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**The Gifted and Talented in New Zealand Secondary Schools: An
Overview of Procedures and Practices in Mathematics**

**A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Educational Studies (Mathematics)
at Massey University**

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ABSTRACT

A large nation-wide survey was carried out to collect data on the extent and nature of programs currently offered to gifted and talented mathematicians in New Zealand secondary schools. Quantitative data was collected on the identification of gifted and talented mathematics students, school-wide policy on the gifted and talented, ability grouping, acceleration and enrichment as well as demographic factors associated with the research variables.

Open questionnaire responses by Heads of Mathematics Departments indicated strong interest in the educational provisions for the gifted and talented. A semi-structured interview was also used with three secondary schools in order to expand upon the issues that had arisen from the postal surveys.

It appears that the situation of the gifted and talented in New Zealand secondary schools is still unsatisfactory. Only 60 % of respondents reported having identified gifted and talented students within their school, 32 % of respondent schools had a written policy on the gifted and talented, just over a third of respondent schools had no forms of ability grouping and just under a half of the respondent schools did not have an acceleration program. The Development Band Certificate was used in 45 % of respondent schools.

The research raises concerns about the lack of well conceived, continuous programs in mathematics available to gifted and talented students in New Zealand secondary schools.

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TABLE OF CONTENTS

ABSTRACT	iii
ACKNOWLEDGMENTS	iv
CHAPTER 1	10
1. INTRODUCTION	10
1.1 Gifted Education in New Zealand: An Historical Perspective	10
1.2 Catering for the Gifted and Talented	13
1.3 Research Objective	14
1.4 Definition of Terms	14
1.5 Ability grouping	15
1.6 Acceleration	16
1.7 Development Band	17
1.8 Overview	18
CHAPTER 2	20
2. LITERATURE REVIEW	20
2.1 Identification of the Mathematically Gifted	20
2.2 Mathematically Gifted Girls	25
2.3 Identification of Mathematically Gifted Students in New Zealand	35
2.4 The Development Band	38
2.5 Acceleration	43
2.6 Ability Grouping	53
2.7 Conclusion	60
CHAPTER 3	62
3. RESEARCH DESIGN	62
3.1 Introduction	62
3.2 Data Collection Methods	63
3.3 Ethical Considerations	65
3.4 Reliability, Validity and Possible Limitations	67
3.5 Limitations	69
3.6 Summary	70

CHAPTER 4.....	71
4. RESULTS.....	71
4.1 Response Rate.....	71
4.2 Identification of mathematically gifted students.....	74
4.3 School policy on gifted and talented education.....	77
4.4 Ability grouping in Year 9.....	80
4.5 Acceleration in Years 9 and 10.....	86
4.6 Problems with acceleration.....	92
4.7 Other subjects accelerated.....	101
4.8 Development Band.....	101
4.9 Other provisions for gifted and talented mathematics students.....	105
4.10 Enrichment/extension programs.....	106
4.11 General comments.....	107
CHAPTER 5.....	118
5. CASE STUDIES OF THREE SECONDARY SCHOOLS.....	118
5.1 School A.....	118
5.2 School B.....	121
5.3 School C.....	126
5.4 Conclusion.....	129
CHAPTER 6.....	131
6. DISCUSSION AND CONCLUSION.....	131
6.1 Identification of Gifted and Talented Students.....	131
6.2 School Policy on Gifted and Talented Students.....	131
6.3 Ability Grouping in Year 9.....	133
6.4 Acceleration.....	134
6.5 Development Band.....	136
6.6 Other Provisions.....	137
6.7 Implications of the Study.....	137
6.8 Implications for Further Research.....	138
6.9 Conclusion.....	139
REFERENCES.....	141

APPENDICES	153
Appendix 1: Questionnaire sent to Heads of Mathematics	153
Appendix 2: Covering letter sent to Heads of Mathematics	156
Appendix 3: Topics sent to Heads of Departments in schools for semi-structured interviews	157
Appendix 4: American Grade Levels	158

List of Tables

Table 3.1 Percentage of students receiving a scholarship pass.	26
Table 3.2 Percentage of students receiving an ‘A’ grade.	27
Table 4.1 Respondents versus non-respondents by region.	71
Table 4.2 Respondents versus non-respondents by decile rating.	72
Table 4.3 Respondents versus non-respondents by school type.	72
Table 4.4 Respondents versus non-respondents by single sex/co-ed.	73
Table 4.5 Respondents versus non-respondents by school size.	73
Table 4.6 Identification of gifted students by school size.	74
Table 4.7 Identification of mathematically gifted students by decile rating.	75
Table 4.8 Identification of mathematically gifted students by region.	76
Table 4.9 Identification of mathematically gifted students by school type.	76
Table 4.10 Identification of mathematically gifted students by single sex/co-ed.	77
Table 4.11 Policy on gifted and talented by school size.	78
Table 4.12 Policy on gifted and talented by decile rating.	78
Table 4.13 Policy on gifted and talented by region.	79
Table 4.14 Policy on gifted and talented by school type.	79
Table 4.15 Policy on gifted and talented by single sex/co-ed.	80
Table 4.16 Ability grouping in Year 9.	80
Table 4.17 General ability grouping by school size.	81
Table 4.18 Mathematical ability grouping by school size.	81
Table 4.19 General ability grouping by decile rating.	82
Table 4.20 Mathematical ability grouping by decile rating.	82
Table 4.21 General ability grouping by region.	83
Table 4.22 Mathematical ability grouping by region.	84
Table 4.23 General ability grouping by school type.	84
Table 4.24 Mathematical ability by school type.	85
Table 4.25 General ability by single sex/co-ed.	85
Table 4.26 Mathematical ability by single sex/co-ed.	86
Table 4.27 Number of students accelerated.	89

Table 4.28 Entry level to the accelerate program.....	89
Table 4.29 Selection criteria for acceleration to School Certificate Mathematics.....	90
Table 4.30 Criteria for repeating School Certificate mathematics.....	91
Table 4.31 Mathematics options available in the senior school.....	92
Table 4.32 Problems with acceleration.....	93
Table 4.33 Subjects with whole class acceleration (≥ 20).....	101
Table 4.34 Numbers of students involved in Development Band Certificate.....	102
Table 4.35 Selection criteria for the Development Band Certificate.....	103
Table 4.36 Acceleration versus Development Band.....	105

CHAPTER 1

1. INTRODUCTION

The provision of education for the gifted and talented in New Zealand has been piecemeal and has often been left to individual educators. Egalitarian concerns have worked against the singling out of gifted and talented children and programs for such children have generally been in-class enrichment programs (Moltzen,1996). There has been an attitude that gifted and talented students do not need assistance beyond that already available and that additional provision is elitist.

Although the Ministry of Education is now in the process of developing policy guidelines for the education of the gifted and talented, there has been no official policy on the education of gifted children in New Zealand and many schools have developed their own policies. Guidelines are given in the various curriculum documents, but teachers have often worked in isolation and there is a need for information regarding the extent and nature of programs currently offered to gifted and talented students.

1.1 Gifted Education in New Zealand: An Historical Perspective

During the 1940's in New Zealand, mass education for all students until the age of 14 to 15 was provided and there was a provision for a few to go on to college or university (Braggett,1993). The 1950's saw the general expansion of secondary schooling as retention rates increased. There was also evidence of increased interest in gifted and talented children and their education at this time. In 1955 a committee, established earlier by the Department of Education, reported its findings on the education of children with superior intelligence. Their preferred model at that time for providing for the gifted and talented was enrichment within the classroom. However, the ministry's attitude towards gifted education began to change as reports from educators from the United States began to influence educators in New Zealand.

The early 1960's saw a report by the Department of Education on the education of the gifted. The emphasis was still on the extension of these children from within a mainstream class and there was still no national policy on the education of the gifted. During the 1960's and 1970's the much increased student numbers in schools meant that more traditionally non-academic students were present in the senior school. Schools were obliged to broaden their curriculum and educational provision for disadvantaged groups was required. Provision for the education of the gifted trailed far behind the need for inclusive programs for other disadvantaged groups. There was a greater concern with removing barriers to achievement than with providing for gifted and talented children.

The pattern of the previous decades continued in the 1970's, where the provision of education for the gifted was left to individuals. The situation for gifted and talented children began to improve in the 1980's with the development of new initiatives at a local level (Moltzen, 1996). While in-class enrichment remained the preferred method of providing for the gifted and talented, there were examples of differentiated and experimental programs occurring at a local school level and an increase in withdrawal programs for gifted and talented students.

Perhaps the most important change to the provision of programs for the gifted occurred with the educational reforms introduced by the fourth Labour Government in 1989. The Education Act of 1989 says that "equity objectives shall underpin all activities within the school" and specifically mentions Maori, Pacific Islands, and other ethnic groups, as well as women and girls, students with disabilities and students with special learning needs (National Educational Guideline, 1990 in Braggett, 1993.) The new national curriculum that began to be developed at around this time emphasised achievement objectives by levels, irrespective of age, and had as an objective that each student will develop to their full potential. Boards of Trustees were obliged to ensure that their school's policies and practices sought to achieve equitable outcomes for all students irrespective of their ability or disability.

Since the advent of Tomorrows Schools, Boards of Trustees have become more aware of the need to provide policies for the education of gifted children. With the increased competition for students, and especially more able students, schools have had to promote themselves more vigorously and part of this promotion has been more emphasis on accelerate and enrichment programs for gifted and talented students. Parental choice of schools has also been seen by principals to have an impact on the provisions for the gifted and talented (Moltzen, 1996). Parents have generally placed more emphasis on the importance of education for the gifted and talented than have principals, and so parents may place pressure on principals to provide more programs for the gifted.

Factors associated with the greater administrative decision-making power afforded the local school, increased parental involvement in school governance, and parental choice leading to increased competition between schools for pupils, appears to be the salient aspects of the reforms to impact on provisions for students with special abilities. (Fraser, Moltzen & Ryba, 1995, p. 291)

Although provision for the gifted appeared to be more widespread than previously, of the 26 countries which were represented in Sydney at the 8th World Conference on the Gifted and Talented in 1989, New Zealand was the only country which had not developed a system policy on school giftedness (Braggett, 1993). Also, a survey by Havill (1990), of 304 primary and secondary schools in the Tainui district, revealed that only one fifth of the schools had developed a policy statement on Children with Special Abilities. The most commonly mentioned strategies in the survey responses were enrichment strategies. A national survey by McAlpine (1992) found that fewer than 20% of respondent schools had formulated a separate policy on children with special needs. Of those that did provide some program, 80% were catered for in the regular mainstream classes and 75% placed emphasis on enrichment programs.

A study by Moltzen and Mitchell (1992) found evidence that while most principals thought their schools were providing for the needs of gifted and talented students, many Board of Trustee members did not. The increased voice that parents now had in school affairs was seen by principals as having a positive impact on provisions for gifted children

in many schools. However, there did not seem to be any significant change in the number of schools that had a separate policy on the education of the gifted and talented.

1.2 Catering for the Gifted and Talented

Recent research (Moltzen, 1996) suggests that in-class enrichment is the most preferred means of catering for the educational needs of the gifted in New Zealand. Often schools combined enrichment with withdrawal programs, which offered students opportunities to work with others of like ability outside the regular classroom, and outside the regular content. Moltzen concludes that: *enrichment is a 'safe' option, it is generally inoffensive, compatible with our egalitarian ideology and not likely to attract charges of elitism; it is a provision that is easy to defend philosophically and pedagogically. It arguably represents the best and worst of our work for the students with special abilities* (p. 15).

However, there has been considerable debate amongst educationalists as to the most appropriate educational provisions for the gifted and talented. Some educationalists are firmly in favour of acceleration, while others are fervent proponents of enrichment. In general, children in New Zealand are rarely accelerated out of their class level, although acceleration on a subject by subject basis has been an option in secondary schools. Of all curriculum areas mathematics has been perceived as the most appropriate to accelerate.

Alongside the debate on acceleration versus enrichment, is the debate on ability grouping. The 1970's and 1980's saw a policy of heterogenous grouping gain favour in New Zealand secondary schools. The inclusion of all children, no matter what their ability, in the same classroom was felt to be beneficial to all. Gifted children would benefit by understanding the difficulties of the less able and slower and average children would benefit by being exposed to more able children.

Secondary schools increasingly recognise the need to provide differentiated programs for talented mathematics students. The optimal learning environment for any student would

be when the level of material and pace of instruction are individually matched with ability and slightly above the student's current level of performance. The *Mathematics in the New Zealand Curriculum* recognises that students with special ability must be *extended and not simply expected to repeat different permutations of the work they have clearly mastered* (Ministry of Education, 1992, p. 12). Information on the extent and scope of programs offered to gifted and talented mathematics students would be of great relevance to the continued development and implementation of Development Band Mathematics resource material and would inform the debate about the provision of programs for talented students.

1.3 Research Objective

The objective of this research is to establish a data base of the extent and nature of programs currently offered to gifted and talented mathematics students throughout New Zealand secondary schools. A baseline of the programs currently offered to mathematically gifted and talented secondary students and the means used to identify those students would enable further research to be undertaken on the education of the gifted and talented mathematics students in New Zealand. Additional to the nation-wide survey, will be in-depth interviews with HODs of Mathematics of selected schools, so that some of the issues involved with the education of the gifted and talented can be explored in greater detail.

1.4 Definition of Terms

Gifted and Talented

There are many terms that have been used to describe gifted and talented students. Gifted, bright, able, talented, above average, talented, intelligent, special abilities are just some of the terms that have been preferred in different times and different places. In New Zealand, the term "children with special abilities" found favour (McAlpine, 1990), although the term "able" has been favoured in the United Kingdom (George, 1992) and "gifted and talented" in the United States of America (Riley, 1998). The most recent New Zealand book published on this subject has as its title *Gifted and Talented: New*

Zealand Perspectives (1996). However, an Education Review Office report published in 1998 was entitled *Working with Students with Special Abilities*. Most recently, the Ministry of Education has convened a working party to write policy guidelines for the provision of education for the gifted and talented in New Zealand schools.

The phrase *gifted and talented* has been used throughout this publication as such usage most closely mirrors current theory and practice.

1.5 Ability grouping

There are many forms of ability grouping. Ability grouping is the separation of children at the same class level into more or less homogeneous groups that differ in terms of general ability, specific aptitude, scholastic achievement, or curriculum competencies. It is not a single organisational procedure. It can involve separate classes of high-, average- and low-ability students, single-subject grouping, cross-class grouping in curriculum areas like mathematics and language arts, remedial groups, accelerated classes, and within-class groupings. Ability grouping can involve tracking, where all classes are taken with the same groups of students. This usually involves different courses and course requirements. The principal types of ability grouping fall into two major categories: between class grouping and within class grouping.

In New Zealand secondary schools, there are two broad types of between class grouping that are used as instructional strategies in the delivery of education to the gifted and talented. The first type is *streaming*, whereby students are grouped according to their ability in one subject, or a combination of subjects, and students remain together for all of their core classes in English, Science, Mathematics and Social Studies. When students are in streamed classes, all of the top mathematics' students may not necessarily be in the top mathematics class. The second type of between class grouping is *banding*, which is the grouping of students of similar ability in specific subject areas. In this type of grouping, all of the identified top mathematics' students would be in the top mathematics classes.

One of the objectives of this research was to investigate the extent of ability grouping in New Zealand secondary schools and the type of grouping involved. Where ability grouping was in place, data was also gathered on the selection processes used.

1.6 Acceleration

Acceleration is a term that is used to describe a variety of strategies. It may be seen as an emphasis on moving through the curriculum at an increased rate, whereas enrichment places an emphasis on increased depth and breadth (Moltzen, 1995, cited in Fraser, Moltzen & Ryba, 1995).

Reid (1991) describes acceleration as an administrative or instructional provision designed to speed the process of academically able students through the formal education system. Likewise Braggett (1992) describes accelerated learners as *those who can progress at a faster pace than normal and forge ahead of their age peers in some aspect(s) of their learning and/or those who can work at a deeper level than their age peers* (p. 19). Thus acceleration is a provisional procedure which allows highly gifted pupils to cover a curriculum in a shorter period than would be required by their peers at a normal classroom pace (Wieczerkowski & Prado, 1993).

Acceleration is a provision that is readily available in secondary schools. Students can take a subject at a higher level while remaining with their peer group for the rest of their subjects. This research aims to discover the extent of acceleration in New Zealand secondary schools and the types of programs that accelerated students are offered in mathematics in the senior school.

The research literature contains much debate about the merits or otherwise of acceleration. A further objective of this research was to investigate the types of problems encountered, if any, with acceleration programs in secondary schools.

1.7 Development Band

The development band in mathematics is the model given by the Ministry of Education for the education of gifted mathematics students.

The intention of the development band is to encourage teachers to offer broader, richer, and more challenging mathematical experiences to faster students. Work from the development band should allow better students to investigate whole new topics which would not otherwise be studied and to work at a higher conceptual level. Talented students should have their interest in mathematical ideas further stimulated and their understanding of the nature of mathematics deepened.
(Ministry of Education, 1992, p. 19)

Although there is a suggestion that the development band is to be used with “faster” students, the identification of gifted and talented students is skimmed over in the Mathematics in New Zealand Curriculum document (MINZC), and the exact type of program that gifted students will take is generally left up to individual schools and teachers.

The New Zealand mathematics curriculum is divided up into strands and each strand is divided into levels. Sample development band activities are given for each strand at each level.

Some support for the development band was provided in 1996 with the publication by the Ministry of Education of *Development Band Mathematics*. This book offers starting points and examples that teachers and schools could use in developing their own programs to suit the needs of the students.

As well as supporting the enrichment pathway, MINZC also suggests the acceleration option should be used judiciously.

For all but an exceptional few, enrichment provides better opportunities for talented students to achieve their potential. The development band is not designed

to hold students back but rather to increase their understanding and knowledge in mathematics and to help them develop higher order thinking skills. (Ministry of Education, 1996, p. 8)

The limitations of time, resources and knowledge for teachers to implement the development band program prompted the New Zealand Association of Mathematics Teachers (NZAMT) to develop material for the development band. NZAMT believed that a significant number of students were not being provided with appropriate extension work (Wallace, 1998). A certificate program was developed that NZAMT felt would be suitable to use as either whole class activities, individual students, mathematics clubs or as part of the teaching program. The response to this program has been enormous (Wallace, 1998) and the certificate courses now run from Year 6 to Year 12. In 1999 the program was extended to Year 4.

The Development Band Certificate courses provide material to enrich the particular strand of mathematics being studied, rather than extend to the next level. Each Year level booklet contains units of study that are based on problem solving activities. Many of the activities are open ended and encourage higher-order thinking; the activities can be done individually or in small groups.

An objective of this research is to investigate the extent to which the development band is used in schools and the selection processes that are used to identify students for development band activities.

1.8 Overview

Chapter Two reviews the literature on the identification and education of gifted and talented students. General issues such as the development band, acceleration, enrichment and ability grouping are reviewed. In Chapter Three the methodology for this study is discussed. The survey design process and the interview process are described.

The following two chapters report the results of the study. Chapter Four deals with the results of the nationwide survey and Chapter Five presents the outcome of three in-depth interviews with staff from three different styles of schools.

Chapter Six discusses these results and gives an overview of the findings. Implications for the education of the gifted and talented in New Zealand secondary schools are suggested, as well as directions for further research.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Identification of the Mathematically Gifted

In a review of the literature on mathematically gifted students, Sowell, Zeigler, Bergwall and Cartwright (1990) found that there were at least two types of mathematically gifted students:

- precocious students who are able to do the mathematics typically done by older students
- mathematically able students who solve demanding problems using qualitatively different thinking processes.

Although the general characteristics that describe academically gifted children also apply to the mathematically gifted, there are some specific characteristics of mathematically gifted children. Chang (1984) says that the term “mathematically gifted” is loosely applied to three groups of students:

- a) *those who learn standard content well and perform accurately, but who have difficulty when taught at a faster pace or at a deeper conceptual level*
 - b) *those who can learn more content and a deeper level, who reason well and are capable of solving more complex problems than average students*
 - c) *those who are highly talented or precocious, capable of performing with little or no formal instruction at the level of students several years older, and of dealing expertly with sophisticated content and difficult problems.*
- (p. 232)

The first group of students described by Chang are those that teachers may mistakenly describe as mathematically gifted. They are the students who are good at traditional

exercises and computation. They complete their work fast and are accurate. They are probably teacher pleasers. If they are categorised as gifted, then they may mistakenly be placed in programs that are too far above their ability level. Rather, the characteristic that separates a mathematically gifted child from one not gifted in this domain is the quality of the child's thinking, or how the child reasons about mathematics (Chang, 1984; Johnson, 1983).

Krutetskii (1976) found that children capable of a high level of mathematics performance display reasoning strategies which are not displayed or even mentally available to children less capable in mathematics. He postulates three major abilities that are essential in the mathematical thinking of the gifted child:

- the ability to proceed quickly from a specific set of instances (generalise)
- the ability to eliminate intermediate steps in the thinking process
- the ability to switch from a direct to a reverse order of operation (flexibility of thought).

Krutetskii (1976) also identifies eight traits that typify the thinking of mathematically gifted children:

- swiftness in reasoning
- quick and comprehensive in generalisation
- a tendency to deal in the abstract
- an inclination to analyse the mathematical structure
- flexibility in thinking
- a desire to search for alternative solutions and select the most elegant solution
- a tendency not to tire when doing mathematics
- a tendency to view the world through mathematical eyes.

Greenes (1981), identified a similar set of skills as follows:

- spontaneous formulation of problems
- flexibility in handling data

- mental agility of fluency of ideas
- data organisation ability
- originality of interpretation
- ability to transfer ideas
- ability to generalise

Qualitative information about a child's thinking can be determined by the use of interviews and observation of children as they work through mathematical problems. However, in reality, the time involved in such measures is rarely available in schools and it is more likely that the identification measures involve achievement tests, which measure mostly computational skills (Gallagher & Gallagher, 1994).

A summary of studies on the identification and prediction of success of mathematically gifted students (Sowell, Zeigler, Bergwall & Cartwright, 1990) found that, in general, tests are more effective as identification tools than other single methods. Standardised instruments appear to give better results than non-standardised instruments.

A large body of research on mathematically gifted children has been generated by the Study of Mathematically Precocious Youth (SMPY) in the U.S.A. This is a program developed by John Stanley to identify and provide appropriate programs for mathematically gifted students. The students are identified at the age of about 12 years by the use of the College Board's Scholastic Aptitude Test (SAT-M) (Stanley & Benbow, 1986). The SAT-M was designed for above-average high school juniors and seniors to measure their mathematical reasoning ability. Stanley and Benbow maintain that a high score on this test at an early age is indicative of a very high mathematical reasoning ability. They argue that *the ability to score highly on a difficult test of mathematical reasoning ability... could only be by the use of extraordinary ability at the 'analysis' level of Bloom's (1956) taxonomy* (p. 362).

