenty years old, has provided services to mathematically gifted youth in addition to its research function. Results of numerous studies directed by Stanley and his colleagues show that, no matter what form of acceleration employed, students who accelerate perform better than those who do not. In other words, if provided with a challenging education that is structured at a pace commensurate with ability level, they achieve. If deprived of an education that corresponds to their level of competence, they do not achieve as highly (Benbow, 1983; Benbow & Lubinski, 1994; Fox, 1974a; Robinson, 1983; Swiatek & Benbow, 1991).

Recognition of Student Accomplishment

Students deserve to be recognized for their accomplishments. For example, students who master high school algebra while in sixth or seventh grade should, in fairness, be recognized and receive appropriate high school credit for their work (Moore & Wood, 1988; Southern & Jones, 1991; Stanley & Benbow, 1982). Again, the literature from SMPY provides us with numerous examples of highly precocious youth who have mastered mathematics far and above the level achieved by their age peers: receiving Ph.D. degrees at age 24;
earning a bachelor's degree in mathematics with high honors at age twelve; entering an Ivy League University at age thirteen; and graduating from Johns Hopkins University at seventeen (Keating, Wiegland, & Fox, 1974; Robinson, 1983; Stanley, 1988; Stanley & Benbow, 1982).

Stanley and Benbow (1982) further suggest that youth who reason exceptionally well mathematically are not using, nor are they valuing, their ability as well as they should. Such youth should "...receive recognition, systematic preparation, and opportunities to become superbly educated and trained" (p.8).

The National Council of Teachers of Mathematics recommends that students should receive appropriate credit for their achievement in mathematics above their standard grade level. Further, their official transcripts should reflect their level of achievement. Students for whom this does not occur are, in effect, being penalized for their work (House, 1987).

Increased Productivity and Time for Careers

Biographies of important mathematicians have taught us that some of the greatest contributions come at an early age. The field of mathematics, which is dependent upon the manipulation of symbols, is an early-peaking field, thus ripe for youthful accomplishment suggests a study by Lehman (as cited in Sayler & Lupkowski, 1992). This is especially true for youth who have been exposed to advanced study in their formative years when their early talent was evident. Extensive experience in mathematics appears to be essential to later productivity (Walberg & Zeiser, 1997).

Stanley and Benbow (1983) found that early completion of advanced graduate training was associated with increased scientific and scholarly productivity. This increase resulted from the time available for scholarly pursuits,
early creativity in their chosen career, and increased earning power.

Walberg and Zeiser (1997) studied the educational productivity factors of ability or prior achievement, motivation, quality of instruction, age or stage of development, instructional time, curriculum of home life, classroom environment and exposure to mass media, and their combined influence on academic learning. They found that early educational advantages multiply and opportunities accumulate and help explain the precocity and accomplishments of gifted students. Time spent enhancing these educational and environmental factors increase not only academic learning, but exceptional talent development and adult eminence as well.

Opportunity for Advanced Exploration in Academic Talent Area

Much of the literature speaks to this opportunity as it relates to early college entrants, especially students gifted in mathematics (Brody, Assouline, Stanley, 1990; Janos et al., 1988; Sayler & Lupkowski, 1992). Most early entrants are well aware of the many advantages open to them as a result of the extra time. They often take more time to explore educational alternatives, study abroad via fellowship offers, change or pursue additional fields of study or enter some form of graduate study. Rarely do early entrants graduate from college and move directly into the work force (Brody and Stanley, 1991).

Fox (1974a) points out that opportunities for mathematically talented students in junior high and high school are almost limitless. This is especially the case when students have been allowed to move through the curriculum as rapidly as their abilities and interests dictate. Enrichment, designed to increase the depth of material covered and the degree of challenge presented, is one possibility. Subject matter acceleration in high school allows students to complete the regular sequence of mathematics classes with time left to
supplement their program with college courses. Such course work provides a rich source of stimulation and, by design, is already geared to the student’s learning pattern (Fox 1974a).

Correspondence courses, academic fairs, competitions, mentoring or internship opportunities, study abroad, summer programming, and Advanced Placement courses are all avenues leading to advanced exploration of the student's talent area (Cornell, Callahan, Bassin, & Ramsay, 1991; Lupkowski & Assouline, 1992; Stanley, 1973). Feldhusen (1997) reminds us that, for optimal development of talented youth, a rich variety of experiences such as those listed previously must be made available. Students need the stimulation and challenge that these experiences provide.