Above grade level assessment is seen as necessary to identify highly gifted mathematics students because some students are so gifted mathematically that when they take

mathematical aptitude and achievement tests developed and normed for their age or grade they answer all or most of the items correctly. Therefore the evaluation of their talents is severely restricted. After the students have been identified by above level testing, they are given an achievement test to see what they know about particular topics (Luprowski & Assouline, 1992).

Stanley and Benbow (1986) estimate that they find the top 1% of mathematically gifted students by their talent searches. One of the findings from SMPY was the disproportionate numbers of males qualifying for the program compared with females. The gender differences in mathematical reasoning were the largest among the most precocious (Raymond & Benbow, 1989). Several possible environmental reasons for this difference have been investigated with no conclusive results.

The SMPY model has been used, in a modified form, to identify mathematically gifted students in Germany. Wagner and Zimmerman (1986) defined mathematical giftedness as a set of testable abilities based on a combination of the SAT-M and the Hamburger Test für Mathematische Begabung (HTMB). The six categories of abilities identified are:

1. Organising materials.
2. Recognising patterns or rules.
3. Changing the representation of the problem and recognising patterns and rules in this new area.
4. Comprehending very complex structures and working within these structures.
5. Reversing processes.
6. Finding (constructing) related problems.

Wagner and Zimmerman (1986) also found that far more boys than girls qualified for inclusion in this program.

Also, testing may overlook gifted mathematicians. Gardner (1997), in response to a presentation from Stanley, said:

our concern with early identification has led to a prizing of tests that purport to indicate who is likely to attain great heights. But precocity is not the same as the capacity to achieve great heights; the race does not always go to the swiftest. (p. 123)

Parental observations of the real-life mathematical skills of their young children have been found to predict accurately the child's performance on psychometric measures of quantitative ability. In a study by Robinson, Abbott, Berninger and Mukhopadhyay, (1997), parents were given the following guidelines to assess their child's mathematical ability. Does the pre-school or kindergarten child:

- ask questions about numbers or time?
- make up games using numbers?
- use adding and subtracting up to five?
- play board games involving counting squares?
- read speed limit signs?

Those children identified by their parents or teachers as being mathematically gifted on the basis of the above criteria were subsequently tested with a battery of psychometric measures at the beginning of kindergarten or first grade. For the group as a whole, performance was advanced not only on the measures of mathematical abilities but on other measures as well. Again, the recruitment process yielded a higher number of male nominees and qualifiers at both grade levels.

A summary of studies on the identification and prediction of success of mathematically gifted students by Sowell, Zeigler, Bergwall and Cartwright (1990) found the following typical characteristics of such students:

- They frequently had parents with higher-than-average educational attainment.
- In problem-solving activities, they have the ability to "grasp the problem as a whole without losing sight of the elements" (p. 151).

- Gifted students take time to orient to the problem-solving task, whereas average-ability students immediately begin to try problem solutions, often before they understand what they are required to do.
- Gifted students generalise mathematical material rapidly and broadly and are able to quickly formulate generalised associations with a minimum number of exercises. Average students establish and reinforce generalised associations gradually.
- Mathematically precocious students are better than average-ability students on short-term memory tasks involving both digit and spatial information.

2.2 Mathematically Gifted Girls

The identification and education of mathematically gifted girls has been highlighted as a concern in the research literature. Gifted girls have been described as *an endangered species... a quiet crisis...wasted talent* (Riley, 1997).

In the next section, the problems associated with the selection of mathematically gifted girls will be investigated, as well as suggestions for educators and practitioners that could enable mathematically gifted girls to achieve their full potential. Firstly, the question of a differential performance in mathematics by males and females needs to be addressed. Perhaps less girls are chosen for gifted programs in mathematics because there are simply not as many mathematically gifted girls as there are boys!

The Gender Difference in Mathematics

Differential skill in mathematics is a critical issue in relation to the professional development of gifted females. Male-dominated fields that convey high status and good financial rewards often require skill in mathematics (Davis & Rimm, 1994).

Although gender differences in achievement have been reported in the literature for several decades, these differences now appear to be diminishing among the average ability population at “*a rate faster than a gene can travel*” (Raymond & Benbow, 1989, p. 144). However, it appears that between-gender differences are still particularly marked when above average performance is considered, with males achieving at higher levels. “*A*

recent meta-analysis of 100 studies both confirms these findings and indicates that gender differences have declined in recent years” (Fennema & Leder, 1990, p. 13).

The differences in the proportion of males and females who score exceptionally are particularly striking. Nearly all the differences in performance between boys and girls at ages 11 and 15 are accounted for by the top 10 to 20 percent of attainers in most topics (Joffe & Foxman, 1986).

The male advantage in math exists, but it is smaller than previously thought.... In studies of gifted students the male advantage is larger than in studies of ‘regular’ students. (Davis & Rimm, 1994, p. 326)

In New Zealand, there have been a number of analyses of final year mathematics examination performance in secondary schools. In all the studies there was a small but consistent (and usually statistically significant) gender difference in mean scores in favour of boys (Blithe, Clark & Forbes, 1993). Of more interest is the existence of a gender difference at the top end of the range of scores. University Bursary results have consistently shown a gender bias in the top range of mathematics scores.

Table 2.1 Percentage of students receiving a scholarship pass.

Bursary Calculus	Girls %	Boys %	Bursary Statistics	Girls %	Boys %
1995	2.6	4.1	1995	2.5	5.3
1996	2.1	4.0	1996	2.7	4.3
1997	2.6	3.5	1997	2.4	3.8

The percentage of boys achieving scholarship passes in both of the University Bursary mathematics papers is 1 ½ to 2 times higher than the percentage of girls in the 1995-1997 results, although the difference has decreased in 1997 (see Table 3.1). At Year 11 a course of mathematics is compulsory for all students with most choosing to sit School Certificate mathematics.

A higher percentage of boys than girls achieved an 'A' pass ($\geq 80\%$), although the gender difference has narrowed considerably in 1997 (see Table 3.2). It would be more informative to know the percentages of boys and girls achieving at the 95th percentile for this exam, however such data was unavailable.

Table 2.2 Percentage of students receiving an 'A' grade.

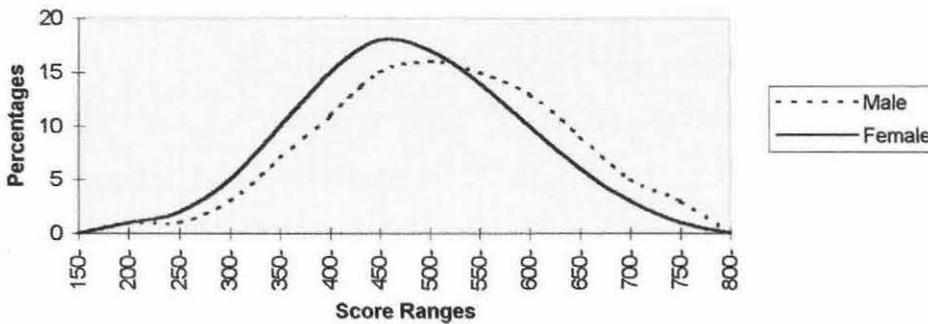
School Certificate Mathematics	Girls %	Boys %
1995	9.4	10.5
1996	10.4	11.9
1997	11.7	12.0

The work of Julian Stanley in the 1980's promoted the male superiority in mathematics. One of SMPY's most controversial findings was the large and consistent sex difference in mathematical reasoning ability favouring boys. In all six SMPY talent searches a large sex difference favouring males was found in the SAT-M. The difference was found at the seventh grade level, ruling out the hypothesis that differential course taking by boys and girls in mathematics causes the sex difference in mathematical reasoning ability. These differences persist over several years and are related to subsequent differences in mathematical achievement (Benbow & Stanley, 1982).

Differences, favouring males, have been observed among mathematically gifted students in 3rd grade American students (Benbow & Lubinski, 1993). This study also noted cross-cultural gender differences: about half of all the mathematically high-scoring girls in the USA were Asian. This study reported that there are 13 males for every female who scores at least 700 on SAT-M before age 13. The ratio is 4:1 for Asians and 16:1 for Caucasians. The same ratio of 4:1 was found when the SAT-M was translated into Chinese and given to 13 year old students in Shanghai. The effect of being female is still present, although the effect of being a female Caucasian is much stronger.

The 1998 Profile of College-Bound Seniors National Report (1998) reveals a largely unchanged scenario. The percentages of males scoring high marks on the SAT I: Math is higher than the percentage of females. The distributions of males and females appear to be different (see Graph 1).

Graph 1 **Score Distributions SAT I: Reasoning Test -Math**



The reported sex differences in mathematical reasoning ability as measured by the SAT-M have generated prominent and heated debate.

A Testing Difference

The finding of a gender difference on test scores has far reaching implications for girls. One consequence of the sole use of the SAT is that more boys gain access to these enrichment programs than girls. A report by the American Association of University Women (cited in George, 1997), warned that Talent searches, using the SAT mathematics score, promote a cycle of under-education of girls in these and related fields and under-identify mathematical or scientific talent in girls.

With disturbing frequency, the SAT-I Reasoning Test is being used to select 7th grade students for university-based academic-enrichment programs across the country. Designed for college-admission purposes, the SAT is being misused as the determining criterion for young gifted students to gain access to many campus-based summer courses, international study trips, college-credit courses, mentors or master teachers, scientific field studies,

supplementary learning materials, advanced-placement courses, career-planning conferences, and even high school credit courses. (George, 1997, p.1)

Could the perceived under-achievement of girls, specifically in mathematics be reduced or eliminated by changing testing and talent-identification practices? George (1997) reported that when students were given the SAT under an untimed condition, girls performed significantly better. More importantly, girls scored as well or better than boys indicating they are capable of the work.

Moreover, an interesting association between grades and SAT scores has been found. SMPY females received better grades in their high school mathematics courses than did SMPY males (Benbow & Stanley, 1982). This grade difference does not occur only in the SMPY students.

In the USA girls and young women achieve better grades than boys and men in the courses they take all the way through kindergarten to the Ph.D. level. They tend to score less well, however, on nationally standardised tests (except in languages) than the boys who achieved lower grades. (Stanley, 1993, p. 135)

However, rather than ascribing the better grades of girls to a superiority in mathematics, Stanley attributes girls' success to factors such as homework, attendance, handwriting, language usage and good behaviour. An earlier study by Hall (1977) in the UK also found that while boys outperformed girls on the scholastic aptitude tests, the girls performed better than the boys on individual subject examinations.

The grade differential in favour of girls still exists in the USA. A follow-up of 10,000 freshmen admitted to the University of California between 1986 and 1998 found that among men and women who had the same SAT scores upon entry to the university, the women tended to have higher grade point averages by the time they left. The courses

they took were no easier than those in which their male classmates enrolled (Leonard & Jiang, cited in Viadero, 1998).

Women who take the SAT are still getting higher grades than men in high school. (College Board Online, 1998, p. 2)

True talent searches should look at a range of factors such as grades, academic interests, multiple test scores, and teacher/parent/self nominations. The use of SAT scores alone to qualify for entry to gifted programs and to college courses is indefensible.

The vast majority of mathematically gifted girls, certainly all those who qualify by the talent search criteria, have the intellectual capacity for any math-related position existing today if to their intellectual ability they add the training, confidence, expectations, attitudes, and personality characteristics needed to explore the concepts of number or the beginnings of the universe. (Kerr, 1997, p. 487)

Biology or Sociology?

There has been an enormous amount of debate in the literature as to the cause of the test differences between boys and girls. It has been speculated that the differential exposure to toys and games by girls and boys during childhood could disadvantage girls. Girls had tended to be given more passive toys while boys were given construction type toys. The different types of childhood experiences were thought to have an effect on spatial awareness.

Benbow and colleagues (Benbow & Stanley, 1982, Raymond & Benbow, 1989) concluded that their data support a biological superiority of male mathematics ability, rather than a sociological superiority.

The over-abundance of mathematically talented males, which is the way I like to look at sex difference in mathematical talent, is, I believe, due to prenatal exposure to testosterone. The reason for the difference in patterns of brain activation between males and females is that there is an excess of

males exposed prenatally to testosterone, and they are basically processing information in a different way from individuals not exposed to high concentrations of testosterone. (Benbow & Lubinsky, p. 62)

Some reports focus on a specific male superiority on spatial tasks.

Each year nearly every state reports students' achievement test scores in the larger newspapers. Each year the reports read something like this: 'Boys and girls do equally well in arithmetic computation. On tests of spatial mathematics, boys far outscore girls. (Meeker, 1991, p. 6)

However, the spatial ability-mathematics superiority is not clear cut. A review of the literature by Friedman (1995) found little evidence of correlations between spatial ability and mathematical ability. For most children and youth there was no advantage for boys over girls. However in the gifted population, girls showed a stronger relationship between mathematical skills and spatial ability. Tartre (1990) also found that spatial skill level was more related to mathematics performance for girls than for boys. Friedman also noted that past attempts to improve mathematics performance by training spatial skills have not been successful.

Although spatial factors may play a part in reducing test scores in mathematics in some gifted girls, sociological factors seem to be more important in preventing gifted girls from becoming gifted women and it is critical to identify some of the barriers to success for gifted girls.

The underachievement of mathematically gifted girls.

The career development of gifted young women is of great concern in the field of gifted education. Although there has been a dramatic increase in the percent of women in science and engineering fields, the continued under-representation of women in most fields of science provides graphic proof of under-achievement of gifted women (Davis & Rimm, 1994). One of the barriers to gifted women becoming more involved in non-

traditional careers is their lack of mathematics preparation. It is evident to even casual observers that talented young women have not fully realised their talents in the occupational world (Kelly, 1993). A pattern of unjustifiably low expectations, lack of confidence, social pressure to underachieve and a bias away from science and technology, established during the first years of education in school, is reflected in the higher stages of education (Ayles, 1992). Kerr (1994) argues that gifted girls continue to have less confidence in their mathematical abilities than do gifted boys, and see less relevance of mathematics to their own lives. The result is that a much smaller proportion of mathematically gifted girls actually pursue careers in maths-related fields than do mathematically gifted boys.

Studies have shown that gifted girls are less likely to enrol in advanced math classes, less likely to enter a gifted/talented program voluntarily, less likely to participate in accelerated math courses, and less likely to be interested in science and engineering careers even when they are capable of them. (Kerr, 1997, p. 487)

Junge & Dretzke (1995) found in a study of high-school students that gifted girls were less sure of their mathematics ability than gifted boys. They were less confident of their chances for success in college-level mathematics classes, and were less interested in mathematics related college majors or in pursuing mathematics related careers. Siegle & Reis (1995) found similar results in their study of fourth through eighth grade students. Girls were less positive about their results than were boys. Terwillger & Titus (1995) also found that the attitudes of middle school males towards mathematics was better than that of females. Disturbingly, over two years in an accelerated program, this gap widened. Females had poorer attitudes about mathematics in the areas of motivation, confidence, and the priority they place on doing mathematics.

Actual enrolments in courses still seems to be influenced by an avoidance of mathematics and science courses by girls. Gender differences in course enrolment in the Talent Identification Program Summer Residential Program at Duke University were most marked for mathematics and humanities (Wilson, Stocking & Goldstein, 1994).

Gender differences in course selection clearly emerged in this sample of highly able adolescents, with more females taking language and humanities/social science courses, and more males taking math courses. The stability of these gender differences across ages 12-16 suggests both that gender related preferences in curricular options in special course are well developed by the time students complete their elementary education, and that these preferences may be resistant to change as students progress through high school. (p. 359)

A 10 year follow-up of SMPY students revealed that at age 23 more males than females were entering mathematics/science career tracks. (51% males compared with 30% of females). Less than 1% of females in the top 1% of mathematical ability from SMPY's first cohort were pursuing doctorates in mathematics, engineering or the physical sciences compared with 8% of such males. Similar results were found with other cohorts of mathematically talents students (Benbow & Lubinski, 1993).

Although the situation of mathematically gifted girls has improved (Kelly, 1993), there is still a long way to go. Because a loss of confidence in adolescent gifted girls is at the critical time when they are choosing courses that will determine their career paths many interventions have been offered including a combination of career counselling and mentoring in order to nurture the gifted girl.

Fox and Tobin (1988) offered suggestions for improving attitudes of gifted females, based on research conducted with 24 mathematically talented, 7th grade girls. The girls were involved in exploration of maths-related careers through four mini-courses pertaining to geometry, statistics, probability and computer science. During the program, girls met with women scientists and mathematicians to examine engineering, medical research, and space exploration. Results of pre- and post-measures of attitude and career interest demonstrated a positive impact on the gifted females' mathematics attitudes and career awareness. According to Fox and Tobin (1988) and Kerr (1988), intervention programming should encourage gifted girls to obtain a positive self-concept pertaining to

mathematical concepts. Though not all models developed to promote positive attitudes by females towards mathematics have incorporated the same strategies, all have reported the importance of career awareness in mathematically related fields (Boswell & Katz, 1980; Fox & Tobin, 1988; Shaffer, 1986).

As well as providing information on careers in mathematics and sciences to gifted girls, the encouragement of a mentor is also important. The relevance of mathematics to gifted girls must also be stressed. Benbow and Lubinski (1993) found that mathematically talented males were more theoretically orientated than females. In contrast, mathematically talented females were more socially and aesthetically orientated. Females had more competing interests and abilities, which drew them to a broader spectrum of educational and vocational pursuits.

Conclusion

A multi-dimensional approach to identification will help ensure that girls with potential for high performance are identified, above and beyond those who score well on a single test of mathematical aptitude. Mathematically gifted girls need guidance which counteracts stereotypes about mathematics ability and gender, as well as continued encouragement to persist with mathematics and science. They need role models to provide motivation and information about future careers. Kerr (1994) eloquently summarises the importance of self-actualisation for gifted girls:

The consequences of neglect are truly more severe for gifted girls. If a girl who is average in math decides not to major in mathematics or a math-related field, the loss is not great to her, to society, or mathematics. But if a girl who is extraordinarily gifted in math decides against math, the loss may be great indeed. She may have been the one to discover a new theorem; she may have been the one to understand gravity, or the cell; she may have had the happiness of doing the work for which she is so uniquely suited. (p. 205)

2.3 Identification of Mathematically Gifted Students in New Zealand

Along with the reluctance to use the word gifted, is a reluctance to actively identify gifted children in New Zealand. There is no systematic identification process of children in New Zealand for mathematical giftedness, although there are several tests of mathematical ability that are available to teachers in New Zealand.

Identification tools.

In the early eighties, Palmerston North Teachers College developed a tool for classroom teachers to determine the extent of a child's special ability in mathematics (CSWA Mathematics Indicator Test, 1993). This test was developed as a response to primary school teachers wishing to learn about techniques to identify children who are gifted mathematically. The test includes a teacher's guide, children's response sheets, and answers as well as recommendations for the amount of above grade level work that a child may require, based on the child's performance in the test.

The Progressive Achievement Test (PAT) in Mathematics has been standardised for New Zealand and is used in some primary and secondary schools. This test is norm referenced for age and for class level. It enables a student to be categorised as being in a particular percentile or stanine compared with other students in New Zealand of a comparable age or class level. Some schools use this test to select students for accelerated or enrichment programs.

The Ministry of Education published a book in 1996 giving guidelines and suggestions for development band mathematics. The objectives of development band mathematics are specified in Mathematics in the New Zealand Curriculum (Ministry of Education, 1992).

*The intention of the development band is to encourage teachers to offer broader, richer, and more challenging mathematical experiences to **faster** students. Work from the development band should allow for **better** students to investigate whole new topics which would not otherwise be studied and to*

*work at a higher conceptual level. **Talented** students should have their interest in mathematical ideas further stimulated and their understanding of the nature of mathematics deepened.* (p. 19, bold type, my emphasis)

However, while encouraging teachers to use development band material, no formal method of identification of suitable students is given. In a later book *Development Band Mathematics* (Ministry of Education, 1996), criteria for identification include the following principles:

- all students are considered for development band work
- the identification process does not unfairly discriminate
- the program developed provides opportunities for all participants to succeed.

The identification procedures are very general and further advice is given: *“the identification of the majority of development band students is straightforward. They are the ones who do their work quickly and achieve good results in tests and assignments”* (p. 16).

This recommendation appears biased towards the ‘teacher pleaser’ and may in fact miss some gifted and talented students. Other methods of identification are also provided. The authors advise the classroom teacher to use a mixture of academic assessments, their own evaluations, and parent-, peer-, and self-nomination as well as work that the student has done in solving problems. Four checklists for identifying mathematically able children are given:

- the checklist for Exceptionally Able Children by Cathcart
- the Brisbane South Checklist by H.J.O. Milne
- the Purdue Academic Rating Scale: Mathematics
- the CWSA Mathematics Indicator Test.

The Ministry of Education expects about 25% of students to be involved in development band work at any one time, although the composition of that 25% would change over

time and over the mathematical strands being studied (Development Band Mathematics, p. 8).

In summary, at present the identification of mathematically gifted students in New Zealand is largely left up to individual teachers and to concerned parents. No definitive tests are available, although several tests are recommended in official ministry guidelines.

Identification of gifted and talented Maori students.

There is very little research relating to the identification of mathematically gifted Maori students. Research by Bevan-Brown (1996) emphasised the importance of using many methods to enable the identification of gifted Maori students. She cautions against relying on self-nomination or parent-nomination: “*parents of MCWSA are often reluctant to identify their children as having special abilities for fear of appearing whakahihi or boastful. (The same reason works against successful self nomination)*” (p. 103).

Bevan-Brown (1996) found that many teachers’ attitudes towards Maori children mitigated against the identification of Maori children:

It was believed that many teachers did not expect Maori children to have special abilities and this created a double disadvantage. Not only were potentially gifted Maori children not being recognised and extended by their teachers but also the ‘pygmalian effect’ meant these children were not extending themselves. (p. 104)

Underachievement could well be a problem for gifted Maori students. Not only are the methods used to identify gifted students unsuitable for Maori students, the programs for gifted students do not take into consideration the needs of Maori students (Bevan-Brown, 1996). There was an expectation by Maori that abilities and qualities of a gifted Maori student will be used in the service of others.

2.4 The Development Band

Introduction

The New Zealand Curriculum Framework specifies seven essential areas of learning that are to form the curriculum of all New Zealand children. The curriculum document states explicitly that acceleration of students should be avoided: *A levels structure may be thought to imply that faster students should automatically be accelerated to the next level. This is not necessarily so, nor is it the aim of this curriculum* (Ministry of Education, 1992, p. 19).

The *Mathematics in New Zealand Curriculum* document specifies the development band enrichment program as the most appropriate model for educating gifted mathematics students. As an alternative to acceleration the development band is to be used to provide enrichment material for “faster” students. Students should not be repeating work which they have already mastered.

The development band must not be considered as an optional extra or simply a reward for good work. Students have a right to the opportunity to extend their mathematical knowledge and power. Accordingly, teachers have a responsibility to provide enrichment opportunities to students. (Ministry of Education, 1992, p. 20)

While there is no research- based justification given for discouraging acceleration, *Mathematics in New Zealand Curriculum* reinforces the apparent harm that can result from acceleration.

Faster students can be extended in their mathematical experience without necessarily accelerating them to a higher level, which for many students may itself limit the extent of their learning. (Ministry of Education, 1992, p. 19)

The Development Band in Mathematics

Within the MINZC document the curriculum is divided up into strands and each strand is divided into levels with sample development band activities. In 1992, the new curriculum emphasised a problem solving approach and constructivism was the ideology behind the suggested learning/teaching styles. Many teachers, although very supportive of the new curriculum, had to make major adjustments to their teaching styles and resources. In the first instance the special provisions in the new curriculum for development band activities received little emphasis in nationwide professional development programs. However, some support for the development band was provided in 1996 with the publication by the Ministry of Education of *Development Band Mathematics*. This book offers starting points and examples that teachers and schools could use in developing their own programs to suit the needs of the students. The discouragement of acceleration as an educational option for gifted students is reiterated:

For all but an exceptional few, enrichment provides better opportunities for talented students to achieve their potential. The development band is not designed to hold students back but rather to increase their understanding and knowledge in mathematics and to help them develop higher order thinking skills. (Ministry of Education, 1996, p. 8)

Although the necessity for making provisions for talented young mathematicians is clearly spelt out, the delivery of such a program is still the responsibility of individual teachers and schools.

It is important that schools make a decision about how they will cater for development band students. The school approach should be noted in the appropriate policy or plan so that teachers and parents know what provision is being made for these students. The goals of a school's development band programme should be clearly defined, and the programme should be evaluated regularly. (p. 9)

The need for such a policy is reinforced by Taylor (1996).

Programming can occur without a written policy, but runs the risk of being ad hoc, and 'add-on', and may only continue so long as certain dedicated personnel remain on the staff. (p. 119)

Currently, there is no research to provide information on how many Departments of Mathematics have written policies specifying the goals and the evaluation methods of the development band program, but it is unlikely that this process is well advanced. Many schools still have no policy on educating the gifted (McAlpine, 1992), although departments within the school may well make provisions for gifted education in specific subject areas.

The limitations of time, resources and knowledge for teachers to implement the development band program prompted the New Zealand Association of Mathematics Teachers (NZAMT) to develop material for the development band. NZAMT believed that a significant number of students were not being provided with appropriate extension work (Wallace, 1998). A certificate program was developed that NZAMT felt would be suitable to use with whole class activities, individual students, mathematics clubs or as part of the teaching program. The response to this program has been enormous (Wallace, 1998) and the certificate courses now run from Year 4 to Year 12.

These Development Band Certificate courses are enrichment courses. The material is provided to enrich the particular strand of mathematics being studied, rather than extend to the next level. Each Year level booklet contains units of study that are based on problem solving activities. Many of the activities are open ended and encourage higher order thinking.

The development band as a curriculum model

There are many research based curriculum models available to use in the development of programs for gifted children, but there is little available research on the existence of such programs in New Zealand. A common thread in the programs for gifted children is that there needs to be a differentiated curriculum.

Unless programmes for gifted and talented students at secondary school are based on principles of learning and teaching that reflect a sound differentiated programme they may resemble little more than a patchwork of practices. (Macleod, 1996, p. 171)

In order for a program to be effective, it must be specified why a program is necessary, what it should provide, when and where provisions for the program should be made available, how these provisions will be put into operation and who will be responsible for implementing these provisions (Macleod, 1996).

Likewise, Riley (1996) states that each curriculum model should have:

- an identified purpose
- underlying explicit or implicit assumptions about the characteristics of learners and the teaching-learning process
- guidelines for the development of specific learning experiences
- clearly defined patterns and requirements for these learning activities
- a body of research surrounding its development.

The development band in mathematics satisfies some of these requirements. The identified purpose of the model is to offer broader, richer, and more challenging mathematical experiences to faster students (Ministry of Education, 1996). The characteristics of the learners are described as faster, talented, able. In *Development Band Mathematics* (1996) several methods of identifying students for development band work are given, as well as suggested teaching methods. The responsibility for implementing the development band, while theoretically that of the Boards of Trustees, seems to rest with the classroom teacher. This is where the concept of the development band as a curriculum provision for gifted students runs into difficulty. Unless professional development time and resources are readily available, it seems likely that such provisions will rely on the interest, ability and enthusiasm of the classroom teacher. As such, the impact of teacher beliefs about provision for our most able students is relatively unknown in New Zealand.

Where the development band is taken seriously and where rich mathematical activities are provided, some enrichment does take place. But it is not clear what percentage of teachers see the need to provide additional and/or separate work for their most able students. (Holton, 1998, p. 13)

Administrative support is also necessary to facilitate the program and issues of teacher preparation and training need to be addressed. Without clear policy, guidelines, and curriculum materials, the development band program depends on the strengths and weaknesses of individual teachers.

From my own experience and the experience of colleagues both here and in a number of other countries, the vast majority of able children have no special provision made for them. Any assistance they receive is the result of being lucky enough to have a sympathetic teacher who has some supportive suggestions. (Holton, 1998, p. 10)

Thus, the development band in mathematics satisfies some of the criteria for a good curriculum model for gifted students. It has an emphasis on higher order thinking, a problem solving approach to learning and it can be used by individuals or in small groups.

However, in order to provide an educationally sound program for mathematically gifted students in New Zealand, there needs to be the provision for acceleration of students to the next year's content (where appropriate). Otherwise the enrichment offered may just be more of the same. While the development band activities may contain variety and a wide range of activities, the level of understanding may be no different from the normal program and consequently lack additional challenge.

2.5 Acceleration

Definition.

Acceleration is generally used to describe programs that emphasise moving through the curriculum at an increased rate, while enrichment places an emphasis on increased depth and breadth (Moltzen, 1995, cited in Fraser, Moltzen & Ryba, 1995). Acceleration can take many forms, from early entry to school, to sitting a national examination ahead of same-age peers. Reid (1991) describes acceleration as an administrative or instructional provision designed to speed the process of academically able students through the formal education system. Acceleration may involve skipping classes, telescoping or compacting the curriculum. Acceleration could mean acceleration to an above-age class or it could refer to advanced academic or intellectual activities with the same-age group.

Accelerated learners are described by Braggett (1992) as those who can “*progress at a faster pace than normal and forge ahead of their age peers in some aspect(s) of their learning and/or those who can work at a deeper level than their age peers*” (p. 19).

Positive aspects of acceleration.

The debate on the use of acceleration has centred on both the academic outcome and the social and emotional effects of acceleration for the student. Sowell, 1993, reviewed empirical research from 14 studies on acceleration for mathematically gifted students.

Studies that featured accelerating the curriculum for mathematically gifted students showed consistently that mathematically gifted students can learn mathematics very well and much more quickly than the regular mathematics curriculum allows. (p. 125)

Moreover, in a review of studies on acceleration, Benbow (1991) was unable to find one scientific investigation that showed that acceleration produced harm to the social and emotional development of gifted students: “*all recent reviews, as well as earlier ones*

not discussed here...converge in their conclusions. It is as true three decades later as it was in 1958 when Goldberg pointed out that it is difficult to find a single research study showing acceleration to be harmful. Rather, many studies have revealed acceleration to be a satisfactory method of challenging more able students. Put more simply, "accelerated students do better than non-accelerated students (Gowan & Demon, 1964, p. 194)" (p. 28).

A best evidence synthesis on the research on twelve accelerated programming options for gifted students was conducted by Rogers (1991). The options were early entry to school, grade skipping, non-graded classroom, curriculum compression/compacting, grade telescoping, concurrent enrolment, subject acceleration, advanced placement, mentorships, credit by examination, early entry to college and combinations of the above. Rogers found there was a significant academic effect of non-graded classrooms for gifted students and only a trivial, positive effect on socialisation and psychological adjustment. Curriculum compression/compacting showed a substantial Effect Size¹ for academic outcome (ES = +.45). Grade telescoping had an Effect Size of +.56 for the academic effect, a small improvement in socialisation of +.22, and a trivial, negative effect on self-concept. Subject acceleration had an academic Effect Size of +.49. Advanced placement had an academic effect of +.29, a socialisation effect of +.24 and a psychological effect of +.07. Early admission to college had an academic effect of +.44 with trivial effects on socialisation and psychological adjustment.

Moltzen (1995) supports these findings with a claim that: *"the weight of evidence supporting acceleration is overwhelming and cannot be ignored by educators ... The overwhelming evidence from research is that careful and considered acceleration does not result in ...negative side effects, and in fact some researchers argue that there is a*

¹ Effect size is the difference between two groups in standard deviation units. For practical purposes, effect sizes larger than about .30 indicate a practically significant difference between an experimental condition (e.g., ability grouping) versus its control (e.g., heterogeneous classes)—approximately three months additional achievement on a grade-equivalent scale (Davis & Rimm, 1994).

greater chance of damage to many children socially, emotionally, and academically by not accelerating them” (p. 292).

Another accelerated mathematics program that showed a significant improvement in achievement was a flexibly paced mathematics program (Mills, Abland & Eustin, 1994) involving third through to sixth grade mathematically talented students. The program's success was largely credited to the specific attention to grouping of students. Although academically talented students have abilities and skills that are highly discrepant from most of their age peers, they do not constitute an entirely homogeneous group. The range of ability and prior knowledge among a group of students who all score in the top 3 percentiles on a grade appropriate test is as great as that found within a general population of students. Grouping students for an accelerated class by general ability level alone is often not sufficient without further differentiation to accommodate such differences in more specific ability. It was only through above level testing that the actual variability and full extent of their knowledge became apparent. The organisers of this program believe that the optimal learning environment would be when the level of material and the pace of instruction are individually matched with ability and paced slightly above the students' current level of performance. After exposure to the flexibly paced mathematics class, these academically talented students, on average, performed better than 80% of a normative sample of students 3 grade levels higher than their own.

A study by Smith (1996) compared the characteristics of students who took an early algebra course to their counterparts who took the course in high school. Accelerated students were less likely to be from minority groups and more likely to be from families of higher socio-economic status. They had higher maths achievement scores in grade 10, higher educational aspirations in grade 10 and were more likely to be in the academic track. They took a full year more of advanced maths, were more likely to take a math course during their senior year, were more likely to have taken calculus, and had higher senior year achievement scores in maths. When social background and aptitude and achievement at 10th grade were controlled for, early access to algebra still had an effect of between a half to a third of a year more maths taken at high school. Maths

achievement was similarly affected, when controlled for social background and aptitude at 10th grade. Smith concludes that “*early access to algebra has a sustained positive effect on students, leading to more exposure to advanced mathematics curriculum and, in turn, higher mathematics performance by the end of high school*” (p. 148).

Evaluations of accelerated mathematics programs for clearly defined student populations have shown positive results. Kolitch & Brody’s (1992) study investigated the mathematics preparation during grades 7-12² of a group of students identified at an early age as demonstrating extremely high mathematical reasoning ability. The focus of the study was to assess the effects of acceleration in mathematics on student achievement and interest in mathematics. Acceleration in mathematics in this study is defined as taking mathematics courses out of grade level. The study found that the highly talented students performed extremely well in all of the courses, including college courses, they took while in school. There was little evidence of burnout in this group.

There are sound theoretical rationales for acceleration (Benbow, 1991). Learning is a sequential and developmental process. There are large differences in the learning status among individuals at any given age. Effective teaching involves assessing the student’s status in the learning process and posing problems slightly exceeding the level already mastered. Benbow argues that acceleration is a productive and practical means of providing such a match.

Acceleration is consistent with theories on learning and achievement motivation. Building upon work in cognitive psychology, one can argue that acceleration has the potential to enhance creativity, outstanding achievement, and higher-order thinking skills. Finally, acceleration can be justified on social and emotional grounds. Gifted students are socially mature and prefer older friends. (p. 27)

² See Appendix 1

Data from the Study of Mathematically Precocious Youth (SMPY).

A large body of data on the mathematical acceleration of gifted children has come from the work initiated by John Stanley in *The Study of Mathematically Precocious Youth* (1991). This study was begun at the John Hopkins University in 1971. The original goal of the study was to identify those students who before the age of 13 exhibited exceptional well mathematical reasoning. The testing instrument was the mathematic section of the College Board Scholastic Aptitude Test. (SAT-M). The aim of the program was to shorten dramatically the amount of time required to complete the four and a half years of pre-calculus at high school.

The students in the SMPY program were tested using above grade level testing techniques. They were accepted into the program if their mathematical reasoning ability as measured by the SAT-M was very high. As the SAT-M is used for testing high school students on entry to college, it was argued that an eleven or twelve year old scoring highly on this test exhibited exceptional mathematical reasoning ability. Once their qualification for the program had been established, they were tested again to establish their specific mathematical achievement. The program entailed fast speed of classroom instruction in a lecture format and extensive homework. This enabled students to move through the mathematics curriculum quickly (Sowell, 1993).

Stanley says of the program:

for many of the students enrolled, the classes proved a godsend because they enabled these youngsters to avoid the boredom, tedium, and frustration of the regular mathematics curriculum, which proceeded at a snails pace for them. Figuratively, they were starved for mathematics at the proper pace and level and rejoiced in the opportunity to take it straight rather than being "enriched" with math puzzles, social studies discussions, trips to museums, critical thinking training not closely tied to mathematics and so forth. (p. 37)

SMPY accelerated students have been studied extensively. A ten year longitudinal study compared the accelerated students with matched, equally gifted students (Swiatek & Benbow, 1991). The accelerates were defined as those who enrolled in College at least one year early; the non-accelerates were those who pursued a traditional educational route. Academically, both groups demonstrated high achievement, were satisfied with their educational achievements and were psychologically well adjusted. Once enrolled in college, the accelerates were able to perform as successfully as the non-accelerates. This is inconsistent with the claim that acceleration leads to gaps in knowledge of the participants. The accelerates did not appear to slow their college education, take time off before pursuing graduate studies, or plan to stop their educational pursuits. They were not more likely than unaccelerated students to experience burnout. Female participants were significantly more likely to attend graduate school than non-participants. The mean level of self-esteem was significantly higher for non-participants, although the average self-esteem in each group was positive. No difference was found between groups in attitudes to mathematics and science. Both groups had positive attitudes to these two subjects.

A further longitudinal study of this group of students was carried out to investigate predictors of high academic achievement (Benbow & Arjmand, 1990). High academic achievement was defined as students who reported attending graduate school full-time in mathematics or science or medical school. Low academic achievement was defined as those who majored in science but finished with a low grade average or who dropped out of college, or never began college, or who did not complete high school. The findings predicted that those with high SAT scores at age 12 will very probably perform well academically in the future. 52 % of all male and 44 % of all female students identified by the talent search were pursuing scientific/medical careers ten years later. Schooling variables had the greatest effect on achievement, although family background and encouragement variables were also important influences on high achievement. Ability in 7th and 8th grade was not a good predictor of subsequent high versus relatively low achievement.

Overall, Benbow and Arjmand (1990) argued that intervention programs have profound effects on achievement levels. They conclude that “*intellectually talented students will not achieve as highly if not provided with appropriate educational opportunities.*” (p. 437). This contradicts conventional wisdom that intellectually talented students make it on their own.

In a similar vein, Benbow (1991) argues that lack of opportunities to accelerate can have a negative impact on a student. Many gifted students achieve below the level of their potential if not provided with an appropriate education. Data from SMPY’s longitudinal study has revealed that gifted children do not achieve as highly if not provided with appropriate educational opportunities.

As well as demonstrating positive learning outcomes, proponents of the SYMPY’s program promote several arguments in favour of acceleration. Acceleration does not provide the gifted with unfair advantages, as it involves using already available resources, curricula, or programs designed for older students but with younger gifted students. Accelerated costs little for a school system to adopt and it may be an optimal method for serving students in small schools. Acceleration may save the students money and/or lengthen their professional lives.

Although acceleration as a curriculum process for gifted students is well supported by many research studies, it is widely accepted that an ideal curriculum model should also include enrichment. The model advocated by VanTassel-Baska (1997) includes three interrelated curriculum dimensions, each of which is responsive to a very different aspect of the gifted learner:

1. Advanced content knowledge that frames disciplines of study.
2. Providing higher order thinking and processing.
3. Focussing learning experiences around major issues, themes, and ideas that define both real-world applications and theoretical modelling within and across areas of study.

VanTassel-Baska also advocates the tailoring of the curriculum for gifted learners through:

- provisions for acceleration and compression of content
- use of higher order thinking skills
- integration of content by key ideas, issues and themes
- advanced reading level
- opportunities for students to develop advanced products
- opportunities for independent learning based on student capacity and interest
- use of inquiry based instructional techniques.

Educator scepticism about acceleration.

Although research evidence seems overwhelmingly in favour of acceleration, there is much educator scepticism about acceleration (Benbow, 1991).

Considering that the body of literature spans five decades and has consistently associated the acceleration of precocious young children with positive changes in their academic achievement and a lack of negative effects on social and emotional growth, one might conclude that the questions regarding the advisability of acceleration have been conclusively resolved. (Southern, Jones & Fiscus, 1989, p. 29)

Concerns relate to the social and emotional development of accelerated students, deprivation of valuable non-academic experiences, gaps in their knowledge or poor retention as a result of accelerated content delivery and lack of suitable role models for the remaining students when the gifted are removed.

Southern, Fiscus and Jones (1989) conducted a postal survey of elementary school principals, teachers, school psychologists and coordinators of gifted programs. A Likert Scale was used to rate the extent to which they agreed with the presumed effects of acceleration using constructs of academic adjustment, social development, emotional development, and inhibition in the development of leadership. Ratings for all groups

tended to fall close to the midpoint, but opinions on items dealing with certain potential difficulties for acceleration were consistent and on every item coordinators were more positive than practitioners. Not many teachers thought that acceleration would result in academic failure or adult instability. Social and emotional concerns generated the greatest reservations among the participants. Follow-up interviews revealed that the most important factors in determining negative attitudes toward acceleration were those associated with social and emotional adjustment. Concerns about the academic welfare of the potential accelerant did not figure prominently in the development of attitudes towards acceleration. When the respondent in the survey had personal or family experience with acceleration, a more favourable attitude was more apt to be reported.

The New Zealand situation.

New Zealand educators seem to have mixed feelings about acceleration. While it is a relatively common practice in secondary schools, there is a preference for enrichment, rather than acceleration (Moltzen, 1996).

Holton and Daniel (1996) state that a benefit of acceleration is to reduce the frustration that talented students often feel if they are only able to work with their age cohort. By letting them work at a higher level, they are able to move more quickly and at a level which is more appropriate to their ability. However, problems with acceleration can arise when the material studied may be ahead of the age level, but the level, speed and sophistication of the delivery may not be very different. Also, Holton and Daniel warn that a fundamental area of mathematics or a fundamental concept may be missed in grade acceleration.

Holton (1995) advocates problem solving in the classroom as a way of extending talented students without removing them from their age group. He maintains that all students in the class can be engaged at a level appropriate to their ability. While most students are tackling the original problem, the more talented students can easily be seeking and solving generalisations and extensions.

The results of a survey of students who had attended a Mathematics Olympiad training camp between 1987-1992 (Holton & Daniel, 1995) indicated that these students were still not being catered for adequately in New Zealand classrooms. Many of these students had found school mathematics too easy, boring and repetitive. However, these students also showed little enthusiasm for acceleration at the secondary level unless it was with a peer group. The style of teaching was more important to the student, with criticism being directed at teachers that showed displeasure outwardly with a student who was 'too' advanced, or who disputed the teacher's methods.

Reid (1991) is a strong New Zealand advocate for acceleration. He maintains that acceleration of students to higher grades enables students to outperform students of the same age and ability who are not accelerated.

However, Townsend (1997) reports that there is evidence that children who are gifted but not accelerated exhibit more behavioural problems, feel less comfortable in school, and have poorer attitudes toward school.

Townsend and Patrick (1993) conducted a survey of New Zealand teachers in Auckland primary schools and teacher trainees at the end of their three year training as to their attitudes to acceleration. Their responses were very similar to those of Southern, Jones and Fiscus (1989).

While respondents were moderately positive that gifted children would be able to cope with the increased academic demand of acceleration, the majority held conservative views about the social and emotional outcomes of acceleration. Only 9 % of this sample accepted that age retention might be potentially harmful. The respondents frequently commented in the free response section at the end of the questionnaire urging a conservative approach to acceleration. The "*the primacy of the regular classroom programme as the first option was also reflected in comments about the need to protect the child's social and emotional needs, and to retain contact with the same age peers*" (p. 38).

Responses to the survey suggest that programs offering special attention to already talented students are viewed by many people as elitist and socially divisive.

... it seems clear that the accumulation of research evidence, particularly in recent years, supporting positive academic and psychosocial effects for acceleration has not been communicated to teachers and teacher trainees.

(Townsend & Patrick, 1993, p. 39)

2.6 Ability Grouping

Definition.

Ability grouping of gifted children is perhaps an even more widely debated issue than that of acceleration. What is ability grouping? Van Tassel-Baska (1992) defines it as "*the organisational mechanism by which students of proximate ability levels within a school curriculum are put together for instruction*" (p. 68).

Ability grouping is the separation of children at the same class level into more or less homogeneous groups based on general ability, specific aptitude, scholastic achievement, or curriculum competencies. It is not a single organisational procedure. It may involve separate classes of high-, average- and low-ability students, single-subject grouping, cross-class grouping in curriculum areas like mathematics and language arts, remedial groups, accelerated classes, and within-class groupings. Ability grouping can involve tracking, where the same group take all classes together.

Positive aspects of ability grouping.

Recent studies, meta-analyses and best evidence syntheses report the positive effects of ability grouping for gifted students.

Slavin (1987) conducted a best evidence synthesis of ability grouping. He found variable effects for between class grouping. When students remained with the same ability

grouped class for all academic subjects, the effect on achievement levels was negligible. However, ability grouping only for reading and/or mathematics was found to be a more effective practice. The advantages were that the students remain in a mixed ability setting most of the day, so they were unlikely to develop any negative feelings associated with streaming. They were also grouped solely on the basis of their achievement in reading or mathematics so a meaningful reduction in heterogeneity in the skill being taught is possible. Slavin found that regrouping is effective if the instructional level and pace are adapted to the level of the students, and students should be regrouped for only one or two subjects.

Slavin (1987) also found that within class grouping was effective in mathematics and the effects were higher for low achievers than for average and high achievers. The effects tended to be more positive when the number of ability groups was two or three rather than four. Cooperative learning was another effective strategy. This was effective when the cooperative learning methods provided the group with rewards based on the individual learning of all the group members. There were no positive achievement effects when students completed a single group work-sheet or other group product.