Exposure to Intellectual Peer Group

Gifted students seem to select companions who are older than themselves. Maturity levels, intellectual interests, and academic interests tend to be more similar (Clark, 1983). Advocates of the accelerative process employed to meet the needs of those highly gifted in mathematics point to the increased opportunities to meet friends and acquaintances that result from this process. Indeed, studies by Pollins (1983) and Brody, et al., (1988) reported that early college entrants not only interact, even blend, with older classmates, they are often not even identified as being young. Gifted students benefit in a variety of ways from relationships with intellectual peers (Cornell et al., 1991; Delisle, 1997; Pollins, 1983).

In most cases, gifted students are comfortable with their intellectual peers at all levels of schooling. They appear to suffer no maladjustment when instruction in mathematics takes place with older students (Davis & Rimm, 1985; House, 1987; Jancs et al., 1988; Keating et al., 1974; Moore & Wood, 1988).
Summary of Benefits of the Accelerative Process

It seems evident from the literature that the accelerative process can provide mathematically gifted students with appropriate educational opportunities that result in a minimum of disruption in the lives of the students and in the educational settings in which they are placed. The research suggests that continuous involvement with academically challenging work will result in better preparation for the rigors of graduate and post-graduate work and adult productivity. Time saved as a result of the employment of the accelerative process can be used for further exploration and study in mathematics and possibly early entrance to the profession of their choice.

Potentially Harmful Effects of the Accelerative Process

The controversy regarding the use of the accelerative process to meet the needs of academically able students is relatively recent. Until the early part of the Twentieth Century, student performance mandated placement and students frequently remained at a level only to the limits of the curriculum.

Four factors emerged in the latter part of the Twentieth Century that caused people to examine the belief that students of differing ages could work together. The first two of these, mandatory attendance for all children and increased educational expectations, were social and economic factors. The third factor was a rise in developmental theories focusing on readiness. These theories implied that children of similar ages were alike in their development, and it was potentially hazardous to instruct children who were developmentally unprepared. Finally, there was a huge increase in the numbers of students that schools were expected to educate; and, therefore, the use of chronological age as a guide to placement became logical and convenient when dealing with the
large numbers (Southern & Jones, 1991).

Opposition to the accelerative process developed slowly, but steadily. A number of harmful effects resulting from this process have been posited over a span of many years. These can be grouped into three broad categories: (a) harmful outcomes for academic progress, (b) social and/or emotional maladjustment, and (c) a reduction in opportunities for extracurricular involvement (Southern & Jones, 1991).

I failed to find, within my time limitations, any studies that reported harmful effects with regards to academic progress for students accelerated in the field of mathematics. In fact, the vast number of studies resulting from the SMPY project refute many of the potentially harmful effects that have been posited for accelerated students.

Uphoff and Gilmore (1986) discuss later success/failure of students who enter school early, but only in generalities. McCluskey and Walker (1986) believe that while acceleration is frequently inappropriate and an "...easy way out..." (p.54), it does work particularly well in the fields of mathematics and science. The SMPY program at Johns Hopkins University has "...shown it is possible to teach very advanced mathematical concepts to young gifted children" (p. 54).

A weak negative relationship between grade acceleration and self-esteem was found in one study by Richardson and Benbow (1990). In their discussion of this finding the researchers suggested that this relationship might reflect changes in the social comparisons that accelerants tend to engage in when placed with older students or in segregated math classes rather than as a result of the acceleration.
Summary of Potentially Harmful Effects of the Accelerative Process

Literature on academic acceleration, especially in mathematics, consistently demonstrates a lack of harmful effects. However, the process continues to be controversial, even among professionals in gifted education. Southern, Jones & Fiscus (1989) surveyed coordinators of gifted programs, school psychologists, principals, and teachers to explore their attitudes about the process of acceleration. Respondents demonstrated less concern about the academic achievement than about the social and emotional development of accelerants. The socioemotional concerns seemed to be based on "common sense notions that are difficult to confront" (Southern et al., 1989, p.34). Practitioners appear to be influenced by experience, not the relevant literature. The authors suggest that future research investigate not the benefits or potential harms, but rather which students will most benefit from employment of the process.

Summary of the Literature Review

My review of the literature related to the acceleration of mathematically gifted students suggests that definitive answers to the two questions posed in my introduction are not to be found. I believe there are three main reasons for this lack of answers: (a) the problems of designing methodologically sound research in a real educational setting; (b) a lack of consensus regarding the definition of social and emotional adjustment and an acceptable way to measure the adjustment; and (c) determining the effect of the process on individuals as opposed to groups of students.