Allan (1991) re-examines the techniques employed in Slavin's best evidence synthesis. She points out a methodological problem that applies primarily to the gifted (the top 3-7%) and to a lesser extent to the high-ability group (the top 33 %). The problem is the ceiling effect resulting from use of standardised scores. The scores of gifted children usually approach the ceiling on standardised achievement tests, making it very hard to show significant academic improvement on their part. Standardised tests also do not necessarily reflect the teaching program.

Allan criticised Slavin's best evidence synthesis because it only included grouping studies that used the same materials and curriculum for all groups of students and excluded all studies of ability grouping for gifted children. Allan says this is

... not supported by any segment of the education profession. But it appears that some researchers are attempting to ask the 'pure' research question of whether grouping as a single isolated factor has any effect on student achievement. The answer, not surprisingly, is mixed, although generally positive. However, this is not the question that educators and parents are asking. They want to know whether grouping, with appropriately differentiated instruction, has an effect on student achievement. When that question is addressed, the results provide a stronger positive answer in both math and reading for all groups of students. (p. 62)

Allan concludes that gifted and high ability children show positive academic benefits from some forms of homogeneous grouping. The best results for the gifted are from either acceleration or from classes designed especially for the gifted that used a differentiated curriculum. However, she argues that while average and below-average ability children may benefit academically from certain types of grouping for specific subject areas, there is little benefit from wholesale grouping by general ability. The evidence does not support the contention that children are academically harmed by grouping, although there is evidence to suggest that students' attitudes toward specific subjects are improved by grouping in these subjects. The effects on self-esteem are small but positive for low-ability children and slightly reduced for average and high-ability children.

Hallinan (1990) has also responded to Slavin's best evidence synthesis.

The fact that the studies Slavin examines show no direct effect of ability grouping on student achievement is not surprising. The studies compare mean achievement scores of classes that are ability grouped to those that are not. Since means are averages, they reveal nothing about the distribution of scores in the two kinds of classes. Ability grouping may increase the spread of the test scores while leaving the mean unchanged. (p. 501)

Hallinan is critical of Slavin's findings because she believes that there is a wealth of social science research that shows that ability groups favour high ability students and disadvantages low ability students (p. 503).

Several meta-analyses on ability grouping have also been carried out by Kulik and Kulik (1982, 1984, 1985, 1990). Their 1984 review of ability grouping in secondary schools concluded that ability grouping had near zero (not negative) effects on the achievement of average and below average students. While they contend that ability grouping did not harm average or below average students, they noted that students assigned to grouped classes for work in specific subject areas responded more favourably to these subjects than did similar students assigned to heterogeneous classes.

In 1984 Kulik and Kulik published the results of their review of elementary school studies. They found that the average Effect Size was +0.19 for ability grouping, but for gifted students the Effect Size was +.49. The effect on self concept was trivial. Their more recent studies (1985, 1990) looked at inter-class ability grouping. Here, high ability students had an Effect Size of +.30 while the effect on average and below average groups was negligible. The effect of grouping on self-esteem of all groups was near zero, although the average- and above-average groups were slightly negative while the low-ability group was slightly positive.

A meta-analysis on gifted pull-out programs was published by Vaughn in 1991. He found an achievement outcome Effect Size (ES) of +.65, a critical thinking differences ES of +.44, a creative thinking assessments ES of +.32 and a self-concept ES of +.11. Vaughn found that when resources are selected to reflect what has been offered in the treatment condition, Effect Sizes are significant and positive. It is possible that the small Effect Sizes reported in previous syntheses may be due to the lack of validity in instrument selection.

Sowell's (1993) review of the empirical research on grouping mathematically gifted students found that gifted students that spent more time with gifted peers performed

better than gifted students on a part-time gifted program or in heterogeneously grouped classes.

Likewise Rogers (1991) review of thirteen studies conclude that the most important guideline for serving the needs of gifted and talented students should be that these students should spend the majority of their school day with others of similar abilities and interests.

... it is very clear that the academic effects of a variety of long and short-term grouping options for both the purposes of enrichment and acceleration are extremely beneficial for students who are academically or intellectually gifted or talented. (p. 25)

Van Tassel-Baska (1992) argues that the achievement of gifted students at both elementary and secondary levels is enhanced by a variety of forms of ability grouping. The achievements of other groups of learners appears to be unaffected by grouping the gifted in such ways. However, ability grouping without curriculum and instructional provisions has no effect on any group of learners. The benefits of ability grouping appear to be activated through a differentiated instructional plan based on student level of readiness. According to Van Tassel-Baska, cooperative learning models do not enhance the achievement of the gifted unless some form of ability grouping is employed. Mixing low-ability and high-ability students together typically results in no growth for the high ability. She concludes that ability grouping should be used in gifted programs.

Negative aspects of ability grouping.

There has been a strong backlash, particularly in the United States against ability grouping (Oakes, 1985).

It is thought that the system of tracking has had a serious, negative impact on the academic achievement of students and has invoked widespread condemnation of ability grouping. Criticism includes claims that:

- elitist identification practices and definitions of giftedness create school
- segregation by economic class and cultural groups.
- the most motivating and challenging curriculum is found in programs for the gifted
- the best trained and most effective teachers work with the gifted, denying the
- benefits of these teachers to students of other abilities. (Oakes, 1985).

According to Oakes (1985), students in the top track gain nothing from grouping, and other students suffer clear and consistent disadvantages, including loss of academic ground, self-esteem, and ambition. Oakes believes that tracking, which is only one form of ability grouping, is unfair to students because it denies them the right to a common curriculum.

However, evidence from ethnographic studies such as that of Oakes(1985) have received some criticism.

Ethnographers have reported that in lower track classes the curriculum is debased, teachers are inexperienced, and instruction is poor; but careful scrutiny of the ethnographic evidence provides little support for such interpretations. When ethnographers have quantified their observations, for example, differences between instruction in upper and lower track classes appear to be small. The interpretation of the differences is also unclear. The reported differences between upper and lower track classes may simply indicate that teachers try to adjust the pace of their instruction to the preparation of their students. (Kulik & Kulik, 1997, p. 240)

A recent study in England (Boaler, 1997) also questions the educational justification for setting or streaming³. Boaler contends that the placing of students in academic groups often results in the fixing of their potential achievement, although ability itself is not a

³ Setting or streaming is ability grouping for all subjects at once.

fixed quantity, arguing that the use of ability grouping is an inefficient system, as it misses a substantial number of talented students and favours a social elite.

Using longitudinal case studies Boaler compared the outcomes of two quite different schools. One school set by ability for mathematics and the other school had mixed ability classes. Students from the school with set classes were clear about their reasons for disliking setting. These were:

- *a lack of understanding when the pace of lessons was too fast*
- *boredom when the pace of lessons was too slow*
- *anxiety, created by the competition and pressure of set environments*
- *disaffection related to the restricted opportunities they faced*
- *perceived discrimination in setting classes* (p. 135).

Not only did the students feel negative towards setting, the national results achieved by both school showed that the mixed ability school performed better than the streamed school.

However, these results are from only two schools and wider ranging research is needed before generalisations can be made, as a lot of other factors such as teaching styles, classroom cultures, student and teacher expectations influence learning as well.

The New Zealand situation.

There has been resistance to homogeneous classes in New Zealand state schools, although almost every school practises segregation on the basis of ability in sporting and sometimes cultural activities. A substantial group of secondary schools stream, set, band or group students on academic ability (Reid, 1991).

Reid (1991), a New Zealand researcher, contends that for most children it matters very little what sort of class grouping we use. However, "*for the gifted and talented it does matter*" (p. 97) and Reid cites overseas research to support his position.

He argues that gifted students benefit greatly from work in accelerated classes, from an enriched curriculum, from spending the majority of their school day with others of similar abilities and interests. Likewise he suggests that all students profit from groupings that adjust the curriculum to the aptitude levels of the group.

Holton and Daniel (1996) found that these students frequently emphasise their need to spend time with their intellectual peers. They noted that larger New Zealand schools are more likely to group talented students (streaming), whereas with smaller schools such opportunities are more difficult to organise.

2.7 Conclusion

It would appear that the research provides support for the use of both acceleration and enrichment techniques, combined with ability grouping, would seem to provide the optimum program for the education of the gifted.

The best models provide accelerated, enriched, and challenging learning experiences that help gifted youth clarify their talent strengths and potential and give them opportunities to move ahead in learning to higher levels and at a pace that fits their abilities. (Feldhusen, VanTassel-Baska & Seeley, 1989, p. 119)

The authors also recommend that a mathematics curriculum for gifted students be fast-paced and emphasise concepts rather than procedures.

Van Tassel-Baska (1992) insists that acceleration and grouping must be the basic requirements of a quality gifted program. She reiterates that recent studies continue to show positive results in cognitive development from acceleration and no negative effects on social and emotional development.

A combination of enrichment and acceleration for gifted students is supported by Schiever and Maker (1997). They say that meeting the needs of gifted students requires

that abstract and complex concepts be taught (enrichment) and that students proceed at a pace more rapid than that of the average learner (acceleration). The level of material and the pace of instruction are dimensions of acceleration that mesh with the inclusion of enriched learning within a problem solving approach to curriculum development. More support for a combination of enrichment and extension comes from Davis and Rimm (1994).

Learning activities can be enriched and accelerated - to fit student capabilities and learning needs, develop creativity and thinking skills, reduce boredom and frustration, and combat underachievement habits by inviting gifted students to work and think for a change. Equally important is the opportunity to interact with others like themselves for social and academic support. (p. 136)

The identification of mathematically gifted students in New Zealand and the development of appropriate programs for them is necessary if the abilities of such students are to be developed to their full potential. Programs for such students should have a differentiated curriculum and the pace of delivery should be matched as closely as possible to the pace of learning for all students. While neither acceleration nor ability grouping impact adversely on low- or average-ability groups, both practices have a clear, positive impact on the academic achievements of high-ability students. Overseas research is overwhelmingly in favour of both acceleration and ability grouping for gifted students. The New Zealand dichotomy of excellence versus equity needs to be resolved so that a synthesis of the two can be used to ensure the best possible education of mathematically gifted students in New Zealand.

CHAPTER 3

3. RESEARCH DESIGN

3.1 Introduction

The basic premise of this research was that there was a need for data to be collected to inform debate on the mathematical programs available to the gifted and talented in New Zealand today. There has been no prior nationwide survey of the programs available in New Zealand secondary schools. Such a large scale collection of data meant that a quantitative approach was more useful than a qualitative approach. Although the subjective experiences of individuals undoubtedly are important, the focus of this research was on quantifying the numbers involved in programs for gifted and talented students, the types of programs available and in summarising the demographic factors associated with acceleration.

The scientific researcher employs objective, systematic investigation with analysis of data in order to discern what is actually the case (Burns, 1997). However the decision to use quantitative methods is not without its costs. The issues involved in this research are complex and have aroused strong ongoing debate in educational circles. Quantitative research fails to take account of people's unique ability to interpret and reflect on their own experiences. Also, a scientific approach cannot be entirely objective, as the researcher will bring their own belief structures to their research, and respondents will answer the survey questions according to their own interpretation of the questions.

In order to partly offset the problems inherent in a purely quantitative approach, a decision was made to include semi - structured interviewing to provide more in - depth information on the issues involved in the survey. Accounts derived from interviews are studied for themes and the advantage of interviews is that they provide illustrative data, which give a sense of reality, describing exactly what the interviewee feels and perceives (Burns, 1997).

3.2 Data Collection Methods

The Questionnaire

According to Burns, the survey is the most commonly used descriptive method in educational research. Cohen & Manion (1994), agree that the postal questionnaire is the best form of survey in an educational enquiry and question the myth about low response rates to postal surveys.

Research shows that a number of myths about postal questionnaires are not borne out by the evidence (see Hoinville and Jovell, 1978). Response levels to postal surveys are not invariably less than those obtained by interview procedures; frequently they equal, and in some cases surpass, those achieved in interviews. (p. 96)

Mailed questionnaires have the advantages of being easy to administer and of being standardised. All respondents are given the same questions and their responses can then be easily compared. Questionnaires can be more reliable than interviews because there is the possibility of answers being given with greater honesty, because of anonymity. Disadvantages to a postal survey are that the responses have to be accepted as given and there is no chance to check that the questions have been interpreted according to the researcher's intent.

A descriptive survey was used in this research, with the aim of estimating as precisely as possible the range and nature of the existing programs for gifted and talented students in New Zealand secondary schools. There was no attempt made to ascertain cause and effect, so hypothesis making and correlational analysis was not a part of this research.

The entire population of New Zealand secondary schools was surveyed, which included area schools and Year 1 to 13 schools. For descriptive surveys, representative sampling of the population is crucial since without representation, estimates of the population statistics will be inaccurate. The difficulty with a high non-response rate is that the data

may be biased. Non-response can result in a data gap that distorts the real situation. Considerable effort was made to obtain a good response rate. The questionnaires (Appendix A) were sent out with a covering letter (Appendix B), and included a stamped addressed envelope. A follow-up letter with further copy of the questionnaire and another stamped addressed letter was sent to non-respondents.

The wording of the questionnaire was designed for clarity and simplicity. Respondents were given clear instructions and leading questions, complex questions and confusing questions were avoided. The practices of good questionnaire design (Cohen & Manion, 1994) were followed, with the initial questions kept simple, while the middle section of the questionnaire contained the difficult questions, and the last few questions were of high interest in order to encourage the respondents to return the completed questionnaire. The questionnaire was pre-tested by some local Heads of Mathematics and adjustments were made as a result of the pre-testing.

The Interview

Informal interviews are used where the interviewer may have a number of key issues which are raised in a conversational style (Cohen & Manion, 1994). Such interviews are used to gather information having direct bearing on the research objectives and can be used as an explanatory device to help identify variables and relationships. Informal interviews are used to probe the motivation of respondents and their reasoning for responding as they do. In semi-structured interviews, a direction is given to the interview so that the content focuses on the crucial issues of the study. This gives greater flexibility than the closed type of questions and permits a more valid response from the informant's perception of reality (Burns, 1997). In particular, respondents can use language natural to them, rather than trying to fit in with the constraints of the study.

Burns cites several other advantages of interviews. The most important advantage is its flexibility. The interviewer has the opportunity to observe the subject and the total situation to which they are responding. Questions can be repeated and their meaning

explained. The interviewer can also press for additional information when a response seems incomplete or not entirely relevant.

However, a number of problems have also been identified with the use of interviews as a research technique (Cohen & Manion, 1994). These problems are associated with the attitudes and opinions of the interviewer, a tendency for the interviewer to see the respondent in their own image, a tendency for the interviewer to seek answers that support preconceived notions, misperceptions on the part of the interviewer of what the respondent is saying, and misunderstandings on the part of the respondent on what is being asked. Rather cynically, Cohen and Manion are of the opinion that interviewing procedures are based on the mistaken assumption that the person interviewed has insight into the cause of their behaviour.

The use of semi-structured interviews was included in this research as a minor counter-balance to the large scale collection of quantitative data. The selection of respondents was not random, and each of the three respondents were from the same geographical area. Schools were selected in order to provide a cross-section of approaches to accelerant programs and each had a different experience with the use of acceleration within their school. The proposed list of topics to be discussed within the interview situation was sent to the schools in advance of the researcher's visit (Appendix C), and a suitable time for the interview to take place was agreed upon. The purpose of the interviews was to expand upon issues that had arisen from the postal surveys. The respondents were able to describe in more detail the advantages and disadvantages of acceleration within their school setting. The interviews were audio-taped, with the permission of the respondent, and responses for each school were grouped under the same general headings.

3.3 Ethical Considerations

In any research situation, ethical principles, rules and conventions must be satisfied. The researcher must ensure that the research process does not harm any of the research

participants. Respondents need to know the purpose of the research and the intended use of the research. Participants must be given the opportunity to decline to participate in the research and also to withdraw from the research process at any stage. The information obtained in the survey and the interview process must remain confidential, so that individuals are not able to be identified. Respondents must be informed that confidentiality will be maintained and feel confident of the researcher's commitment to that (Burns, 1997). Schools are very sensitive about information that may be used against them in the community and so any information gathered must not lead to the identification of particular schools.

The researcher has additional obligations which must be met:

For example if the subjects agree to be present at a specific time and place then the researcher must also. If the researcher has promised to send a summary of results to the subjects then that must be done. The researcher must not run overtime as many subjects may have made arrangements to fit round the time requirement already notified. (Burns, 1997, p. 21)

In conducting this research the following steps were taken to ensure that these ethical considerations were accounted for:

- Approval was given by the Human Ethics Committee, Massey University.
- Approval was given by the school principals to conduct the interviews within their schools.
- Informed consent from the three HODs of mathematics was obtained before the audiotaped interviews. They were given written information about the audiotaping procedure, including the option of stopping the interview at any time, the secure storage of the tapes, the use of the tapes, and the assurance that neither their school nor themselves would be able to be subsequently identified. The interview times were at the convenience of the respondents and the length of time required for the interview to take place was specified before appointments were made.
- Informed consent from HODs of Mathematics was assumed by the researcher on the return of the completed postal survey. Participants were informed about the

researcher's credentials and why the survey was being undertaken. They were given a comprehensive explanation of the nature and purpose of the research, their rights to decline, to withdraw from the research at any time, to have their privacy and confidentiality protected, and to receive information about the outcome of the research in an appropriate form. The data from the survey will be aggregated so that identification of individuals or schools will not be possible.

3.4 Reliability, Validity and Possible Limitations

When data are gathered and conclusions are drawn, confidence in the research process must be satisfied. Reliability means consistency. If data are reliable, then the same results would be found for the same individuals at different times. The reliability of research involves the extent to which studies can be replicated. Another researcher who uses the same procedures, variables, measurements, and conditions should obtain the same results (Wiersma, 1995). The validity of research involves the interpretation of research results with confidence and the generalisability of the results. Reliability and validity influence the credibility of the research and the confidence that can be placed in the findings.

Reliability

For social researchers, achieving reliability in the traditional sense is impossible (Merriam, 1998). It would not be appropriate to expect replication of this research. The purpose of this research was to find out current practices and programs for gifted and talented mathematicians in New Zealand secondary schools, but educational practices are often in a state of flux, and what was the case when this research was undertaken, is very likely to have changed by the next survey. This study provides a benchmark against which subsequent changes in the programs and practices reported can be measured.

Validity

Validity and reliability do not necessarily go hand in hand. Research results may be reliable but not valid: *When we are dealing with human beings, rather than inanimate*

scientific material, it is easy to realise that while we can measure something reliably it may well not be valid (Burns, 1997, p. 293).

The validity of the data collected in this research is dependent upon the respondents having truthfully and correctly answered the survey questions. Some of the demographic information given could be checked with other external sources, such as Ministry of Education data. The programs that run within a school could be specified in other school publications, such as prospectus or curriculum statements. However, in this research, the use of good questionnaire design, the anonymity of responses, and the willingness of so many HOD to write lengthy responses, seems to indicate that it would not be unreasonable to make some generalisations from the data collected.

The Researcher

The researcher inevitably brings expectations and constructs to the research process. It is the researcher who designs the questionnaire, develops the questions and organises the way the responses will be collated, and who draws conclusions based on the data gathered. Experimenter bias must be acknowledged in any body of research.

Researchers too are human! They have attitudes, values, needs and motives which, try as they might, they cannot stop from contaminating their experiments. ... A further source of bias lies in the subjective interpretation of the obtained data. (Burns, 1997, p. 144)

The researcher is an experienced HOD of Mathematics in a state secondary school who has taught mixed ability classes, low and high ability classes. As well as active involvement in education, the researcher is a parent of two primary school aged children who have both been identified as being 'well above average' in mathematics.

As a result of experience in mathematics education, as well as a strong interest in the education of the gifted and talented, the researcher brings a number of assumptions to the research project:

- that ability grouping has a place in the education of the gifted and talented
- that acceleration is a necessary educational strategy for some gifted and talented children
- that teachers have concerns about the practice of acceleration within their schools
- that teachers have concerns about the types of programs available to gifted and talented students
- that teachers have a desire to learn about the programs and practices in schools other than their own.

3.5 Limitations

As with any postal survey, the response rate will determine the degree of generalisability of results. Although all efforts were made to achieve a high response rate, non-respondents will need to be analysed to determine any discernible differences between respondents and non-respondents.

The terms used in the questionnaire were unfamiliar to some respondents. Although the terms used reflect current research and practice, some respondents obviously interpreted the terms differently, and this affected their responses to some questions. In particular, the use of the term “gifted” was not a term that was commonly used to describe able mathematicians and it may have been better to have used “talented” or specified the percentage cohort.

Lastly, this research focused on programs and practices of secondary schools. Although teachers were surveyed and asked for their opinion on the programs run within their schools, the opinion of the students themselves were not sought. This research can report only on the teachers’ perspective on the success or otherwise of the programs available to gifted and talented mathematics students. The overall picture would need to consider student and parental perception of effects of acceleration and ability grouping, as well as the satisfaction reported by students of the programs available to them.

3.6 Summary

The focus of this research was on collecting quantitative data to describe the current situation in New Zealand secondary schools on the programs and practices available to gifted and talented mathematics students. A nationwide postal questionnaire was used to collect the data. Three semi-structured interviews were also used to enlarge on some of the issues that had arisen from the responses to the postal survey.

CHAPTER 4

4. RESULTS

4.1 Response Rate

Out of the 400 schools surveyed, 235 sent back completed questionnaires. This was a very pleasing response rate and may indicate the level of interest in this topic amongst Heads of Mathematics' Departments in New Zealand schools. Many of the responses were very detailed and excerpts from the responses will be included in a later section. The demographic details of the non-respondents were analysed and compared with the demographic details of respondents.

Table 4.1 Respondents versus non-respondents by region.

Region	Respondents		Non-respondents	
	Number	Percentage	Number	Percentage
Auckland	47	58%	34	42%
Bay of Plenty	11	55%	9	45%
Canterbury	30	61%	19	39%
Gisborne	7	78%	2	22%
Hawkes Bay	14	70%	6	30%
Manawatu	13	46%	15	54%
Nelson	7	54%	6	46%
Northland	10	43%	13	57%
Otago	14	52%	13	48%
Southland	13	81%	3	19%
Taranaki	10	71%	4	29%
Waikato	26	62%	16	38%
Wellington	28	64%	16	36%
West Coast	5	56%	4	44%
Total	235		160	

The regions of Manawatu, Nelson, Northland, Otago and the West Coast were under-represented, whereas Gisborne, Hawkes Bay, Southland and Taranaki all had very high response rates.

Table 4.2 Respondents versus non-respondents by decile rating.

Decile rating	Respondents		Non-respondents	
	Number	Percentage	Number	Percentage
1	16	57%	12	43%
2	15	48%	16	52%
3	31	67%	15	33%
4	34	69%	15	31%
5	36	67%	18	33%
6	21	45%	26	55%
7	17	47%	19	53%
8	16	64%	9	35%
9	24	86%	4	14%
10	25	76%	8	24%
Unknown			18	
Total	235		160	

The schools with very high decile ratings appear to have the most favourable response rates, but the response rate of the schools from other decile ratings does not follow any apparent pattern.

Table 4.3 Respondents versus non-respondents by school type.

School Type	Respondents		Non-respondents	
	Number	Percentage	Number	Percentage
Integrated	20	87%	3	13%
Private	17	49%	18	51%
Public	198	59%	139	41%
Total	235		160	

Integrated schools are particularly well represented in this survey, while private schools are under-represented.

Table 4.4 Respondents versus non-respondents by single sex/co-ed.

Single sex/co-ed	Respondents		Non-respondents	
	Number	Percentage	Number	Percentage
Girls	46	75%	15	25%
Boys	31	62%	19	37%
Co-ed	158	59%	112	41%
Unknown			14	
Total	235		160	

Each school type is well represented in the responses to this survey. By far the most common school type was co-educational, but girls' schools had a very high response rate.

Table 4.5 Respondents versus non-respondents by school size.

School size	Respondents		Non-respondents	
	Number	Percentage	Number	Percentage
≤ 200	20	57%	15	43%
201-400	51	59%	35	40%
401-600	45	54%	38	46%
601-800	35	65%	19	35%
801-1000	27	63%	16	37%
1001-1200	28	76%	9	24%
1201-1400	14	70%	6	29%
> 1400	14	78%	4	22%
Unknown	1		18	
Total	235		160	

Larger schools are very well represented in this survey and smaller schools are very slightly under-represented. The response rate is good for all school sizes.

Summary

Although there was an excellent response rate, care must be taken when interpreting results by demographic characteristics. Some regions are under-represented in these results and private schools are also under-represented. The total number in some sub-groups is very low and a very slight change in number would have a major effect on the percentage calculated.

4.2 Identification of mathematically gifted students.

The identification of very able students must occur before the educational needs of these students can be met. The survey did not ask schools to provide a detailed description of the identification process. The Ministry of Education estimate that up to 20% of students will be identified as mathematically gifted (Ministry of Education, 1996). This is rather a generous estimate, but other researchers have also indicated that the top 15% to 20% of students will be identified as gifted (Reis and Renzulli, 1986). Other, more narrow definitions of giftedness, may classify the top 5% of such students as gifted (McAlpine, 1996).

One hundred and forty-two schools (60% of the respondents) had students that had been identified as mathematically gifted. This leaves 40% of the respondents with no students identified as being mathematically gifted. The wording of this question: "Does your school have students that have been identified as mathematically gifted?" may have led some HOD's to answer "no" to the question, even though they may acknowledge the presence of above average, or very able, mathematics students within their school. The use of the term "gifted", although standard practice in the literature within this area, may have been misunderstood. In retrospect, it may have been better to have asked if the schools had students with special ability in mathematics.

Table 4.6 Identification of gifted students by school size.

School size	Identification of gifted students		
	Yes	No	% of responses which identified gifted students
<= 200	7	13	35%
201-400	27	24	53%
401-600	27	18	60%
601-800	22	13	63%
801-1000	19	8	70%
1001-1200	18	10	64%
1201-1400	9	5	64%
> 1400	12	2	86%
Unknown	1		
Total	142	93	60%

Larger schools were more likely to have identified mathematically gifted students than smaller schools. Only 35 % of the responses from schools with less than two hundred students reported any mathematically gifted students. Although smaller schools would not have as many mathematically gifted students as the larger school, they should still have had the same proportion of mathematically gifted students in their schools who need to be identified.

Table 4.7 Identification of mathematically gifted students by decile rating.

Decile	Identification of gifted students		
	Yes	No	% of responses which identified gifted students
1	6	10	38%
2	6	9	40%
3	20	11	65%
4	23	11	68%
5	22	14	61%
6	11	10	52%
7	11	6	65%
8	12	4	75%
9	15	9	63%
10	16	9	64%
Total	142	93	

The decile rating of a school is a reflection of the socioeconomic status of the families of the students attending a particular school. Schools with low decile ratings attract significantly more public funding than do schools with high decile ratings. This is because schools with lower decile ratings are thought to have more students in need of special programs, resourcing needs are higher and there is less resourcing from the parent body. Low academic achievement, early school leaving age and higher rates of suspensions are all associated with low decile ratings (Schools' sector report, 1998). In general, the percentage of schools identifying mathematically gifted students increased with the decile level of the school. This supports literature that suggests that lower socioeconomic groups and some ethnic groups are under-represented in gifted identification (McAlpine, 1996).

Table 4.8 Identification of mathematically gifted students by region.

Regions	Identification of gifted students		
	Yes	No	% of responses which identified gifted students
Auckland	30	17	64%
Bay of Plenty	6	5	55%
Canterbury	18	12	60%
Gisborne	3	4	43%
Hawkes Bay	8	6	57%
Manawatu	9	4	69%
Nelson	5	2	71%
Northland	3	7	30%
Otago	8	6	57%
Southland	8	5	62%
Taranaki	8	2	80%
Waikato	19	7	73%
Wellington	14	14	50%
West Coast	3	2	60%
Total	142	93	

There were strong regional differences in response to the identification of gifted students. Given that mathematically gifted students would be present throughout all regions, disparities in identification rates may indicate the influence of regional factors. Both Northland and Gisborne have very low rates of identification, which ties in with the above results on the effect of the socioeconomic status (decile rating) of the schools. (Table 4.7).

Table 4.9 Identification of mathematically gifted students by school type.

School Type	Identification of gifted students		
	Yes	No	% of responses which identified gifted students
Integrated	10	10	50%
Private	12	5	71%
Public	120	78	61%
Total	142	93	

Private schools are most likely to have students identified as gifted. However, private schools are under-represented in the responses to this survey, so this result may not be

typical of that of private schools in general. Integrated schools have an appreciably lower rate of identification of gifted students.

Table 4.10 Identification of mathematically gifted students by single sex/co-ed.

Single sex/co-ed	Identification of gifted students		
	Yes	No	% of responses which identified gifted students
Boys	21	10	68%
Girls	28	18	61%
Co-ed	93	65	59%
Total	142	93	

Boys' schools have a higher rate of identification of gifted students than the other school types. This is consistent with a propensity to stream in boys' schools (see Table 4.20).

4.3 School policy on gifted and talented education.

New Zealand schools are not specifically required to have a written policy on gifted and talented children, although the Ministry of Education is in the process of developing policy guidelines for schools. In 1992, only about 20 percent of schools had a separate policy on gifted and talented children (Moltzen, 1996). A school policy on gifted and talented children is an important step toward identifying them (McAlpine, 1996). Cathcart (1994) believes that a school policy represents commitment by school management to the education of gifted and talented children. Without such a policy, education initiatives are dependent upon the enthusiasms of current staff. In this survey, 75 of the respondents had a written school policy (32%). Although this an increase from the 1992 survey, there were still more than two-thirds of schools with no written policy. As would be expected, those schools which were seen to be more likely to identify gifted students (eg., large schools) were also more likely to have a written policy on gifted education.

Table 4.11 Policy on gifted and talented by school size.

School size	Policy on gifted and talented		
	Yes	No	% of responses with policy
≤ 200	3	17	15%
201-400	10	41	20%
401-600	12	33	27%
601-800	11	24	31%
801-1000	13	14	48%
1001-1200	12	16	43%
1201-1400	6	8	43%
> 1400	7	7	50%
Unknown	1		
Total	75	160	32 %

The size of the school had a marked effect on school policy for gifted and talented students. The smaller the size of the school, the less the likelihood of having a written policy. This result ties in with Table 4.6. The existence of written policy may have a positive effect on the number of students identified as being gifted and visa versa.

Table 4.12 Policy on gifted and talented by decile rating.

Decile rating	Policy on gifted and talented		
	Yes	No	% of responses with policy
1	3	13	19%
2	6	9	40%
3	11	20	35%
4	7	27	21%
5	6	30	17%
6	8	13	38%
7	5	12	29%
8	3	13	19%
9	16	8	67%
10	10	15	40%
Total	75	160	

However, the decile rating of a school, although positively correlated to the identification of gifted students, did not seem to have any apparent effect on the existence of a written policy on gifted and talented students.

Table 4.13 Policy on gifted and talented by region.

Region	Policy on gifted and talented		
	Yes	No	% of responses with policy
Auckland	15	32	32%
Bay of Plenty	5	6	45%
Canterbury	10	20	33%
Gisborne	2	5	29%
Hawkes Bay	4	10	29%
Manawatu	6	7	46%
Nelson	3	4	43%
Northland	1	9	10%
Otago	3	11	21%
Southland	4	9	31%
Taranaki	2	8	20%
Waikato	7	19	27%
Wellington	12	16	43%
West Coast	1	4	20%
Total	75	160	

Responses from all regions indicated that less than half of the schools had a written policy for gifted and talented children. Bay of Plenty, Manawatu, Nelson and Wellington all had a higher reported rate of policy than other regions. Northland, Taranaki and the West Coast all had 20% or less schools with a written policy. This rate is no different from that reported in 1992 (Moltzen, 1996).

Table 4.14 Policy on gifted and talented by school type.

School type	Policy on gifted and talented		
	Yes	No	% of responses with policy
Integrated	4	16	20%
Private	9	8	53%
Public	62	136	31%
Total	75	160	

Private schools were far more likely to have a written policy on gifted and talented students than integrated and public schools. Integrated schools were least likely to have a written policy. These results mirror those of the identification of gifted and talented students (see Table 4.9).

Table 4.15 Policy on gifted and talented by single sex/co-ed.

Single sex/co-ed	Policy on gifted and talented		
	Yes	No	% of responses with policy
Boys	10	21	32%
Girls	18	28	39%
Co-ed	47	111	30%
Total	75	160	

Girls' schools were more likely to have a policy on gifted and talented students than boys' school or co-ed schools. However, it is interesting that boys' schools were still more likely to have identified students as being mathematically gifted (see Table 4.10).

4.4 Ability grouping in Year 9.

One of the options for educating the gifted and talented is to group together students with similar abilities. There is some evidence that gifted and talented children tend to benefit from homogeneous groups and that they prefer to work in such groups (Moltzen, 1995). Ability grouping in New Zealand secondary schools can be by general ability, where students are selected for the top classes based on ability in English, Mathematics and possibly Science. Some schools group students together based solely on ability in Mathematics and some schools have both methods of ability grouping.

Table 4.16 Ability grouping in Year 9.

General ability	Yes	Mathematical ability				Total	
		Yes	%	No	%	N	%
	Yes	42	18 %	82	35 %	124	54 %
	No	31	13 %	80	34 %	111	47 %
Total		73	31 %	162	69 %	235	100 %

Altogether, 66 % of the response schools use some form of ability grouping. In this survey, 84 schools out of 237 (35 %) grouped their top Year 9 mathematics classes based on general ability. Only 31 % of schools grouped the top mathematics students together in Year 9 based solely on their mathematical ability. Although the literature suggests that it is this type of ability grouping that is of most benefit to gifted and talented students (Reid, 1991; Moltzen, 1995; Holton and Daniel, 1996), it appears that

grouping on mathematical ability alone is not a favoured option in New Zealand. The remaining 80 schools (34 %) had no ability grouping.

Ability grouping by school size.

Table 4.17 General ability grouping by school size

School size	General ability grouping		
	Yes	No	% of responses with general ability grouping
≤ 200	3	17	15%
201-400	11	40	22%
401-600	24	21	53%
601-800	19	16	54%
801-1000	21	6	78%
1001-1200	20	8	71%
1201-1400	12	2	86%
> 1400	11	3	79%
Unknown	1		
Total	122	113	

Table 4.18 Mathematical ability grouping by school size

School size	Mathematical ability grouping		
	Yes	No	% of responses with mathematical ability grouping
≤ 200	2	18	10%
201-400	6	45	12%
401-600	16	29	36%
601-800	15	20	43%
801-1000	8	19	30%
1001-1200	11	17	39%
1201-1400	5	9	36%
> 1400	8	6	57%
Unknown	1		
Total	72	163	

Again, the percentage of schools that ability group in Year 9 is affected by school size. Small schools are unlikely to have the numbers of students or staff or sufficient flexibility in the timetable to enable this form of ability grouping.

*Ability grouping by decile rating***Table 4.19** General ability grouping by decile rating

Decile rating	General ability grouping		
	Yes	No	% of responses with general ability grouping
1	2	14	13%
2	7	8	47%
3	21	10	68%
4	17	17	50%
5	18	18	50%
6	9	12	43%
7	8	9	47%
8	9	7	56%
9	12	12	50%
10	19	6	76%
Total	122	113	

Decile 1 schools very rarely streamed their Year 9 classes while decile 10 frequently streamed. There was little evidence of a pattern in the other decile ratings.

Table 4.20 Mathematical ability grouping by decile rating

Decile rating	Mathematical Ability Grouping		
	Yes	No	% of responses with mathematical ability grouping
1	7	9	44%
2	7	8	47%
3	9	22	29%
4	11	23	32%
5	7	29	19%
6	7	14	33%
7	3	14	18%
8	6	10	38%
9	7	17	29%
10	8	17	32%
Total	72	163	

Interestingly, the schools with the lowest decile ratings have the highest percentage of ability grouping by mathematical ability (banding). Several HOD's reported that they

ability grouped in order to try and raise the standard of mathematics in schools with lower decile ratings.

Ability grouping by region.

Table 4.21 General ability grouping by region

Region	General ability grouping		
	Yes	No	% of responses with general ability grouping
Auckland	30	17	64%
Bay of Plenty	7	4	64%
Canterbury	18	12	60%
Gisborne	2	5	29%
Hawkes Bay	9	5	64%
Manawatu	11	2	85%
Nelson	4	3	57%
Northland	4	6	40%
Otago	6	8	43%
Southland	3	10	23%
Taranaki	3	7	30%
Waikato	14	12	54%
Wellington	10	18	36%
West Coast	2	3	40%
Total	123	112	

There were large regional differences in the ability grouping of Year 9 students. Southland had the lowest rate of general ability grouping, followed by Gisborne and Taranaki. Interestingly, Taranaki schools reported the highest rate of identification of gifted mathematics students (Table 4.8) and also the highest rate of grouping based on mathematical ability (Table 4.22). Schools in Manawatu report the highest rate of general ability grouping.

Table 4.22 Mathematical ability grouping by region

Region	Mathematical ability grouping		
	Yes	No	Percentage of schools with mathematical ability grouping
Auckland	20	27	43 %
Bay of Plenty	5	6	45 %
Canterbury	3	27	10 %
Gisborne	3	4	43 %
Hawkes Bay	3	11	21 %
Manawatu	3	10	23 %
Nelson	1	6	14 %
Northland	2	8	20 %
Otago	2	12	14 %
Southland	4	9	31 %
Taranaki	5	5	50 %
Waikato	11	15	42 %
Wellington	10	18	36 %
West Coast	0	5	0 %
Total	72	163	

Taranaki had the highest rate of grouping Year 9 students based on mathematical ability, while Canterbury, Otago, Nelson and the West Coast all report very low rates. It would appear that there are strong regional influences on ability grouping of students for mathematical instruction. Changes between regions could well be related to expectation for schools to do as the one down the road does.

Ability grouping by school type.

Table 4.23 General ability grouping by school type

School Type	General ability grouping		
	Yes	No	% of responses with general ability grouping
Integrated	4	16	20 %
Private	10	7	59 %
Public	109	89	55 %
Total	123	112	

General ability grouping is most popular among the private schools, with the rate for public schools very similar to that of the private schools. Integrated schools did not

favour this option. Integrated school also had a lower rate of identification of gifted students than that of the other school types (Table 4.9).

Table 4.24 Mathematical ability by school type

School Type	Mathematical ability grouping		
	Yes	No	% of responses with mathematical ability grouping
Integrated	6	14	30 %
Private	4	13	24 %
Public	62	136	31 %
Total	72	163	

Integrated schools have a higher rate of grouping based on mathematical ability than they did for general ability grouping. The rate of grouping based solely on mathematical ability is lowest for the private schools.

Ability grouping by single sex/co-ed.

Table 4.25 General ability by single sex/co-ed

School Type	General ability grouping		
	Yes	No	% of responses with general ability grouping
Girls	21	25	46 %
Boys	24	7	77 %
Co-ed	78	80	49 %
Total	123	112	

General ability grouping is by far the most favoured method of delivering the mathematics curriculum to Year 9 boys. Only 23 % of the boys' schools surveyed did not have general ability grouping.

Table 4.26 Mathematical ability by single sex/co-ed

School Type	Mathematical ability grouping		
	Yes	No	% of responses with mathematical ability grouping
Girls	20	26	43 %
Boys	8	23	26 %
Co-ed	44	114	28 %
Total	72	163	

Although girls' schools were least likely to group classes for mathematics based on a general ability grouping, they were most likely to group for mathematics based on the mathematical ability of the students. Boys' schools were least likely to ability group based solely on mathematical ability.

4.5 Acceleration in Years 9 and 10.

Acceleration is one of the methods of curriculum delivery for gifted students that is available to schools. Although there is strong evidence in the literature in favour of acceleration, enrichment has been the favoured curriculum delivery model in New Zealand schools (Townsend, 1996). In this survey, schools were asked if they had a policy on accelerating students to sit School Certificate Mathematics earlier than Year 11. The practice of acceleration seems to be fairly widespread amongst New Zealand secondary schools as 54 % of responses (126/235) reported the acceleration of students.

Table 4.27 Acceleration by school size.

School size	Yes	No	% of responses permitting acceleration in mathematics.
≤ 200	5	15	25 %
201-400	24	26	48 %
401-600	22	24	48 %
601-800	25	10	71 %
801-1000	14	13	52 %
1001-1200	18	10	64 %
1201-1400	10	4	71 %
> 1400	10	4	71 %
Unknown		1	-
Total	128	107	

Acceleration does seem to be influenced by school size: small schools appear less likely to accelerate students. This matches the identification data (see Table 4.6).

We hope to do more to accelerate gifted students but this has been difficult with the constraints of a small school with large junior classes and high teacher workloads.

Table 4.28 Acceleration by decile rating.

Decile rating	Yes	No	% of responses permitting acceleration in mathematics.
1	6	10	38 %
2	8	7	53 %
3	13	18	42 %
4	20	14	59 %
5	22	14	61 %
6	11	10	52 %
7	10	7	59 %
8	8	8	50 %
9	14	10	58 %
10	16	9	64 %
Total	128	107	

However, apart from at the very lowest rating, the decile rating of a school did not seem to influence the decision making about acceleration. This decision is interesting given the trend of increased identification of gifted children with increased decile rating that was apparent in Table 4.7.

Table 4.29 Acceleration by region.

Region	Yes	No	% of responses permitting acceleration in mathematics.
Auckland	27	20	57 %
Bay of Plenty	8	3	73 %
Canterbury	16	14	53 %
Gisborne	1	6	14 %
Hawkes Bay	8	6	57 %
Manawatu	9	4	69 %
Nelson	5	2	71 %
Northland	2	8	20 %
Otago	3	11	21 %
Southland	6	7	46 %
Taranaki	4	6	40 %
Waikato	16	10	62 %
Wellington	19	9	68 %
West Coast	4	1	80 %
Total	128	107	

Regions were quite different in their responses to acceleration. Gisborne, Northland and Otago had very low rates of acceleration, while the Bay of Plenty, Nelson and the West Coast all had high rates of acceleration.

Table 4.30 Acceleration by school type.

School Type	Yes	No	% of responses permitting acceleration in mathematics.
Integrated	8	12	40 %
Private	11	6	65 %
Public	109	89	55 %
Total	128	107	

Integrated schools do not accelerate as much as other school types. Private schools have the highest rate of acceleration of the three school types.

Table 4.31 Acceleration by single sex/co-ed.

School Type	Yes	No	% of responses permitting acceleration in mathematics.
Girls	25	21	54 %
Boys	19	12	61 %
Co-ed	84	74	53 %
Total	128	107	

Boys' schools have the highest rate of acceleration, while the rates of girls' schools and co-ed schools are very similar.

Numbers accelerated.

It is important to note that although 54 % of response schools reported acceleration of students, the numbers of students being accelerated ranged from one student to over thirty students (Table 4.32).

Table 4.32 Number of students accelerated.

Numbers accelerated	Number	Percentage
1-5	57	44 %
6-10	22	17 %
11-20	14	11 %
21-30	24	19 %
>30	11	9 %
	128	100 %

In particular, it appears that whole class acceleration is not a common practice. Only 27 % of schools that do permit acceleration had groups of 21 or more. The majority of schools accelerate only between one and five students, according to student need.

Entry level to the accelerate program.

Entry to the accelerate program is usually from Year 9 or Year 10, although in a few cases schools reported acceleration from Year 7 or 8.

Table 4.33 Entry level to the accelerate program.

Year Level	Number	Percentage
Yr 7-8	3	2 %
Yr 9	35	27 %
Yr 10	76	59 %
Yr 9 or 10	6	5 %
Not specified	8	6 %
Total	128	

As can be seen from

Table 4.33, the majority of students enter the accelerate program from Year 10. Although students may have been placed in a high ability grouped class in Year 9, decisions on acceleration are not usually made until students' progress in a secondary school can be monitored.

Selection criteria for acceleration.

Teachers used a wide range of criteria for selection of students to enter the accelerate program (Table 4.34). Ideally, selection should not depend on any one approach but employ a wide range of methods. Research suggests that neither test nor teacher observation alone is adequate for the task (McAlpine, 1996).

Table 4.34 Selection criteria for acceleration to School Certificate Mathematics.

Criteria for entry into accelerated program	Number	Percentage
Teacher's recommendation	35	27 %
Standardised tests	41	32 %
Information from contributing schools	7	5 %
Parent selection	7	5 %
School tests/exams	57	45 %
Student's personal qualities	20	16 %
Results in problem solving competitions.	7	5 %
Student self selection	10	8 %
Peer selection	1	1 %

Many of the schools that did accelerate their students mentioned more than one method of selection. Thus, the numbers in Table 4.34 total more than the 128 schools that allow entry into School Certificate Mathematics before Year 11. The most favoured criterion

was from results in tests and exams, followed by teacher selection. Results in problem solving competitions, information from contributing schools and parent selection were the least favoured criteria for selection.

Repeating School Certificate Mathematics

Not all respondent schools had a set mark that an accelerate student had to achieve in order to continue to the next year level (Table 4.35). Most school reported being flexible about their criteria for proceeding to a course higher than School Certificate.

Table 4.35 Criteria for repeating School Certificate mathematics.

School Certificate Mark	Number	Percentage
≤ 80	9	7 %
≤ 70	19	15 %
≤ 60	20	16 %
≤ 50	12	9 %
Unspecified	68	53 %
Total	128	100 %

Courses offered in the senior school

Many schools offered similar courses in the senior school to their accelerated students. The following table (Table 4.36) demonstrates the options available to senior students.