Is acceleration harmful or beneficial? Despite the lack of definitive answers, the reviewed literature does allow at least one conclusion to be drawn
that helps to answer this question. It is quite clear in the reviewed research that accelerated students are going to excel academically. Gaps in basic skills, feelings of undue pressure or stress, and excessive academic demands do not appear to be issues of significance.

From the literature review, acceleration does appear to be an option that must be considered in attempting to meet the needs of mathematically gifted youth. It is an efficient, effective, and economical way of providing a mathematics curriculum that matches the abilities of a gifted student.
Chapter III

Methodology

This chapter presents a description of the methodology used to conduct this research. In addition to the statement of purpose, it contains a description of: (a) the subjects in my research, (b) the survey instruments I employed to collect data, and (c) the research design and procedures.

Statement of Purpose

The purpose of this research was to determine the effects of acceleration on the attitudes toward and achievement in mathematics of a sample of gifted middle school students.

Subjects

The subjects surveyed were thirty-five seventh through ninth grade students each of whom had participated in accelerated mathematics classes for a minimum of three years. They all attended school in a small, Midwestern, rural school district of approximately 1200 students. The participants were all white and predominantly middle-class. There were no minority students. The children were selected for the accelerated mathematics program on the basis of district-selected criteria including IQ, achievement in mathematics, test scores, teacher and parent recommendation and scales of motivational and learning characteristics.

The majority of students had entered the program as fourth graders, although some joined a year or two later. The majority of students had received a compacted elementary curriculum enabling them to complete the sixth grade mathematics curriculum by the end of their fifth grade year. They were then
instructed using a pre-algebra, pre-geometry, applied arithmetic program during their sixth grade year. All students began the first year of algebra in the fall semester of their seventh grade year and continued with this curriculum for two years. The students in ninth grade studied the second year algebra curriculum. All students were accelerated by at least one full year.

The accelerated mathematics classes were taught by the two regular middle school mathematics instructors, neither of whom had received training in teaching gifted and talented students. The classes were self-contained and ranged in size from five to twenty-one.

**Instruments Employed to Collect Data**

Two instruments were employed to collect data for this research project. Survey instruments were designed for both the students and the parents. A spreadsheet was created to record the letter grades earned by student participants. A letter grade was recorded for each semester of participation.

**Survey Instruments**

The design of this study included the development of two separate survey instruments, one for the students and one for the parents of participating students. The student survey instrument consisted of ten statements (see Appendix A) designed to reflect the respondents' attitudes toward mathematics and their achievement in mathematics as a result of being in the accelerated classes. The ten statements on the parent survey instrument (see Appendix B) were designed to elicit the respondents' attitudes toward the accelerated mathematics program in general and their child's participation specifically. Each statement was generated as a result of the issues raised in the literature review. Both groups of respondents were asked to express their relative
agreement / disagreement with each statement using a Likert-type Attitude Scale: I strongly agree; I agree; I am undecided; I disagree and I strongly disagree.

In addition to the ten statements already discussed, each survey included an open-form item whereby respondents were encouraged to clarify their feelings regarding the mathematics program.

Specific statements on the student survey asked for student perception of the importance of being in an accelerated mathematics class (Statements 1, 2, 6, and 10); the appropriateness of content and pacing (Statements 5, 7, and 9); and their attitude towards achievement (Statements 3, 4, and 8). Specific statements on the parent survey asked for parent perception of the importance of their child’s participation in the mathematics program (Statements 2, 3, 6, 8, and 10); the appropriateness of pace and content (Statements 1, 5, and 7); their child’s achievement in mathematics classes (Statement 4) and communication regarding participation in the program (Statement 9).

**Grade Recording Spreadsheet**

A spreadsheet was designed to collect the semester grades of each student during each semester of participation in an accelerated math class. Following the collection of data, the individual names of the students were cut off the spreadsheet. The data then consisted solely of the count of each letter grade earned in any given semester. Anonymity was guaranteed to each student.

**Research Design and Procedures**

The survey instruments that I developed were sent to the Office of Human Subjects Coordinator in late March 1998 and, in early April, the UNI’s
Chair of the Institutional Review Board sent me notification of approval of my project.