Table 4.36 Mathematics options available in the senior school

Year 10	Year 11	Year 12	Year 13
School Certificate	↔ Sixth Form Certificate Mathematics ↔	Bursary Statistics and/or Bursary Calculus ↔	Repeat Calculus or Statistics and/or take other Bursary mathematics Baccalaureate
or	↔ Level 2 National Certificate mathematics Unit Standards	or	↔
or	↔ Combined Schools exam and resit S.C. Mathematics	or	↔ University papers
↔	↔ Bursary mathematics subject to HOD approval	or	↔ No mathematics
≥ 90 % in School Certificate			

Although many of the accelerated students were able to continue to take advanced level courses, it is unfortunate that taking no mathematics courses in Year 13 was an option in several cases. Acceleration could mean that a gifted and talented mathematician may actually stop taking mathematics courses in the senior school.

4.6 Problems with acceleration.

The advantages and disadvantages of acceleration have been thoroughly debated in the literature. Townsend (1996) is adamant that there is overwhelming evidence in favour of acceleration to meet learner needs, although he acknowledges the fears that still exist about the effects of acceleration on both academic and psychosocial aspects of development. When students sit School Certificate mathematics before Year 11, they are accelerated into the next year level. A possible concern with this is that the student's social needs are not being met. Also, a student might work on material that is a year or more ahead of their peers in terms of the curriculum, but the delivery of the curriculum may not be suited to the learning needs of a gifted student (Holton, 1996). School responses (Table 4.37) identified a wider range of problems associated with the acceleration of students.

Table 4.37 Problems with acceleration.

Problem	Number	Percentage
Lack of grounding in mathematics	5	4 %
Effect on Sixth Form Certificate grades available	4	3 %
Parental pressure	20	16 %
Timetable	36	28 %
None	33	26 %
Poor performance in Bursary	19	15 %
Students dropping maths	3	2 %
Sixth Form Certificate year wasted	2	2 %
Students repeating courses they have already succeeded in	6	5 %
Having to accelerated students that are not suitable for acceleration in mathematics	4	3 %
Poor performance in Sixth Form Certificate	7	5 %
Lack of maturity/social problems.	16	13 %

Of the schools that do accelerate, 74 % had some problems with acceleration. Where problems with acceleration were mentioned, more than one problem was often listed. Some of these problems were minor, but many schools reported serious concerns with student performance. Parental pressure for their child to join the accelerate program against the wishes of the school was a concern for 16 % of these schools. Many of the HOD's comments on the problems of acceleration were very detailed. The comments are not necessarily common to all, but rather cover the spectrum of responses.

Lack of grounding in mathematics.

- *Some students have felt their grounding was not thorough enough to get the kind of grades they really want in Form 6 and Form 7.*
- *Lack of basic concepts - seem to have missed some skills.*
- *Tried acceleration for the first time this year. It probably caused gifted kids to miss a good grounding.*

- *Students who have multi-levelled to Bursary Calculus or Statistics sometimes find that their basic skills are somewhat lacking because they did not get sufficient practice at it earlier.*

Effect on Sixth Form grades available.

In New Zealand, the grades available for Sixth Form Certificate are dependent upon the School Certificate results achieved by students the previous year. A lower School Certificate mark than expected would generate a lower grade for distribution to the Sixth Form Certificate candidates. A school has a finite number of grades at each level to award to students. A grade of 1 is the highest possible, whereas a grade 6 is equivalent to a C pass in School Certificate. This may well be a more significant concern for a small school.

- *Form 6 grades are lowered by sitting School Certificate in Year 10. Some students may bring in a 1 if they sit in Year 11 rather than in Year 10, whereas they bring in a 3 or a 4. As we don't have many top grades this is relevant.*

Parental pressure.

Unrealistic expectations by parents of their children was seen as a problem by 16 % of respondent schools that have an accelerate program. Although students were unsuitable for acceleration according to their teachers, some parents insisted on acceleration for their children.

- *Parental pressure to allow students who did not reach our requirement of 80 % in School Certificate to study Sixth Form Certificate mathematics in the following year.*
- *Parental pressure- this has eased by our policy of extending sideways.*
- *Unrealistic parental expectations.*
- *Some parents have inflated ideas of their child's ability and put pressure on the school to include them.*

- *There is extra pressure on teachers and a reluctance of students to extend themselves. In most cases extension is detrimental. It is better to extend horizontally. There is pressure by parents to accelerate, which can be a factor in choosing schools.*
- *There is community/school pressure to accelerate. We have accelerated large numbers in the past, many of whom should not have been accelerated. Acceleration is now limited to those who do well in school testing, plus excel in external competitions.*
- *Parental and/or school pressure is often unrealistic. Because of the lower than average nature of our pupils and the school, we often perceive 'average' students as being gifted. The school is quite small, so putting enrichment programs into place is difficult.*
- *Group activities are encouraged as a lot of these students are not good at working together. They need to learn cooperation and work under less structured conditions. There is parent pressure to offer School Certificate in Form 4. Extension is preferred with Development Band.*
- *Parents indicate that they expect the school to have a special program for the better academic children. Equity/positive discrimination/political correctness meant that in one year some students were moved 40 places up a ranked list to ensure the "right" gender were in the program.*
- *HOD believes in horizontal acceleration or acceleration of individual students on a subject by subject basis, but has no power to change things. Prior to this year, students were selected at the beginning of Form 3 and accelerated then. There are problems with HUGE parental pressure and social issues when students need to be removed from the program. I would support acceleration if individual students could be accelerated on a subject by subject basis.*

- *Maths teachers' preference would be extension and enrichment. Accelerate class has been a management decision mainly to impress parents.*
- *Acceleration still seen as very desirable and used as a marketing issue by schools for parents.*

Timetable problems.

Difficulties in accommodating the subject combinations of accelerated students was the problem with acceleration mentioned most often by respondent schools. Multi-level courses were more difficult to arrange in smaller schools.

- *Unable to band at Form 6 and 7 so classes become very mixed. This places considerable demands on the teacher. For example, one Form 7 Bursary Calculus class has one accelerated Year 9 student, Year 12 accelerated students, Year 13 students, Year 13 students repeating - some to improve low marks, some to obtain scholarship from already high marks.*
- *The accelerated students were kept together in a class of 10 to 15 students. This proved restrictive on the timetable so these students are now mixed in with the other Year 11 students, although in the same class.*
- *The need to keep the original Year 10 class together for the next few years does place restrictions on the subject choice of some of the students and constraints on the timetable. Also, Year 10 students who enter the school with School Certificate mathematics cannot enter the program until Year 11. We have a junior and a senior timetable.*
- *Timetable is the main problem.*
- *All accelerated students have to work as a group in their Year 10 class. This means divided teacher time plus distractions since there is no banding/streaming and the class has all the usual Year 10 problems.*

- *Because we only have one class at each level, if a Year 11 student wants to take Sixth Form Certificate mathematics, then they wouldn't be able to take a School Certificate subject on at that time.*
- *For a Year 10 student to do School Certificate mathematics, they lose one or two periods out of their Year 10 program. Usually they catch up in their own time. One mathematics teacher is given one hour of tutorial time to go over class work missed by accelerated students.*

Poor performance in Bursary mathematics.

Several schools reported a concern with the achievement of the accelerated students. Achievement at a lower than expected level in the Bursary Statistics and Calculus examinations was of particular concern.

- *Students are not performing well in Year 13, maybe not even passing or not doing two mathematics courses.*
- *Top students who are accelerated often don't succeed in Bursary, maybe only the top two or three students do succeed. We now feel it would be better to use development band material at Years 9, 10 and 11 instead of acceleration.*
- *Some students who are accelerated finish with Bursary Calculus grades of 65 - 70 % and then quit. If left unaccelerated, we would have expected marks over 80 % in Year 13. We have some real success stories. One student was an Olympian two years in a row. Another passed eight Scholarship grades by the end of Year 13, but too many do not perform to the best of their ability, despite ability and parental support.*
- *Able Year 12 students are lacking the maturity to successfully complete Bursary mathematics. Year 12 students find it difficult to cope with Statistics or Calculus and complete Sixth Form Certificate at the same time. Several Year 12 students know that they are going to repeat the course in Year 13 and they are not serious about their work.*

- *Often their acceleration “ability” peters out after Sixth Form Certificate. They do not score well in Bursary.*
- *The main problem appears to be that students do not do well in their first attempt at Calculus and even if they repeat they do not get the results expected.*
- *We found that while they gained our top School Certificate marks, we found they didn’t do very well as Form 6 students and did extremely poorly at Bursary, most having to sit the Bursary subjects again. This year we have only one accelerated student—an overseas students.*

Lack of maturity/social problems.

Although many studies have shown no negative effects from acceleration on a variety of aspects of social and emotional development, it is a commonly held view amongst New Zealand educationalists that acceleration is socially harmful (Townsend & Patrick 1993). Several of the respondent schools reported a concern with some aspect of the accelerated student’s social maturity.

- *The accelerated students can’t cope socially mixed with older students.*
- *Too much brain, no sense.*
- *Problems with the social adjustment of students suddenly in a class with older students.*
- *Social issues rather than academic issues cause problems.*
- *There is a feeling that pupils can be immature in senior classes.*
- *Parents feel that students will be odd socially.*

- *They don't fit in socially. Their fifth year at school often sees them drift and lack motivation. This varies with the maturity of the students.*
- *Some students become arrogant, lacking in application.*
- *Our main problem is a few students, usually boys, who do not work to capacity-lazy, disorganised. They are interested in the subject but don't finish off.*

Successful acceleration.

Out of the 128 schools that accelerated students to Year 11 and above, 33 reported no problems with acceleration. Many of these schools have had a long tradition of successful acceleration and have found ways to overcome perceived problems.

- *No real problems because we do not have a significant number of students in this category.*
- *Acceleration in maths is popular in this school and has full parental support.*
- *The student needs to have good work habits and be committed, as well as being good at maths. The key is that the acceleration is considered a good thing and not to exert pressure.*
- *We have learned to live with the perceived problems.*
- *School is very willing to facilitate. Parents kept informed of opportunities, alternatives.*
- *Continuity used to be a problem, but the university course has fixed that. Streaming used to be a problem at the Year 10 level, but now we are banding that has disappeared.*

- *We are a large enough school to overcome most of the banding/course problems.*
- *Some students have been able to obtain nine Bursary subjects all above 86 % (over 3 years).*
- *Maths has a clear policy of identifying students in Year 9. The HOD individually talks to the students and parents. No pressure is brought to bear on students to accelerate. A Year 11 class is timetabled at the same time as the top Year 10 mathematics class, so that students can opt out of School Certificate if the acceleration is not working.*
- *The accelerate program has meant a large increase in Bursary marks in both Statistics and Calculus. There is a drop in School Certificate marks, but this is immaterial as the students are going to University.*
- *Generally the Yr 10 students are all in the top 10 results in the school. Yr 10 regularly score in the range 65-75% with one student gaining 95% last year. The measure of success and the respect these students are shown by their older classmates reflects their mathematical expertise.*
- *We have been running this extension program for 4 years now so this is the first year we have the scholarship class for Calculus. It has been very worthwhile-the students should do very well in Bursary and the few who have opted for NZEST have a good grounding. Selection of students into Year 9 classes is difficult because we feed off a large number of contributory schools. Selection into Year 10 School Certificate Maths. Is also difficult. We have to carry more than are probably suitable because a class of 20 is not viable here. We need to have 28-30 students.*
- *Mathematics is an excellent subject to accelerate-it allows for flexibility and we have found that it gives 4th formers a goal to strive for.*

- *The acceleration of Yr 10s into S.C. has been very successful in recent years. These students have generally been top of the S.C. group. (>85%). Their S.F.C. grades are usually 1's or 2's and Bursary results over the following two years are always good. We have had several students obtain Scholarship results due to acceleration.*

4.7 Other subjects accelerated.

Although mathematics seems to be the most favoured subject to accelerate, some schools reported acceleration in other subjects. Some schools had 20 or more students being accelerated in a subject other than mathematics, while others had only one or two. Most likely, the schools that accelerated more than 20 were accelerating whole classes.

Table 4.38 Subjects with whole class acceleration (≥ 20)

Subject	Number
English	15
Science	20
History	5
Geography	8
Classical Studies	1
Physics	1
Japanese	1
Social Studies	1
Music	1
Economics	1

Science was the most popular subject for whole class acceleration (20 schools), with English also being popular (15 schools), although whole class acceleration was still far more prevalent in mathematics (35 schools).

4.8 Development Band.

The limitations of time, resources and knowledge for teachers to implement the development band program prompted the New Zealand Association of Mathematics Teachers (NZAMT) to develop support enrichment material. NZAMT believed that a significant number of students were not being provided with appropriate extension work

(Wallace, 1998). NZAMT developed a certificate program suitable to use as either whole class activities, with individual students, mathematics clubs or as part of the teaching program. The response to this program has been enormous (Wallace, 1998) and the certificate courses now run from Year 4 to Year 12.

The program provides enrichment activities for the particular strand of mathematics being studied. Activities are open ended and encourage higher order thinking and the activities can be done individually or in small groups. Schools were asked if they used the Development Band Certificate courses.

Out of the 237 schools that responded, 106 (45 %) were using the Development Band Certificate courses. Many schools offered their students both acceleration and Development Band involvement (Table 4.39).

Table 4.39 Numbers of students involved in Development Band Certificate.

Numbers accelerated	Year 9	Year 10	Year 11
1-5	14	18	7
6-10	11	10	3
11-20	8	7	1
21-30	13	11	4
30-40	7	5	
> 40	10	20	4

Schools that had streamed classes often used the Development Band Certificate with the whole class. The use of the certificate was more widespread in Year 10, although a few schools used the certificate in Year 11.

Entry into the Development Band Certificate.

As with the entry criteria for acceleration, schools had more than one method of selecting students for the Development Band Certificate course. The predominant factor for influencing the introduction of Development Band programs was the presence of ability grouping in a school. In 35 of the schools, students in the top stream or top band of mathematics were all entered into the Certificate course. Self selection was favoured more for entry to the Development Band course than for entry into the accelerate

program (see Table 4.34), while results in standardised tests and school exams and tests were much less important for entry into the Development Band course than for the early sitting of School Certificate.

Table 4.40 Selection criteria for the Development Band Certificate

Criteria for entry into Certificate	Number	Percentage
Teacher's recommendation	25	24 %
Standardised tests	21	20 %
Information from contributing schools	3	3 %
Parent selection	1	1 %
School tests/exams	23	22 %
Student's personal qualities	7	7 %
Results in problem solving competitions.	4	4 %
Student self selection	19	18 %
Compulsory for top stream/top band classes	35	33 %

Acceleration versus enrichment.

While the Development Band Certificate is specifically an enrichment program, there may well be other forms of enrichment activities taking place in schools. However, the data gathered here refers only to the Development Band Certificate courses. Out of the 235 schools that responded to this survey, 47 use both acceleration and the development band programs (Table 4.40). Acceleration alone was reported by 81 (34 %) of the response schools, while the development band alone was reported by 57 (24 %) of the respondent schools. Fifty schools (21 %) neither accelerated nor ran the development band certificate.

Some HODs reported that the use of the Development Band Certificate places pressure on staff to provide the class time to run the activities and also requires time to mark student work.

- *Apart from one year 10 class, all Development Band Certificate work is done by the students in their own time and relies on a high degree of self discipline and self motivation from the students. There is one staff member with responsibility for overseeing the courser but currently there is no Maths Club provided to support the*

students. The staff in the Maths Department are currently too busy to give up their lunch hours for extension work.

- *There is not enough time to fully develop with the students a rich mathematical activity. We seem to only have time to touch the surface of a problem instead of asking the 'what if' questions. The development band activities are good, but again there is not enough time for teachers to help students with them.*
- *We are running the NZAMT program as a supplement to class-work. It's difficult to find the time to monitor the progress of the pupils and to supply the extra help required. We have been allocated extra hours this term to help get the program running. Extension is very important for students at a school where academic excellence is seen as a priority.*
- *Teacher workload is increased by running extension/enrichment work. The NZAMT material is a lifesaver but the organising, maintaining and marking involved is still a huge pressure. Time needs to be put aside for staff running these programs.*

Nevertheless, some HODs were very appreciative of the NZAMT certificate course.

- *We have a policy of not accelerating. We are keen advocates of enrichment rather than accelerating. The development band material has been a godsend. The syllabus of examinations still limits the delivery of a truly rich enrichment program.*
- *The development band program has helped classroom teachers immensely.*
- *We don't accelerate except under exceptional circumstances. MINZC encourages enrichment rather than acceleration, through the development band. Enrichment needs promotion to parents.*

- *Having development band activities available for all students who wish to participate (not only those in top bands) and monitored and encouraged by specific staff member with this allocated responsibility has been an excellent means of extension for those able and interested students at our school.*
- *We try to make this part of every lesson so everyone can try if they wish-it is not seen as elitist. The Development Band material is excellent & a godsend to schools especially as many teachers at our school are non-specialists.*
- *Development Band material is excellent but should come with more marking schedules to make administration easier.*

Table 4.41 Acceleration versus Development Band.

		Acceleration				Total	
		Yes	%	No	%	N	%
Development Band	Yes	47	20 %	57	24 %	104	44 %
	No	81	34 %	50	21 %	131	56 %
Total		128	54 %	107	45 %	235	100 %

4.9 Other provisions for gifted and talented mathematics students.

Schools were asked what other activities their able mathematicians were involved in. The responses were wide ranging and rather than summarising how many were in each category, the different types of activities are listed below.

Competitions.

Australian Mathematics Competition.

National Bank Junior Mathematics Competition.

Waikato mathematics competition.

Eton Senior Mathematics Competition.

Mathswell competition.

Caxton Competition.

Bank of New Zealand Competition.

Mathsmind Competition.

Mathex competition.

Canadian mathematics Challenge.

24 Challenge.

Investigative competition.

Able Maths Camp.

Calculator Skills Level Certificate.

University of Otago Problem Challenge.

Maths Day.

In-school competition evenings.

Baccalaureate.

Tournament of the Towns.

Future Problem Solving.

Quiz teams for maths spectacular.

Canta Maths.

Weekly internal competition.

4.10 Enrichment/extension programs.

- Maths Olympiad.
- Enrichment mathematics for Years 9 and 10 after school each fortnight for two hours at a time. This is extension in a fun environment.
- Enrichment group after school.
- University or other problem solving programs.
- Extension program, although focussed in the development band, also includes additional material and training for competitions.
- University monthly Friday night meetings with interesting speakers on a range of topics.
- Mathematics club.
- Enrichment group at another college.
- The best Year 10 students are offered entry to Sixth Form Certificate and miss School Certificate mathematics.
- Project work.
- Trips.
- Mathematics Digest.
- Several cross-curricular projects, each of one weeks duration.
- Additional mathematics classes (4.30 - 7.00 p.m.) to prepare School Certificate students for their reference test.
- Approximately 30 students at Years 10 and 11 are taken out of class once a week for extension maths, where they do problem solving questions and learn new concepts not usually taught at those year levels.

- Year 9 and 10 able students receive one period per week out of class with a teacher for extension work.
- Enrichment week at the end of Year 9.
- Accelerate learning seminars - specialist learning programs from a psychologist.
- Form 4 and Form 7 seminars (Southland Maths Association.)
- South Island problem Solving Scheme.
- Family Maths.
- Mentoring.

Tutoring.

Lunchtime tutoring.

Peer tutoring.

Examinations.

Combined schools examinations.

External scholarship examinations.

4.11 General comments.

Finally, schools were asked if there was anything further they wished to add about the provision of programs for the education of the gifted and talented. Some of the responses were very detailed and related to earlier sections. A range of responses which provide additional insight to the school program is given below.

1. The first group emphasise concerns about equity and the pressure to help all.

- *We feel we could do better for some of our more able students but present demand seems greatest at the other end of the achievement scale.*
- *It is nice to work with this group of students, but there is no equity. The energy is going into the top and bottom and the great mid-band group is left out.*
- *We are trying to get the students to do some basic maths.*

- *Even our best students are quite limited so real extension is seldom an option. Getting a good grasp of the core is the goal for most.*
- *No problems in this area. Need better resources for less able students. Loads available for able students.*

2. Some teachers felt that it was more difficult to accommodate the needs of gifted students because of the school type.

- *In a decile 1 school it's really hard to encourage a gifted student as there's usually only about 1 each intake year. They need support and encouragement of colleagues to keep them going.*
- *We are a small area school and suffer from lack of resources, equity issues, classes where students have PAT results of age percentiles of 1 through to 92.*
- *Providing extension in a small school with mixed ability classes has its own set of problems. Students need to work in small groups with little guidance due to the demands of the rest. There is much parental pressure to extend some students but little in the way of resources to actually do this effectively.*
- *The problem in the school has been the lack of systematic programs over the years. There are students here who would probably come into the category of mathematically more capable, but the opportunities have not been there for them to come through. A particular problem of smaller schools, and a high turnover of maths teachers (any teachers) means that the consistency of approach has not been maintained.*

3. Student embarrassment was seen by some teachers as a barrier to the achievement of gifted and talented mathematics students.

- *In this culture of "not being cool" to achieve very few make themselves available for extension. The school is presently working hard on improving this culture.*
- *Very few people want extension in maths. There is a "tall poppy" syndrome-nobody wants to be seen as good at maths. A great pity-but peer pressure is greater than anything else. Most kids treat maths (and maths teachers) as the next step up from dentists!*
- *Students at all levels detest going on stage at assemblies to receive awards because of peer attitudes towards excellence in maths.*
- *Our numbers of high ability students are small and as a result they tend not to want to stand out from the rest and usually do not want to do any extra work. They also tend to be very active in other extracurricular and outside school activities which limit their time.*

4. The lack of resources was a major issue for many respondents. There were concerns with a lack of funding, a shortage of staff with the expertise to teach gifted and talented students and a lack of time to develop and maintain learning programs.

- *Have insufficient funding to provide what is required in extension or remediation. Try to provide extension through projects on each unit in Yrs 9 & 10.*
- *Resources/time/material/financial always a problem.*
- *The more non-maths specialists employed for our junior maths, the weaker the program becomes. There is a lack of Mathematics graduates opting to teach maths.*

- *It is easier to extend than to enrich because many staff can extend but do not have the skills or techniques to enrich.*
- *The single biggest issue is one of time and the availability of a capable teacher to run these programs. Last year - in Term 4 _ some extra time became available and 1 teacher was allocated 8 students for 6 weeks. Brilliant . The kids were wonderful, the 6 weeks were action packed and we got a national result - a recognition of excellence for student work. Wouldn't it be nice to have budgeted time and to be able to put programs in place for these kids with a teacher who is given a time allocation to do the work, not expected to do it on top of a full teaching load which is sprinkled with administration, sport and pastoral duties. Frankly, being "excellent" as well as "normal" is wearing me out.*
- *There is resistance from staff to introducing the Development Band Certificate because of the workload.*
- *Provision of extension programs is determined by three factors: teacher interest-without this, time and resourcing matter little; time- to prepare resources, materials, ideas and to organise; provision of readily useable or adaptable resources.*
- *Time - I am a sole charge teacher with a different load each year. This year I am teaching Years 8,9,10,11,12 Maths and Years 7,8 key-boarding, Year 9,10 Computer Studies, and I am also the careers adviser and the correspondence school liaison person. In Year 11 I'm teaching School Certificate and MAP 1 at the same time. I've run out of energy for adding extras to my teaching even though I know I should be extending my students. I feel like I'm hitting my head against a brick wall!*

- *TIME is the real barrier. We have heaps of resources and no real problem with money now. But not enough time to set up & run proper courses/programs.*
 - *We have sources of enrichment material in classes. The major issue is time/management. We have 1 teacher with an allocation of 2 hrs for extension-inadequate to do what we really want.*
 - *Main problem is teacher time and lack of teacher expertise to run programs.*
 - *TIME. The school has a policy of adhering to the technology requirements ad nauseam and to TASTER programs. We do have a large number of less able students so alternative programs in the senior school tend to need pre-requisites in the junior school. This means that maths is taught for 4 hours per week for $\frac{3}{4}$ of the school year. It is very hard to get through the required prescription.*
5. Several schools indicated that they had trialed different types of programs and made decisions based on these experiences.
- *We experimented with a number of students sitting School Certificate in Year 10 about 6 years ago. We concluded that sideways extension was much better. We found problems with selection, parental pressure, social segregation, future programs and repeating work for those that did not make the grade.*
 - *Parental/school and even student pressures opt for acceleration. We are in the process of formulating policy and course for able maths students ie identify, isolate (once a week), create, etc, etc. Limited time and resources. Hope students will get round these or other problems once we get them together.*
 - *We are considering dropping the NZAMT Development Band work as it does not seem to suit our students as well as we hoped it would. They find the units*

too long and get discouraged. They prefer to work with each other and with teacher guidance on shorter units which are related to their current program.

- *We ran enrichment programs for about 8 yrs in Maths, English and Science with an open curriculum. These were held just as an option in the General Studies periods. As years passed the time allocated reduced due to timetabling problems until the programs became too disjointed (pupils sometimes not seen for 2 weeks). The program was finally abandoned. It was successful in the early stages. We tried many methods for student selection, with varying results. The enrichment work was not compulsory and we felt that after a few years students opted into it when invited more for the perceived status than because of inclination. Allocation of staff was also a difficulty. As timetable problems increased, there were times when inappropriate staff were timetabled to take the courses.*

- *We are reviewing the program and this is being done with the students, staff, parents and the University. We are looking at a change and the YR 12 level where the majority of the accelerated students will go into an extension Yr 12 course with a focus on proofs, including mathematics which is no longer in the Year 13 courses and minimal overlap. Some students will continue straight to Bursary Calculus to do the University course in Year 13. Others will repeat S.F.C. The aim of this course is "To develop logical processes through proofs and reasoning". This should have the effect of giving them confidence in the other academic courses also. We will track these students more accurately than in the past.*

- *Used to have Yr 10 students sit S.C. and consequently accelerate through S.F.C. and UB. Yr 10 students were motivated to do S.C. but their "natural" ability ran out during their S.F.C. year, with the result that about 1/3 had to repeat S.F.C. Motivation problems at Form 7 ("I'm doing Calc again next year" and "I did Calc last year" [students did not have to repeat a subject but*

many chose to do so]. All combined to encourage us to ditch the accelerate program and replace it with a hugely successful Development Band course. This started in Form 4 in 1996 and was extended to include Form 5 in 1997 and now Form 3 as well in 1998. We find that SFC is challenging enough and are unlikely to extend the program further. Our students are at last learning how to research, write projects and persevere. A very positive change.

- *Generally works well with very little parental pressure or complaints. Students respond well but there are those who are accelerated and are not especially able and who come to grief in Form 6. (These are few in number but of concern). The standard Form 3 course offers very little in the way of a challenge for our bright students. The major problem is the disparity between School Certificate and Sixth Form Certificate. Algebra skills are weak.*
- *We have 8 hrs of learning support time available for extension/remedial work. Selected students are withdrawn once a week for extra tuition. Our Form 3&4 schemes are being revamped to include extension/enrichment ideas. Despite our 8 hrs of learning support we are not able to reach all our students who would like extension work because of timetable difficulties.*

6. Other schools detailed the types of programs that were operating successfully.

- *One Form 3 class this year is an especially selected class. Students had to apply to get in. They sat entrance tests especially designed to test mathematical ability. Some students won scholarships to be in the class. The intention is to keep the numbers to about 20 students. We do have parental pressure to offer School Certificate in Form 4. I am against this. I prefer to extend students using Development Band activities. Hopefully parental pressure will not change this. We try and train the students in time management and use research investigations as well as mathematical ones.*

- *Our program of extension also includes a group of 8-12 at each Yr group (Yr 9&10) that tackle problem solving, research projects, competitions in a group situation meeting once a week in a variety of situations by a variety of staff from different faculties.*
- *Currently offering development programs at YR 11 & 12. Both these courses are completely Unit Standards based. The Yr 11 course is run alongside S.C. with all students in the same class, sometimes doing the same work, other times doing reinforcement activities. Year 12 has a separate program.*

7. The final group of responses related to philosophical and personal opinions on the relative merits of acceleration and enrichment.

- *Teachers who accelerate just give a Form 4 student the next year's textbook and that keeps the student out of the teacher's hair.*
- *There is also external pressure to extend as other schools in the region also extend and parents may choose to send their child to a school that offers extension.*
- *Students are given opportunity in all classes for sideways extension where a need is seen to occupy them (all mixed ability classes).*
- *Students enjoy extension/enrichment programs. We have resources to run them, but not enough time to run them effectively. The most valuable outcome that I aim to achieve from these programs is the skills to deal with the language involved in solving/posing mathematical problems as most of our students do not come from a background that is rich in language.*
- *All of our students are involved in a wide variety of activities-sports, cultural etc and so are generally very busy. The odd one or two will want to enrich or*

extend their maths knowledge in their own time, but the vast majority are happy to keep up with their basic school work requirements.

- *We haven't really got enough very able students for a class (S.C. level) in Yr 10. Some teachers do not enjoy doing enrichment activities as much as others and this can affect the students' exposure to such programs. Our department is quite divided on acceleration. Personally I would like to see only a handful of top students at Year 10 doing School Certificate.*
- *I fundamentally believe that enrichment rather than acceleration is the way to go, but there is parental pressure for acceleration. Successful enrichment depends heavily on the calibre of the maths teacher involved, their breadth of knowledge of maths, of teaching strategies, of willingness to "let go" a directed approach to teaching.*
- *I have serious philosophical doubts about the value of acceleration. This is why we have moved towards the development band material. Extension material is vital. It allows us to expose students to new ways of thinking and constructing knowledge for themselves. These top students are going to be the thinkers of tomorrow. They are going to delve into areas which no-one has thought of yet. Accordingly we must equip them with investigative processes that allow them to take on this role.*
- *I far prefer the development band idea than accelerating through to sit SC early. Better for a student to get in the 90's or an A pass with their peers (and subsequent SFC grade) than a "good" mark in the 70's in YR 10.*
- *Enrichment programs should be just that. I have a philosophical problem with shoving kids up by years—often they attain marks well below their potential. The reasons given for acceleration I think hide the real ones: to make the school look good and to keep the parents happy or able to boast to each other.*

- *Our school is more interested in the broad overall development of each student, rather than pushing students into accelerated groups. We meet individual needs where possible, and encourage goal setting for learning and for life. Selection, timetabling, resources would all be issues if an accelerated class was created. I have a personal viewpoint that acceleration is not a long-term success story. Too many succumb to pressure or just lose interest. What is wrong with doing things at a normal pace and doing them to an excellent standard? This creates confident and competent students who have a well-balanced outlook on life. I am very wary of parental pressure to accelerate - often for all the wrong reasons.*
- *We don't accelerate. We teach a wide curriculum and extend outwards. No student does S.C. maths early here. This is a strength of the school!*
- *All benefit from enrichment. Those in the top 5 % benefit from acceleration. Parents do not usually pressure these students, but are always inordinately grateful that someone is giving the students' ability full rein.*
- *Parents are keen for acceleration and do not seem much interested in extension work. Some parents have very highly inflated opinions of students abilities.*
- *Acceleration of students has become less popular and only the very gifted are capable of maximising their potential in this area. Extending students sideways is proving more popular and more worthwhile for the students, teachers and parents.*

Summary

Teachers expressed a range of views - sometimes reflective of school programs, sometimes reflective of their personal experiences with a group of students and other times more philosophical. The concern about the education of gifted and talented students was evident throughout the responses, as was the need for adequate resources to provide sound educational programs. The above comments are not necessarily typical of the responses, but serve to highlight different aspects.

Many respondent schools were actively involved in trying to meet the academic needs of gifted and talented students. However, although the barriers to success were the perennial ones of time, resources and teacher training, the passion for mathematics education was apparent in many of the responses.

CHAPTER 5

5. CASE STUDIES OF THREE SECONDARY SCHOOLS

The Heads of three Mathematics Departments were interviewed in order to gain a deeper understanding of some of the issues involved in the practicalities of providing suitable educational programs for gifted and talented mathematics students. The schools were all in the same city and each school had a roll of over 1000 students in 1998. The two single sex schools had similar high decile ratings (8 and 9), while the coeducational school had a lower decile rating of 6.

Each of these schools had taken a different stance with respect to the provision of educational programs for gifted and talented students. Their different positions were representative of the programs in place in many New Zealand schools.

5.1 School A.

This school is a large, traditional, boys' school. It has always had a large roll, but the school has experienced considerable roll growth in recent years. The emphasis is on academic success in external examinations. The school has had an accelerate program which has been in place for many years. Many parents who send their sons to this school would be well aware of the accelerate program and of the school focus on examinations.

HOD Mathematics: *We're definitely exam orientated and they know that from the 3rd form they'll have exams. We're traditional.*

Unit Standards are not offered in mathematics and according to the HOD there is not the time for Development Band material.

HOD Mathematics: *We're pretty well flat out covering the syllabus. But let's face it... for a lot of parents here School Certificate is still the main aim and not this play-way stuff. We try and get them through School Certificate and even if it takes two years, our parents would still want us to have a crack at it.*

Selection of students

Boys are tested when they come into the school in Year 9 and reports are received from the contributing schools. Two top classes of 32 boys each are selected for the accelerated program and the selection is based on their english, science and mathematical ability.

In 1998, the Year 9 intake was about 340 boys. For the first month in Year 9, the boys in the accelerated classes do the same program as the rest of the Year 9 classes and then they sit a test at the end of that month in Mathematics and English and Science. Any adjustments that need to be made to the composition of the classes are made at this time. It was felt from past experience that information from contributing schools is not necessarily a reliable predictor of who should be suitable for the accelerated program.

HOD Mathematics: *We check that we have got it right because some schools tend to over-promote their kids and some tend to under-promote so we've got to give everybody a chance.*

The accelerated classes are streamed on general ability, so are composed of the same boys for mathematics, science and english and this appears to pose no major problems.

HOD Mathematics: *So you get some in there who are good at English and struggle at Maths and vice versa, but generally they do all right anyway.*

There is an opportunity for those boys who have not been selected for the accelerate classes in Year 9 to go into the program at the end of Year 9. Also, some of the boys

who have been in the accelerate program may withdraw at this stage. This is not perceived as being a failure of the selection process, but as a result of parental pressure.

HOD Mathematics: *Then there is the kid whose parents are not keen on accelerated programs and they seem to make the kid unsure about doing it and they won't cope, but that's fine. They just go through the normal classes.*

Although only some boys are able to take part in the accelerated program, there is no perceived parental pressure to have boys placed in the accelerated classes and there are no perceived problems with the accelerated system.

HOD Mathematics: *The kids who have got ability have tended to have gone through primary systems where they have been good students. Their parents are interested in their work at home and they generally have good work habits.*

Acceleration

This school has had an accelerate program in place for many years. The school believes that such a program improves the motivation and learning outcomes of the more able student.

There is no doubt that the more able students often find themselves in a class where the progress is slow and they end up becoming bored. This sometimes leads to poor work quality and output, lack of motivation and even behavioural problems. Being put into a class of similar ability students prevents this from happening and also results in the class progressing at a faster rate. Two types of acceleration then become possible – lateral extension or vertical extension. Lateral extension occurs in Forms 3 and 7 while vertical extension happens in Forms 4, 5 and 6. (School publicity material)

In the mathematics classes, the accelerate Year 9 boys cover the Year 9 Mathematics course in the first half of the year and then cover the Year 10 course in the second half

year, although from 1999 the classes will go straight on to the Year 10 program in Year 9, after the first month at school is over. In Year 10, the two accelerate classes do School Certificate in Mathematics, Science and English. They generally have a higher average in School Certificate Mathematics than the Year 11 students, although the top of the Year 11 have already been taken out of this group. The average for the two classes is over 80% and there are no boys who achieve under 50%.

In Year 11, these classes complete Sixth Form Certificate Mathematics and English and four additional School Certificate subjects. These students end up with seven School Certificate subjects, increasing the breadth of the subjects available to them. Repeating School Certificate is rare for this group. The top two Year 11 classes all do six subjects, whereas the other Year 11 classes do five subjects. Accelerate students also sit the Combined Schools Examinations in Mathematics and English.

In Year 12, the accelerate classes take a full University Bursary course. Most students resit their Bursary subjects in Year 13, although some choose different subjects. There are scholarship classes in Statistics, Calculus, Physics, Economics, Accounting and Chemistry. Massey University papers are also available extramurally. Extension mathematics material is covered in the scholarship classes. The goal for these students is to achieve scholarship passes in the NZQA University Bursary examinations and also to sit the separate NZEST Scholarship examinations.

The perceived benefits of the accelerated system are dual: the choice offered to the boys of either studying subjects in depth or of being able to take a broad range of subjects. There has been no major change to the accelerated system for some time and the system has been in place for over twenty years.

5.2 School B

School B is large girls' school with an enrolment policy in place to limit further roll growth. The school size has remained stable since 1995.

Selection of students

Students are tested when they come from their feeder schools to visit the secondary school. Two top stream classes are selected and the rest of the students are placed into mixed ability classes in Year 9. The students remain in these classes for their core subjects.

In Year 10 there is ability grouping of mathematics classes. Class size is reduced by creating one more class than there are form classes. The two top stream classes, as well as the other able Year 10 students, are all put into three form classes. Then the middle group of ninety students are put into three form classes and a similar bottom grouping is made. The groups of three form classes are then ability grouped for mathematics, so they will be coming out of their form classes and going to three separate teachers for mathematics. This system allows for movement in and out of the classes.

HOD Mathematics: *So if we decide to bump them up or down then we can do that. If in the first week it is apparent that someone is in the wrong place then it just means they go to a different class. The second class of that first option line would be equivalent to the first class in the next option line. Just because you're not in those top three classes doesn't mean you'll miss out.*

The Year 11, 12 and 13 classes are mixed ability classes. There are no special scholarship classes in Year 13.

HOD Mathematics: *We have talked about that generally, not just in mathematics, but in other subjects like science. So we could get all our best students in one class, but the school's philosophy, timetable structure is such that we've decided not to do that. I'm not so hell-bent on ability grouping as to think that it is going to be a tremendous advantage. It's also tough if you've got the class that has got all Grade 5's. It is quite nice having a few sparky people in the class.*

Extension mathematics program

In Year 10 extension, the extension is lateral rather than vertical. With the top Year 10 class, some of the activities from the NZAMT Development Band were trialed last year. This year (1998), the class is doing the Development Band Certificate. The program is found to be very good, but the marking of the work is very difficult and time consuming. It was suggested that the provision of more model answers from NZAMT would ease some of the marking burden. The Year 10 top class does not study any material from the School Certificate course, although they may develop a concept with more depth than would the other classes. They also do tasks that are outside the core curriculum.

HOD Mathematics: *We had a conference here last year and we had a real problem. We had to fit more than 300 people in the hall. I gave the 4th form the problem of the seating arrangement and they had to go away and do it and ring up all the hire centres and find the ideal patterning. They had to measure up and price everything out and then present their findings in a business-like way. So we did things a bit more like that, which was still using 3rd and 4th form skills, but at a higher level, rather than just going up to School Certificate levels.*

There is a gifted and talented program in the school which is run by two staff members. The program, which has been running for two years, is offered to Year 9 and 10 students and uses the Renzulli Secondary Schools Enrichment Model. Students are self selecting for the course, but the two staff running the course will counsel potentially unsuitable students against taking the course. However, no-one is refused entry. Each project that the students do in this course involves some mathematics.

Acceleration

The school has accelerated larger groups of students in previous years but currently allows acceleration to a more limited extent.

HOD Mathematics: *When I first got here in 1995, there was one whole class of students taking School Certificate Mathematics from the 4th form. In the next year, that was 1996, we didn't know if School Certificate was going to go, so we said let's not do it at all. In 1997 we agreed as a department that we weren't going to accelerate on such a scale. We were going to spend a lot more time identifying the students who were really gifted. In 1997 we had 8 and this year we've got 7.*

There is pressure from parents to have their daughters do School certificate Mathematics in Year 10. The pressure comes from the expectation that the same type of systems that are in place in the boys' school will prevail in the girls' school.

HOD Mathematics: *It is expected by the public that we should mirror the policies and actions of the Boys' School. That's the way it works in a conservative society. Generally the pressure is in the form of open night, or they may have another child within the school, and ask at parent/teacher interviews why we don't accelerate, and want me to justify why we don't. I am very happy to enter into discussion with those parents. I feel I'm more than qualified to justify our decision. It's not a decision we make lightly. It's a decision we revisit. We say that we do accelerate, but rather than saying we've got to get 30 students, we select students who are worthy of it. They've got to benefit from it and it's not going to be too stressful emotionally and socially, as well as academically.*

The stance taken by the Department of Mathematics is supported by the Principal, although the decision is not unanimously supported within the Department. A staff member within the department has said that if her daughter is not accelerated, then her daughter will be taken to another school.

When reviewing the school policy on acceleration the Head of Department interviewed some Year 13 students who had been accelerated as a class group.

The HOD reported that most students were pleased to have been a part of the 'whole class' accelerated program, but now found the program more difficult in Year 12. This

was because they were doing Calculus at the Bursary level, but also had the pressures of their other Sixth Form Certificate courses to cope with. The focus of their work was on Sixth Form Certificate and the students had a mad rush to work hard at the end of the year on Calculus. The HOD reported that this had a social cost, as these students had to work at the end of the year when their peers had finished their course. He also was concerned that one of the students dropped out of the accelerate program after doing Sixth Form Certificate mathematics in Year 11. Although she received a creditable grade for Sixth Form Certificate, she felt that she had worked extremely hard to receive such a grade and she wished to consolidate her learning before taking Bursary courses.

HOD Mathematics: She said she worked her tail off to get really good marks in the third form and she regretted that now, because if she hadn't worked so hard she might not have been asked to go into the accelerate class and she lost a lot of confidence in her sixth form year and didn't feel she had mastered the work. She redid the sixth form year and got a '1' the second time round.

The HOD suggested that problems with the old system had influenced the current program. Under the old system, although the top School Certificate Mathematics results were scored by some of the accelerated students from Year 10, there have been a number of students who have not succeeded on the accelerate program. Some have left school, unable to cope with the pressures of acceleration. Some students felt that they would have had a better chance of obtaining an 'A' grade in Bursary if they had not been accelerated. Additionally, the HOD was concerned with the dilemma created by taking a Bursary Mathematics course in Year 12, with the result that the subject that a student is best at may possibly not be included in the final Bursary result. He felt that students could often disadvantage themselves by sitting external examinations earlier than their peer group.

HOD Mathematics: Although we have had successful students who have gained the equivalent of scholarships from the 6th form, they can't get a scholarship from the 6th

form. Last year we had someone who scored 92% in Bursary Statistics and she doesn't end up with a scholarship. Is that a success?

He felt that in general both the students who were involved in the accelerate program, and those who were not, thought that the option to accelerate was good. They liked the fact that acceleration did not take place across all subjects and were supportive of the selective nature of the current acceleration program.

5.3 School C

School C is a coeducational school that has had a considerable roll growth over the last five years. The school is perceived as a successful school within the community and offers an alternative to single sex education. The school has streamed classes in Year 9 and 10 and accelerated classes sit School Certificate from Year 10.

Selection of students

Information is provided from the contributing schools as well as from PAT tests. According to the HOD, the information from the contributing schools is sometimes useful for identifying gifted and talented students and sometimes not. Three top classes are selected and these classes are re-evaluated after six or seven weeks. The results of Year 9 testing determine who goes into the three top classes in Year 10. The classes are streamed for general ability, not subject specific ability. This has the disadvantage that students may be good at English, but average at Mathematics.

HOD Mathematics: They can have a PAT score of 50 and I feel sorry for those kids, particularly if the class gets to really run. They are left feeling that they can't do maths, but they're very good.

The top three classes in Year 10 each have a different program. The top class is extended vertically and does School Certificate Mathematics, the second class is horizontally extended and does the NZAMT Development Band material. The third group are ...

the group of good, solid citizens who will be our 60+ % in School Certificate. A good block in the middle. The rest of the people are much like the 3rd formers-a great unwashed mass.

Ability grouping for mathematics occurs only in Year 10, and it was the HOD's perception that the students involved in the accelerate program felt that this was their best year.

HOD Mathematics: *The year in which they worked hardest because they were in a big group of their peers and they didn't want to be left behind. And they find that when they go back into an ordinary sixth form, just performing against ordinary sixth formers, they don't have to work. They do find it a real shock at how slow some of the rest of them work.*

Acceleration

The accelerate program has been running for five years and was started because of parental pressure. At the end of the second year of the existence of the accelerate class a public meeting was held for those going into Year 10.

HOD Mathematics: *There was standing room in here only and the families just came pouring along. We sent then off a letter that said we've got two deals. One was with me doing School Certificate and the other was another teacher doing straight 4th form work with sideways extension. It worked out really well. We weren't going to accept kids into the School Certificate who we didn't think would pass unless they put the pressure on us.*

It was felt by the HOD that the original pressure to have an accelerate class came from parents who wanted their children to be accelerated in mathematics. All of the top 4th form class sit School Certificate Mathematics, but do not sit other School Certificate

subjects, although the selection of the top class is not based solely on mathematical ability.

HOD Mathematics: *I think it was a small group of parents who were maths/science oriented and they would argue that this is the language that their kids want to learn.*

In Year 11, the accelerate students do a 6th form mathematics course that is entirely based on Unit Standards. They can then do a Bursary Mathematics course in Year 12, and can either repeat this in Year 13, or take other Bursary subjects. The first group of students to come through the whole class accelerate program are now in Year 13, and the Mathematics Department intends to survey this group to provide more information on the success or otherwise of the accelerate program. There appears to the HOD Mathematics to be four distinct groups within the program. The first group is composed of students who have got a lot out of the program.