Individual parent packets, each containing a cover letter, an informed consent form, a survey, and two self-addressed, stamped envelopes, were prepared. The elementary building principal agreed to administer the student surveys on site, including the reading of the cover letter and providing the informed consent forms. Completed surveys would be collected and parent packets would be distributed for students to take home. This method would result in a nearly 100% return rate for student surveys and a reasonable return rate from parents. Respondent anonymity was guaranteed.

Unfortunately, the actual administration of the surveys was not conducted according to this plan. Rather, a person other than the elementary principal distributed the prepared parent packets and the student surveys simultaneously. The cover letter and informed consent forms were not discussed with students and no time was given to complete the surveys on site. Students were encouraged to take all materials home and return them, via the envelopes I had included in the parent packets, as soon as possible.

During the week following the distribution of materials, classroom teachers related a verbal reminder to students to return the surveys. In spite of these attempts, the return rate reached only 37% (N=13) for the student surveys and 34% (N=12) for the parent surveys.

The grade data collection went according to the plan outlined. The elementary principal and an associate principal recorded each grade earned by each student every semester he or she participated in accelerated mathematics classes. The individual names were cut off the spreadsheet, and I received the total count of letter grades earned for up to five semesters of participation.
Data Analysis

For the purpose of my data analysis, the two outside categories on both ends of the Likert Attitude Scale were combined: agree and strongly agree; disagree and strongly disagree. These combinations simplified the process of reporting the results in percentages. The undecided column was counted as a separate category.

For discussion purposes, the student survey statements were combined into the following categories: (a) perceived attitudes toward mathematics following participation in accelerated mathematics classes, (b) the appropriateness of content and pacing, and (c) achievement in the accelerative mathematics class. The statements from the parent survey were combined into the following categories: (a) perceived attitudes toward participating in the accelerated mathematics program, (b) the appropriateness of pace and content, (c) the achievement of their child in the accelerative mathematics class, and (d) their perception of the communication regarding their child's participation in the program.

The grade report data was analyzed in two ways: (a) The count of each letter grade by grade level, and (b) the count of each letter grade for all respondents. The analysis of this data is included in the discussion on perceived achievement in the mathematics class.

I received few responses to the open questions from either the parents or the students. The student responses and excerpts of the parent responses were included in the discussion when appropriate. The responses from the parents are included in Appendix C in their entirety.
Chapter IV

Results

The results of my study revealed general trends within each category of statements. Included in this section is a discussion of those trends and a presentation of the numerical data. The tables present both the student response, designated with an (S), and the parent response, designated with a (P), for each category of statements. Presenting the data in this manner simplified the process of comparing the responses between the two groups of subjects; students and parents. The total number of student respondents was 13; parents who responded to the survey numbered 12.

Student and Parent Attitudes Toward Mathematics

Over half of the responding parents reported that having their child enrolled in the accelerated mathematics class was important (N=8), that participation effected their child's attitudes toward mathematics in a positive manner (N=8), and that their child would continue in the program (N=10). Fifty percent (N=6) of the parents felt that it was important for their child to be with other children who needed higher level mathematics, while 33% (N=2) disagreed with this idea.

It is interesting to note that while 69% (N=9) of the responding students reported they would continue in the program, only 38% (N=5) of them indicated that they liked the accelerated classes. The percentage of students indicating that they liked mathematics better since participating in the accelerated classes was also low: almost half (N=6) were undecided and 31% (N=4) disagreed with this statement. Slightly over half (N=7) of the students indicated that it was important to be with other students with similar needs, while 46% (N=6) were
undecided. These findings do not seem to corroborate the research that suggests students will have more positive attitudes toward mathematics as a result of participating in accelerated mathematics classes.

Of the thirteen students who responded to the survey, only two chose to provide feedback on the open question. Both responses relate to this category. One student wrote, "I enjoy ELP and I am glad that I got the opportunity to be in this class." A second student wrote, "I think that it has made me try harder, because I want to get a good grade even though I'm in an accelerated class."

Table 1 summarizes these attitudes toward mathematics as a result of participating in accelerated mathematics classes as reported by both responding students (S) and parents (P).