HOD Mathematics: *They get heaps out of it and get 85+ and just take off. The families feel that they have been extended and they just have a ball. There are 10-13 in that group.*

There is a bottom group whose families feel that it has been a worthwhile experience because the students have learned how much work is necessary to become a high performing student.

HOD Mathematics: *Because they are good kids, they've never had to work really hard to learn things. It's always come easily and suddenly they've found out that if they follow the easy path they get 60's or early 70's in School certificate first time up and it's a foundation on which they can actually take off the following year across all of their subjects.*

The group that causes concern is the middle group. This group is not quite ready to be accelerated.

HOD Mathematics: *The kids we are seeing now that have come right through and it has not been of any benefit to them. Their algebra skills are still scratchy and they might have been better off in the 4th form to do a whole term of algebra.*

The HOD Mathematics also sees a fourth group of students who are very bright, but who have not benefited from acceleration.

HOD Mathematics: *Despite the fact that we have made an effort to extend them, the system has failed them. I have actually watched some of them come through and watched them fall off the rails. They really stand out in this system. I think we probably have a mechanism to clearly identify them but what we do with them when we do identify them is another matter. I think extension makes them more poppyish; makes them stand out more. They leave school not having achieved anything.*

There was a suggestion that some students are selected who should not have been.

HOD Mathematics: *The thing that scares us most is the kid who either through family support or through the experiences of a previous teacher have learned how to learn. And therefore are able to mask a good average maths ability but who really don't have it in terms of really thinking about maths. They should be getting 80 in School Certificate but in an accelerated system they find it harder and get 60+ the first time up.*

The HOD thought that some students have also not performed as well in Bursary mathematics as expected and some students have left school before completing Year 13. The accelerate program is to be analysed and reviewed for 1999.

5.4 Conclusion

The three school involved in the case studies had quite different responses to acceleration in mathematics.

School A has chosen to have whole group acceleration in three subject areas. Although this school had the largest Year 9 intake, it still only had two accelerate classes. Many schools would have a much higher percentage of their Year 9 intake in top stream classes. Perhaps because of the relatively small percentage of accelerated students (16% of the Year 9 intake in 1998), and the school's long history of acceleration, the difficulties that other schools have experienced with acceleration have not occurred at this school. The school's culture is examination oriented and parents and students would accept this as the norm. The expectation is that accelerated students will achieve scholarships in the Bursaries examinations in Year 13 and the structures of the school facilitate this expectation. Ability grouping of students takes place throughout the school for this accelerated group. There appears to be little discussion of other alternatives for gifted students, nor is there any desire by the school to make a change in the accelerate program.

School B has previous experience with whole class acceleration in mathematics and has currently rejected the concept. This school still allows acceleration of individual students, but it does not try to make up a class of such students. Enrichment activities are preferred, although there is some parental pressure to accelerate. The school administration supports the provision of programs for gifted students, but does not insist upon acceleration as being a necessary prerogative.

School C is currently debating the merits of acceleration. There has been an accelerate mathematics class for the past five years. The program has had a mixed success and several concerns have been identified. Students have not all performed as well as expected and some students have left school before reaching Year 13. The classes are ability grouped in Years 9 and 10, but then the accelerate students are combined with the rest of the students for the Sixth Form course and for Bursary Mathematics. The school's timetable does not allow the students to remain together, and there is no policy to ability group beyond Year 10.

CHAPTER 6

6. DISCUSSION AND CONCLUSION

It was obvious from reading through the responses from the Heads of Department that there is a strong interest in providing good educational programs for gifted and talented mathematics students. In order to deliver an appropriate program, gifted and talented students must first be appropriately identified.

6.1 Identification of Gifted and Talented Students

One of the difficulties in identifying gifted and talented students is that there are no easy methods of identification that are guaranteed to be effective in all cases. In the schools that responded to this survey only 60 % reported having identified gifted and talented mathematics students within their schools. Identification was usually based on tests—either mathematics based or general ability.

Demographic factors appeared to play a part in the identification process. Larger schools were much more likely to have identified gifted and talented students than small schools; low decile schools reported a low level of identification, while regional differences were also apparent. Gisborne and Northland had low rates of identification, while Taranaki, Nelson and Waikato all had high rates of identification. Private schools had a high rate of identification (71 %) as did boys' schools (69 %). It appears that socioeconomic factors are also at play in the identification of the gifted and talented mathematician.

6.2 School Policy on Gifted and Talented Students

Although many individual secondary teachers have made provisions for gifted and talented students within their own departments, the absence of a school-wide policy can mean that the access to appropriate educational provisions is piecemeal and inconsistent.

But provision for the needs of children with special abilities can never be fully implemented by just one member of the staff. If it is to be truly effective, such provision should be continuous and consistent throughout a child's school experience. (Cathcart, 1997, p. 128)

A previous survey (Moltzen, 1996) found that only about 20 % of schools had a separate policy on gifted and talented children. In the present survey, 32 % of schools had such a policy which, although definitely a large increase, still leaves a sizeable majority of school without a policy.

Respondents from small school (400 or less students) reported a very low rate of policies for gifted and talented students, whereas more than 40 % of the larger schools (over 800 students) had policies. This finding closely mirrors that of the identification of gifted and talented students. Although the decile rating of a school was positively correlated with the identification of gifted and talented students, it had little apparent effect on the existence of a policy.

Regional differences were present, but in a different way than in the identification of gifted and talented students. Other factors, apart from the presence of a written policy, may be leading schools to identify gifted and talented students. Just over 50 % of the respondent Otago schools had identified gifted and talented students, but only 20 % of those schools had a written policy. Private schools were far more likely to have a written policy on the education of the gifted and talented than integrated or public schools, while girls' schools were more likely to have a policy than boys' schools or coeducational schools.

The presence of a written policy may well lead to a cohesive program for gifted and talented students, but it is evident that schools are actively engaged in running programs in the absence of policy.

6.3 Ability Grouping in Year 9

Ability grouping is still a contentious issue in education today (Boaler, 1997). The schools that responded to this survey reported a variety of grouping practices. Some schools (35 %) grouped their top students on general ability and kept the group together for all core subjects. Other schools (18 %) had one or more accelerate class based on general ability, but students were then grouped by mathematical ability for their junior mathematics classes. In some schools (13 %), mathematical ability was used to group students for their mathematics classes, but students were in mixed ability classes for their other core subjects. The remaining schools (34 %) had no form of ability grouping.

Features of respondent schools that were associated with streaming of Year 9 classes (general ability grouping) were being a larger school (over 800 students), a decile rating of 10, Manawatu schools and boys' schools. A low incidence of streaming was found in small schools (under 400 students), decile 1 schools, schools in Gisborne or Southland and integrated schools.

Streamed classes do not necessarily contain all the top mathematics students and they can contain students who are weak mathematically, but good at English. In addition, some Heads of Department reported the necessity to include weaker students in the streamed classes to make the numbers up to a full class size.

The factors associated with streaming of classes were not the same as those associated with grouping based on mathematical ability. Grouping of Year 9 classes by mathematical ability was reported by 13 % of the respondent schools. This type of grouping (banding) was more likely to occur in girls' schools than in boys' schools or coeducational schools. It was very unlikely to be used in small schools (under 400 students) or in schools in Canterbury or Otago.

The overall incidence of ability grouping for mathematics based solely on mathematical activity was low, yet this is the type of grouping that is most often recommended for gifted and talented mathematics' students. A study of students involved in the out-of-

school extension program run by the New Zealand Mathematical Olympiad Committee (NZMOC) surveyed students' attitudes to a range of topics, including that of streamed classes (Curran, Holton, Marshall & Haur, 1999).

Some of the students in our survey had been in streamed classes. None complained about them. A number who had not had that experience indicated that they would have found it more stimulating if they had been in streamed classes for maths. (p. 26)

6.4 Acceleration

A good educational program for gifted and talented students should include acceleration (Van Tassel-Baska, 1992). The type of acceleration surveyed in this study was the early sitting of School Certificate mathematics. School Certificate is the first national examination that students can sit and it would appear to be a relatively easy option for schools wishing to accelerate some of their students. However, there are problems attendant on the early sitting of School Certificate. The follow-up programs in the senior school need to be well thought out if students are to continue to engage in worthwhile and meaningful activities in mathematics. Also, the fact of doing School Certificate a year early does not mean that a gifted and talented mathematics' student will have their program delivered to them appropriately. Being part of a slow School Certificate mathematics' class may well hinder the mathematical learning of a young gifted and talented mathematician.

Fifty-five percent of respondent schools reported having an acceleration program that enable students to sit mathematics earlier than Year 11. Large schools (over 1200 students) were more likely to accelerate students than smaller schools, private schools had a high rate of acceleration, as did boys' schools.

Whole class acceleration is not a common practice. Only 27 % of the respondent schools that do permit acceleration had large groups of 21 or more students sitting School

certificate mathematics earlier than Year 11, while 61 % had accelerated less than 10 students at a time.

Although McAlpine (1997) says that the most commonly used method of identification is teacher selection, students in this survey were most often selected for the accelerate program based on the results of school tests and exams (45 %). The next most common method of selection (32 %) was based on the results of standardised tests, such as Progressive Achievement Tests, TOSCA and the University of New South Wales tests, followed by teacher recommendation (27%). McAlpine says that it is important to be aware of several methods of identification and not to rely too heavily on one method alone and in this survey many of the schools did use more than one method of identification.

Of the respondent schools that did accelerate students, 74 % of these schools had experienced problems with acceleration. Many of these schools had experienced problems in more than one area. Schools had timetable problems where there were difficulties in accommodating students' choice of subject in the senior school. It was also difficult for some schools to place their Year 10 students in a School Certificate mathematics class. Parental pressure was a problem for 16 % of these schools. Teachers perceived parents as having unrealistic expectations for their students. Some Heads of Department felt that parental pressure for an accelerate program had influenced the decision making processes of the senior management team at the school to provide such a program, regardless of the educational needs of the students. Concern was also expressed with the achievement of some of the accelerated students in the senior school. It was thought that some students were underachieving in the senior school through lack of grounding in mathematics, lack of maturity, and conflicting pressures of Sixth Form Certificate and Bursary. A lack of mathematical alternatives in the senior school for students that had been accelerated was considered to be a problem by some Heads of Department.

Just over a quarter (26 %) of the respondent schools that permitted acceleration reported no problems with acceleration. A few of these schools had only recently begun to accelerate students, but some of the schools in this group had been successfully accelerating students for years. These schools had developed strategies which worked for them and many of the strategies were to do with effective communication of expectations to parents, as well as keeping parents informed about the programs in place. Although mathematics was clearly the most favoured subject to accelerate among the respondent schools, acceleration also occurred in almost every subject. In most cases, the acceleration was in individual cases according to student need. Whole class acceleration was most common in mathematics (35 schools), but also occurred in science (20 schools), english (15 schools), geography (8 schools) and history (5 schools). Single instances of whole class acceleration in other subjects were reported.

6.5 Development Band

An excellent program for gifted and talented students would offer an enriched and accelerated curriculum (Van Tassel-Baska, 1992). Development Band in the *Mathematics in the New Zealand Curriculum* (Ministry of Education, 1992) is an example of an enrichment program. Acceleration without enrichment may not provide a qualitatively different program, while enrichment without acceleration may merely encourage 'busy' work.

Many schools are taking part in Development Band Certificate course run by the New Zealand Association of Mathematics Teachers (NZAMT). The aim of this course is to provide enrichment activities for able students. Of the respondent schools in this survey, 45 % had students enrolled in the certificate course. The use that schools made of the certificate seemed to be with whole classes that were ability grouped. Thirty of the Year 9 classes and 36 of the Year 10 in the respondent schools had more than 20 students enrolled in the certificate.

Selection criteria for the certificate course was quite different from the criteria used for the selection of accelerate students. The most common reason given for entry into the

certificate course was that it was compulsory for the top mathematics classes. The teacher's recommendation was the next most common reason given (24 %), with self selection being cited relatively frequently (18 %). Standardised tests (20 %) and school tests and exams (22 %) were still important, but not nearly to the same extent as in the entry into the accelerate program.

6.6 Other Provisions

Many other provisions for gifted and talented mathematics' students were reported by respondent schools. Schools entered their students in a wide range of competitions, as well as offering many extension and enrichment programs. Certainly, the will to provide for gifted and talented students was evident in the provisions made in many schools. However, the time to develop programs, the lack of well qualified mathematics teachers and the perceived lack of resources available was mentioned by several Heads of Department as a barrier to learning for the gifted and talented.

6.7 Implications of the Study

Implications for National Policy

The provision of programs for gifted and talented mathematicians in New Zealand secondary schools differs widely from school to school. The provision of such programs should not need to depend on school size, or whether the school is single sex or coeducational, or whether a school is sited in a particular region. National policy guidelines for the education of the gifted and talented are urgently needed and the current development of these guidelines by the Ministry of Education is welcome.

Implications for Schools

A school-wide policy that takes into account current research and best practice in gifted and talented education would support the development of appropriate programs within schools. Ability grouping, acceleration and enrichment programs all have a place in the education of the gifted and talented. Identification procedures should embrace a wide

variety of methods and care should be taken to identify the gifted and talented within all sections of the school community.

Implications for Teachers

Many teachers have never received any professional development in the field of gifted education. Training would enable teachers to be receptive to current theory and practice and would assist teachers to put into place appropriate strategies in their classrooms. There are already many programs available to the gifted and talented mathematician in New Zealand secondary schools, but not all teachers are aware of the range of programs that is currently available. Time and professional development to implement the Development Band in mathematics is needed, along with information on the benefits to the student of acceleration and ability grouping.

6.8 Implications for Further Research

1. This study provides an overview of the current programs for gifted and talented mathematicians in place in New Zealand secondary schools. Many schools reported briefly on the types of programs that ran within their school and three schools were asked to describe their programs in more detail. More detailed studies of some of the types of programs available would provide exemplars of good practice that could assist schools in the development of their own programs.
2. This survey was completed by the Head of Mathematics at each school. The opinions expressed can not necessarily be generalised to other staff at the school. The Board of Trustees, the Principal and other staff may well have an entirely different perspective on the success or otherwise of the programs for gifted and talented students within the school. Further school-wide research is needed to investigate the overall view of gifted and talented education in New Zealand secondary schools.
3. Programs for gifted and talented students are in place because there is an educational need for such programs. Those most affected by the success or otherwise of the programs, the students themselves, are an unheard voice in this research. While the

main goal of this research was to provide an overview of current practices, further research is needed to investigate the students' view on the effectiveness and suitability of the programs, especially the long term effects on students participation in future mathematics learning. The social and emotional effects on students of ability grouping and acceleration need to be considered in both the short and long term.

4. Parents of gifted and talented children need to have their concerns aired. Too often, parents were regarded as applying unwarranted pressure on schools to accelerate their children. Research is needed to investigate the satisfaction of parents with current programs for gifted and talented children.
5. Overseas research has indicated that white, middle class students who are academic achievers are identified more readily than students from low socio-economic groups or from ethnic minorities (Davis & Rimm, 1994). New Zealand research is needed on the effects of socio-economic status and ethnicity on the identification of gifted and talented students.

6.9 Conclusion

Ability grouping, acceleration and enrichment are all essential components of a good educational program for gifted and talented students. While some New Zealand schools provide programs that combined all three components, many schools did not. Nearly half of the respondent schools did not accelerate students and just over one third of the schools had no form of ability grouping. While there are many excellent programs in place in New Zealand, there is a need for consistency in the educational provisions available to gifted and talented students. All New Zealand schools need to offer a well thought out, cohesive program for gifted and talented students that takes into account the needs of the particular school and student population. Otherwise, the educational needs of the gifted and talented mathematics student in New Zealand are still dependent on the efforts of individual teachers and schools.

Unless we provide optimum programs for our gifted and talented mathematics students we run the risk of wasting our best mathematical talent. "*The human waste in terms of both student and faculty time is inestimable, and this waste can be found in both rich schools and poor, and even in schools that have well established programs for the gifted*" (Renzulli, 1991, pp. 75-76). Where the needs of the gifted and talented are not met, there is the potential for lost academic growth, lost creative potential, lost enthusiasm for educational success and eventual professional under-achievement. Some gifted and talented students will find school intolerable and leave, while others will hide their talents or make do as best they can. Inappropriate and poorly conceived programs for the gifted and talented are potentially damaging to both society and to the individual.

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12. Does your school have a policy on accelerating students to sit School Certificate Mathematics earlier than Year 11?

Yes Go to Qu. 13
No Go to Qu. 19

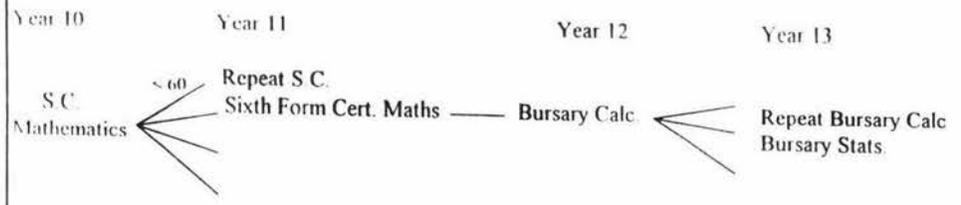
13. How many students would this involve each year on average?

- 1 - 5 6 - 10 11 - 20 21 - 30 > 30

14. At what year level do students enter the accelerated learning program?

15. How are students selected for the accelerated learning program?

16. Use a flowchart or otherwise to describe the options available to students who sit School Certificate Mathematics before Year 11. A possible example is given



S.C. Mathematics

17. Some schools have experienced some problems with acceleration, such as timetable restrictions, parental pressure, lack of continuous programs in the senior school, etc. Have you encountered any difficulties with acceleration of students?
If your answer is yes could you briefly specify the type of difficulties you have encountered

Yes / No

18. If other subjects at your school are accelerated, please list them below

Subject	Approximate number of students involved
_____	_____
_____	_____
_____	_____
_____	_____

19. Are students in your school involved in the NZAMT Development Band courses?
Yes Go to Qu 20
No Go to Qu 22

20. How many students are involved at each level?

21. How are students selected for the courses?

22. What other activities are your more able mathematics students involved in?
eg. Maths Olympiad, competitions, maths clubs, tutoring, etc.

23. Is there anything you wish to add about the provision of extension or enrichment programs in mathematics? Some issues might be availability, resources, learning outcomes, selection of students, parental/school pressures, equity, etc.

Thank you very much for your cooperation in completing this questionnaire. I really appreciate you giving up your time to help me. A summary of the results of this survey will be sent out to you during Term 3.

Appendix 2: Covering letter sent to Heads of Mathematics

May 1998

Jan Winsley
 C/- Institute of Fundamental Sciences
 Mathematics
 Massey University
 PB 11222
 Palmerston North



**MASSEY
 UNIVERSITY**

Private Bag 11222
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 Telephone +64-6-356 1100

Dear HOD Mathematics.

I am in my third year of study for the Master of Educational Studies in Mathematics course at Massey University. I am doing a thesis this year and the topic of my research concerns the provision of mathematics programmes for high ability students in secondary schools in New Zealand. In order to establish an overview of the programs currently being offered I have sent a questionnaire to all secondary schools.

You are invited to fill out the questionnaire and return it in the enclosed prepaid envelope.

Individual questionnaire responses will be kept confidential to the researcher and supervisor. Returned questionnaires will be stored in a secure place by the researcher and will be destroyed upon completion of the research. Response information will be aggregated and no school will be identified by name in any written reports.

All respondents will automatically be sent a summary of the questionnaire responses in Term 3 of this year. This will give you and the members of your Mathematics Department an opportunity to see what schools around New Zealand are doing in regard to programs for high ability students.

Should you have any queries about the questionnaire or wish to obtain further information about the project in general I can be contacted in the evenings on (06) 8768278 or by email at winsleyjn@clear.net.nz. Alternatively, you may contact my research supervisor Dr Glenda Anthony during work hours on (06) 3505336.

I would like to clarify two of the terms that I have used in the questionnaire:

- By **streaming**, I mean the grouping of a whole class or classes by ability. *The streamed class would remain the same for all of the core subjects.*
- **Banding** is the ability grouping of students by subject. *The class would remain together in its entirety for just that one subject.*

As a mathematics teacher myself I realise that time for such things is of a scarcity nowadays and greatly appreciate your input. Thank you again for your time.

Yours sincerely,

Jan Winsley
 HOD Mathematics
 Hastings Girls High School.

Appendix 3: Topics sent to Heads of Departments in schools for semi-structured interviews

Questionnaire Schedule for Case Studies of Enrichment/Acceleration Mathematics Programs.

Thank you for agreeing to be interviewed about the mathematics programs in your school. Listed below are the questions that I would like you to talk about. There may well be other issues that you would like to discuss. Under the requirements of the Massey University Ethics Committee, you have the right

- to refuse to answer any particular question
- to withdraw from the study at any time
- to ask any questions about the study at any time during participation

Interviews will be recorded on audiotape with the permission of the interviewee and transcriptions of the recordings will be made by myself. Taped responses will be kept confidential to the researcher and supervisor. The tapes will be held securely and will be destroyed at the completion of the research. Your school will not be identified by name or otherwise in any written reports.

A summary of the research findings including the questionnaire and case studies will be sent to your school in Term 4 of this year.

The questions are as follows:

1. How many mixed ability or streamed classes do you have in Year 9, 10, 11?
2. If streamed or banded, how are students selected for these classes?
3. Is there movement in and out of classes? How is this determined?
4. Are there equity issues raised in the composition of these classes?
5. What type of enrichment and/or acceleration is offered in Year 9 and 10?
6. How long has such a system been in place?
7. What do you think are the benefits of such a system?
8. What do you think are the disadvantages of such a system?
9. Is this the preferred school-wide option, or this a departmental decision?
10. What happens to the class at the end of Year 9?
11. What happens to the class at the end of Year 10?
12. If students were accelerated, how many resat S.C. last year? Are resitting this year?
13. If students were accelerated, how many resat Bursary last year? Are resitting this year?
14. Are parents happy with such a system?
15. Do you have specialist maths teachers teaching these programs?
16. How do you follow up the success of your program?
17. If you have changed your system recently, what were the reasons for your change?
18. What would be your ideal program for teaching able mathematics students if time and resources were not a problem?

Appendix 4: American Grade Levels

American Grade Levels (Riley, 1996)

Elementary School

Kindergarten - entered at age 5, but not on the child's 5th birthday
(the cut-off date for an August start is usually a birthday on or before November 1st)

1 st Grade	-	age 6
2 nd Grade	-	age 7
3 rd Grade	-	age 8
4 th Grade	-	age 9
5 th Grade	-	age 10

Middle School

6 th Grade	-	age 11
7 th Grade	-	age 12
8 th Grade	-	age 13

Secondary School

9 th Grade	-	age 14
10 th Grade	-	age 15
11 th Grade	-	age 16
12 th Grade	-	age 17