Table 1

Student and Parent Attitudes Toward Accelerated Mathematics Class

(Student N = 13  Parent N = 12)

<table>
<thead>
<tr>
<th>Survey Statements</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S) It is important to me to be in a class with other children who need higher level mathematics sooner.</td>
<td>53.8%</td>
<td>46.1%</td>
<td>0%</td>
</tr>
<tr>
<td>(P) It is important to my child to be in a class with other children who need higher level mathematics sooner.</td>
<td>50.0%</td>
<td>33.3%</td>
<td>16.7%</td>
</tr>
<tr>
<td>(S) I plan to continue taking ELP mathematics classes.</td>
<td>69.2%</td>
<td>23.0%</td>
<td>8%</td>
</tr>
<tr>
<td>(P) I will encourage my child to continue taking ELP mathematics classes.</td>
<td>83.3%</td>
<td>8.3%</td>
<td>8.3%</td>
</tr>
<tr>
<td>(S) I like the ELP mathematics class</td>
<td>41.7%</td>
<td>58.3%</td>
<td>0%</td>
</tr>
</tbody>
</table>
(P) I like the ELP mathematics program. 66.6% 25.0% 8.3%

(S) I like mathematics better now than I did before enrolling in ELP mathematics. 23.0% 46.2% 30.8%

(P) The ELP mathematics program has had a positive effect on my attitude toward mathematics instruction at school. 66.6% 23.0% 7.7%

(P) Having my child be in the ELP mathematics is important to me. 66.6% 23.0% 7.7%

The Appropriateness of Content and Pacing

Table 2 summarizes the responses of students and parents regarding the appropriateness of the content and the pacing in the accelerated mathematics classes. I had hoped that the open question might offer an explanation of the responses, particularly for this category. However, there were but three comments from responding parents of students. None of the students offered additional information.

Table 2

Appropriateness of Content and Pacing in the Accelerated Mathematics Class

(Student N = 13  Parent N = 12)

<table>
<thead>
<tr>
<th>Survey Statements</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S) Material in the ELP mathematics class is presented at just the right pace for me.</td>
<td>61.5%</td>
<td>23.0%</td>
<td>15.4%</td>
</tr>
</tbody>
</table>
On average, more than half of the responding students (N=8) and parents (N=7) believe that the content and pacing in the accelerated mathematics class is appropriate. An examination of the individual statements in this category, however, offers a slightly less positive accounting of content and pacing.

For example, almost 40% (N=5) of the student respondents indicated disagreement or indecisiveness regarding the pacing of material presented in the mathematics classroom. This suggests that a less than optimal match between pace, content, and student ability was occurring in the accelerated mathematics class. Further evidence to support this suggestion comes from the parent response to the amount of homework being completed. Forty-one percent (N=5) of the responding parents were undecided about the appropriateness of the amount of homework their children were responsible for.

More responding students (N=9) agreed that the teacher understands
their needs in the accelerated mathematics class better than did the parents (N=6) who responded to this survey. However, an overwhelming majority of responding parents (N=10) felt that their child's needs were being met in the mathematics program.

All three parent responses (see Appendix C) on the open question referred to the category of content and pacing. It is interesting to note that the responses represent opposing viewpoints with regard to this issue. One parent wrote, "I was happy with what was being taught, and the pace of instruction until my child reached middle school. At that point, I feel the curriculum was 'dumbed down'..." The second parent expressed the following concern, "Quite often my daughter would comment that the assignments were given with little explanation and a lot of the kids didn't understand how to do the work..."

In contrast to the first two comments, a third parent expressed support for the level of challenge without specifically addressing the issue of pace. "I believe all children should have the opportunity to challenge themselves. ELP math has met that need for my daughter."

Effects of Accelerated Classes on Achievement in Mathematics

Stanley and his colleagues at Johns Hopkins University have reported in a number of studies that students who accelerate, perform better than those who do not (Benbow, 1983; Benbow & Lubinski, 1994; Fox, 1974a; Robinson, H., 1983; Swiatek & Benbow, 1991). The results I obtained in this small study seem to corroborate these findings. A majority of the students (84.6%) and parents (91.7%) who responded to the survey reported that earning a good grade was important to them. More than three-fourths (N=10) of the students were proud of the work they had accomplished. I found it interesting to note that
more than half (N=7) of the responding students reported that they focused more on the content of the class than on the grades they were earning. Table 3 summarizes the survey data for this category of statements.

Table 3

**Effects of Accelerated Classes on Achievement in Mathematics**

(Student N = 13  Parent N = 12)

<table>
<thead>
<tr>
<th>Survey Statements</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S) In ELP mathematics, I focus more on learning the material than I do on my grades</td>
<td>53.8%</td>
<td>30.8%</td>
<td>15.4%</td>
</tr>
<tr>
<td>(S) I am proud of my work in ELP mathematics class.</td>
<td>76.9%</td>
<td>15.4%</td>
<td>7.7%</td>
</tr>
<tr>
<td>(S) It is important to me to earn a good grade in ELP mathematics.</td>
<td>84.6%</td>
<td>7.7%</td>
<td>7.7%</td>
</tr>
<tr>
<td>(P) It is important to me that my child earn a good grade in ELP mathematics.</td>
<td>91.7%</td>
<td>8.3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 4

**Semester Grades Earned by Participants of Accelerated Mathematics Classes**

(Participants N=35  Total Number of Grades Earned N=97)

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>No. Of Grades Earned</th>
<th>A's</th>
<th>B's</th>
<th>C's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seventh (N=9)</td>
<td>9</td>
<td>22.2%</td>
<td>55.6%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Eighth (N=21)</td>
<td>63</td>
<td>36.5%</td>
<td>61.9%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>
Table 4 summarizes the semester grade data. The semester grades received by participants in the accelerated mathematics classes offers further corroboration of the positive effects of acceleration on student achievement. Over three-fourths of the participating students (N=32) received semester grades of “B” or better. The largest percentage of students receiving a grade of “C” were in seventh grade. These grades reflect the first semester of their participation in the middle school setting, which at this site, means a move from an elementary building to a middle school building.

Communication Regarding Participation in Accelerated Mathematics Classes

The final category of statements summarizes the opinions of responding parents concerning the communication between the school staff and parents regarding their child's participation in accelerated mathematics classes. Of interest here is the fact that none of the responding parents reported being undecided about this important component of the accelerated program. Ten of the twelve responding parents agreed that the communication was satisfactory. However, two of the twelve parents were not satisfied with the communication that had been occurring.

Summary

The data received from this small sample of participating students and their parents can be summarized in the following manner:
1. Parents indicated a significantly more positive attitude toward the mathematics program, on average, than the students. The students who responded to this survey indicated ambivalence in their attitudes toward mathematics as a result of being in accelerated mathematics classes with one exception. A majority (N=9) of responding students said that they would continue taking accelerated classes in the future.

2. The data seem to indicate that a significant number of both parents and students are undecided about the appropriateness of content and pacing in the accelerated mathematics classes. Ambivalent feelings were reported in the areas of pacing, the amount of homework, and the teacher's understanding of the needs of participants.

3. In general, participation in accelerated classes had a positive effect on achievement in mathematics. Ninety-one percent (N=32) of the participants in this study earned grades of "B" or better.

4. Communication regarding students' participation in accelerated mathematics classes was satisfactory for the majority (N=10) of responding parents. The remaining parents (N=2) felt it was unsatisfactory. No responding parents were undecided about this issue.
Chapter V
Conclusion, Recommendations, and Summary

A discussion of the findings of this research study in terms of their significance for professional practices and recommendations, based on my findings, are presented for consideration in this chapter.

Conclusions

Conclusions to be drawn from this study are limited by the low percentage of surveys returned by both students and parents. It should be emphasized that the conclusions I have made are not generalizable to the participants as a whole.

Moore and Wood (1988) found that elementary students reported positive benefits in end-of-the-year questionnaires following participation in accelerated classes. They learned more mathematics in the class than they would have in a regular class. Bartkovich and Mezynski (1981) found that junior high students felt work in accelerated summer mathematics classes was “...more fun, more exciting, and more productive than their experiences in mathematics” (p. 78). Brody and Benbow (1987) found that students experienced no negative effects on social and emotional adjustments while participating in accelerated mathematics classes throughout the high school years.

At all levels of schooling, the literature reported no negative effects, and indeed, some positive effects resulted from participation in accelerated mathematics classes. This study seemed to support these results. Even though participating students and parents expressed some ambivalence with regard to individual statements on the survey, the majority of responding students (N=9)
reported that they would continue taking accelerated classes. Nine of the thirteen responding parents also indicate that they would encourage their children to continue their participation. This would suggest that both parents and students felt positive about what the experience was providing. In fact, eighty-three percent of responding parents felt that their child’s needs were being met in the accelerated program.

The literature review revealed numerous studies that reported achievement of students who participated in some form of acceleration was as good or better than that of students who did not participate (Benbow, 1983; Brody & Benbow, 1987; Fox, 1974a, Swiatek & Benbow, 1991). The results of this study seemed to corroborate this finding as well. The achievement of the majority (N=32) of responding participants was above average or better.

More respondents indicated that they were undecided about issues than I had expected. My review of the literature suggested that participants in accelerative mathematics programs feel very positive about the accelerative process. While the participants in this study did not report total disagreement with the process, there was some ambivalence regarding its employment. One might conjecture as to how the results would have changed if the option to check undecided had not been made available on the survey. The overall preponderance of checks in this category suggest a need for increased communication among participants, teachers and parents.

**Recommendations**

In spite of the low return rate, an analysis of the data revealed several areas in which I believe recommendations are appropriate. The first of these is in the area of communication. The results of this survey suggest that the benefits
of accelerative programming in mathematics have not been communicated well to staff and parents in the district. The surveyed school district is a small, rural community. Southern & Jones (1992) found that attitudes in rural school districts toward acceleration tend to be more conservative. The staff and parents may need to be convinced of its benefits and freedom from potential harm.

I would recommend that, in the case of the surveyed school district, an introduction to the accelerated mathematics program be developed and offered to parents and students on a yearly basis. An important component of this program might include the presentation of any data collected from past and present participants regarding their attitudes toward the accelerative mathematics program. This yearly effort in communicating with parents, staff and students would go far in building support for and acceptance of this method of meeting the needs of the mathematically gifted student.

The second area that I believe needs to be examined is that of content and pacing. Wolfe (1986) suggests that “Special attention needs to be given to academically advanced middle school learners.... A particularly vulnerable area is mathematics” (p.82). She continues by suggesting that students must be taught by teachers trained in educating the gifted and once the program begins it must be allowed to continue. Without sufficient inservice training for the teachers involved, the program may be unsuccessful.

Findings such as these reported by Wolfe (1986) suggest that the moderately high level of ambivalence from both parents and students regarding the content and the pacing of this particular program is an area that needs further investigation. I would suggest that the staff of the surveyed program gather, on a consistent time table, more data from the students and the parents concerning the pace at which material is presented, homework expectations,
and the expectations of students and parents in the area of teacher support for their learning needs. It is important to gather this additional data to ensure the continuance of the class and to provide support for both the teachers and the participants. This data could be included in the yearly program discussed previously.

My final recommendation concerns the need for additional research. Many of the programs for mathematically gifted students that have been researched have been in progress for many years (Stanley, 1988; Stanley & Benbow, 1982; Swiatek & Benbow, 1991). Researchers speak of the long-term benefits of accelerative programming in mathematics. The program in this school district is in its infancy. What will the students of today have to say about their experience three or five years from now? This information would be valuable to the maintenance of the school district’s program. I therefore recommend that a method of data collection be developed so that participants in the program are periodically invited to offer feedback about the benefits of the acceleration program. Feedback from high school graduates who participated in the accelerative mathematics classes would be especially meaningful to the staff and could also be shared at the suggested yearly presentation.

Fox (1976) states that the need for identifying talented students and offering them innovative educational programming is especially “acute” (p.33) during the junior high school years. It is at this point where schools appear to be “the least flexible” (p.33). She suggests that it is a “rare junior high school that can provide adequate subject-matter acceleration for gifted students ” (p.34).

The school surveyed in this study appears to be one of the “rare” schools to which Fox makes reference. It is my hope that as a result of this small study, the recommendations I have made will be considered and the
accelerative mathematics program will be allowed to develop and grow to meet the needs of the mathematically gifted students residing in the community.

Summary

This research study was undertaken for the purpose of answering the following questions: (a) What are the effects of participating in an accelerated mathematics program on student attitudes toward mathematics? (b) What are the effects of participating in an accelerated mathematics program on student achievement in mathematics? and (c) What are the perceptions of parents regarding the effects of participation in an accelerative mathematics program on the attitudes and achievement of their children?

A review of the literature related to acceleration in mathematics suggested that there were no definitive answers to questions regarding the benefit nor potential harm that might result from employment of the process. In general, acceleration was found to be an efficient, effective, economical way to provide an appropriately challenging curriculum for the mathematically gifted.

I selected a small, midwestern, rural school district in which to investigate the answers to my questions. Thirty-five middle school students and their parents were invited to respond to a survey designed to ascertain their attitudes toward and achievement in mathematics. In addition, the grades earned by each student during each semester of participation were recorded. The responding students had been accelerated a minimum of one full year.

Unfortunately, the administration of the survey instruments did not go according to the outlined plan and, as a result, return rate was lower than anticipated. The data I did receive was grouped according to the following categories: (a) perceived student attitudes toward mathematics following
participation in accelerated mathematics classes, (b) the appropriateness of content and pacing as perceived by students, and (c) achievement in the accelerative mathematics class as perceived by students. The statements from the parent survey were combined into the following categories: (a) perceived attitudes toward participating in the accelerated mathematics program, (b) the appropriateness of pace and content, (c) the achievement of their child in the accelerative mathematics class, and (d) their perception of the communication regarding their child's participation in the program.

Resulting trends within these categories showed that responding parents had significantly more positive attitudes toward the accelerative mathematics program than did the responding students. Both groups of respondents, parents and students, indicated their intention to continue participation in the accelerative mathematics program. In general, participation in the program had a positive effect on achievement in mathematics. Ambivalent feelings were expressed by both responding parents and students with regard to the content and the pacing of content in the accelerative program. Responding parents reported that communication regarding their child's participation in the program was satisfactory.

Although conclusions were difficult to draw from this study due to a low return rate the data did seem to support the findings from the reviewed literature. Participation in the accelerated mathematics classes seemed to cause no harmful effects on the responding students. The fact that so many student respondents indicated that they would continue taking the accelerative mathematics classes, suggested that they have positive feelings regarding their participation. Finally, responding parents seemed supportive of the program and would encourage their children to continue participating in the accelerative
mathematics classes.

I made the following recommendations for the accelerative program discussed in this study: (a) to examine current communication practices regarding the accelerative mathematics program for the purpose of increasing the understanding of the benefits of the accelerative mathematics program, (b) to conduct further research to determine what, if any, problems exist in matching the content and pacing to student ability, and (c) to develop an ongoing program of data collection so that long-term effects of student participation in the program can be investigated.
References


Appendix A
Student Survey

The following statements are opinions. Please state your attitude towards each opinion by checking:

<table>
<thead>
<tr>
<th></th>
<th>a. I strongly agree</th>
<th>b. I agree</th>
<th>c. I am undecided</th>
<th>d. I disagree</th>
<th>e. I strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>It is important to me to be in a class with other kids who need higher level mathematics sooner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>I like mathematics better now than I did before enrolling in ELP mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>In ELP mathematics, I focus more on learning the material than I do on my grades.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>It is important to me to earn a good grade in ELP mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Material in the ELP mathematics class is presented at just the right pace for me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>I plan to continue taking ELP mathematics classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>The ELP teachers understand my need for the accelerated mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>I am proud of my work in ELP mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>I have learned more in the ELP mathematics class than I would have in the regular mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>I like the ELP mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please use the space provided below to make any additional comments that you believe would help me to understand your feelings regarding the ELP mathematics program and its affects on your attitude towards and achievement in mathematics.
Appendix B
Parent Survey

The following statements are opinions. Please state your attitude towards each opinion by checking:

a. I strongly agree
b. I agree
c. I am undecided
d. I disagree
e. I strongly disagree

<table>
<thead>
<tr>
<th>Statement</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My child's needs are being met in the accelerated mathematics program.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Having my child be in the ELP mathematics program is important to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The ELP mathematics program has had a positive effect on my attitude towards mathematics instruction at school.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. It is important to me that my child earn a good grade in ELP mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The amount of homework my child has seems about right for an accelerative mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I will encourage my child to continue taking ELP mathematics classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. The teachers better understand the academic needs of my child in the accelerated mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. It is important to me that my child be in a class with other children who need higher level mathematics sooner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Communication regarding my child's participation in the ELP mathematics program has been satisfactory.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I like the ELP mathematics program.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please use the space provided below to make any additional comments that you believe would help me to understand your feelings regarding the ELP mathematics program and its affects on your child's attitude towards and achievement in mathematics.
APPENDIX C
Parent Responses to Open Question on Survey

Parent One

"I was happy with what was being taught and the pace of instruction until my child reached middle school. At that point, I feel the curriculum was "dumbed down" to allow students who had dropped out of the program (by choice) to catch up. Teaching Algebra I over a two year period was done without consulting parents and with no hard evidence to support the contention that it was the best option.

The two years of Algebra I / Math have not challenged my child. I question how she will respond to the pace of Algebra II in the block schedule format after having two years to complete Algebra I."

Parent Two

"Quite often my daughter would comment that the assignments were given with little explanation and a lot of the kids didn't understand how to do the work. The teacher expects that since they are in the ELP program that they should easily understand how to do the work. I also don't know if I agree with his grading system. If a "B" was achieved on the test they were given, they could raise it to an "A" just by going in and talking to him."

Parent Three

"I believe all children should have the opportunity to challenge themselves. ELP math has met that need for my daughter. I hope she continues to have the chance to continue."