

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

# **Multiple Perspectives on the Education of Mathematically Gifted and Talented Students**

**A dissertation presented in partial fulfilment of the requirements  
for the degree of Doctor of Philosophy in Education  
at Massey University, Palmerston North,  
New Zealand**

**Brenda Anne Bicknell**

**2009**



## ABSTRACT

This study examines multiple perspectives on the education of a group of fifteen Year 6 and Year 8 students identified as mathematically gifted and talented. The students' mathematical experiences, both past and present are examined using evidence from school policy documents; student, teacher, and parent interviews; questionnaires; and classroom observations. The purpose of this case study was to seek understandings about awareness of the characteristics of mathematically gifted and talented students, the identification of and educational provisions for mathematically gifted and talented students, parental involvement, and school transfer.

The group of fifteen students consisted of ten Year 6 students who transferred from primary school to a new school for Year 7, and five Year 8 students who moved to secondary schools for Year 9. These students had been identified by their school and teachers as gifted and talented in mathematics.

This predominantly qualitative study is underpinned by an interpretive paradigm and influenced by a sociocultural philosophy of learning and teaching. The literature review presents the dilemmas, similarities, and differences that prevail in the field of gifted education. A more specific focus is given to the education of mathematically gifted students to highlight gaps in the field. This two-year study tracking a group of students provides a cohesive approach to understanding the educational provisions for students identified as mathematically gifted and talented in the New Zealand setting. The multiple case studies included interviews, questionnaires, documents, and observations.

The research findings show that there is not a comprehensive understanding by schools and teachers about the characteristics of mathematically gifted students. Despite the documentation of a range of identification processes in school policies, a multiple method approach is not practised in many schools. Provision of appropriate programmes is variable and determined by factors such as school organization, identification, teacher knowledge and expertise, and resources. Parents play a key role in their children's mathematics education as motivators, resource providers, monitors, mathematics content advisers, and mathematical learning advisers. Schools, teachers, parents, and peers all contribute to the success of a student's transfer from one phase of schooling to another; they support a student's social and emotional well being and influence curriculum continuity in mathematics.

This study provides insights into the various determinants of the development of mathematical talent. For New Zealand schools and teachers, it provides evidence that understanding the characteristics of mathematical giftedness is important and that identification processes must reflect this understanding. Provisions must be well considered and evaluated; the role of parents should be understood and valued; and home-school communications strengthened. Together, all stakeholders share a critical role in the education of mathematically gifted and talented students.

## ACKNOWLEDGEMENTS

I would like to acknowledge and thank the many people who have contributed to this study and thesis. This document is evidence of a long-time interest and commitment to the area of gifted education and mathematics. The study would not have been possible without the students, their parents, and their teachers who willingly, with sincerity and openness, shared their thoughts and experiences, past and present, with me.

I would like to thank my chief supervisor Associate Professor Tracy Riley for her wonderful support and interest, and for sharing her admirable expertise and experience in the field of gifted education. I would also like to acknowledge my second supervisor, Dr Jenny Poskitt, for her positive and constructive feedback, and for her appreciation of the importance of a balance in life. Thanks are also extended to Leanne for her professional expertise in helping make this thesis a cohesive whole.

Finally, on a personal level, I want to acknowledge the love and support of my family, especially my sister Clare and dearest friend John. I am also grateful to have such caring and loving children, and a wonderful network of friends and close colleagues who have taken an interest in my study. This positive support from so many 'significant others' has helped bring this thesis to fruition. Thank you.

# TABLE OF CONTENTS

Abstract .....	i
Acknowledgements .....	ii
Table of Contents .....	iii

## **Chapter One: Introduction**

1.1 Introduction .....	1
1.2 International Background .....	2
1.3 New Zealand Background .....	3
1.4 Personal Perspective .....	4
1.5 Research Aims and Objectives .....	5
1.6 Structure of the Thesis .....	5

## **Chapter Two: Literature Review**

2.1 Introduction .....	7
2.2 Definitions and Conceptions of Giftedness .....	8
2.3 Mathematically Gifted .....	11
2.4 Identification .....	16
2.4.1 Observations .....	19
2.4.2 Tests .....	20
2.4.3 Using Problem Solving as a Means of Identification .....	23
2.4.4 Other Methods of Identification .....	25
2.4.5 Is Any Identification Procedure Necessary? .....	26
2.5 Teaching and Learning Mathematics .....	27
2.6 Provisions for the Mathematically Gifted .....	28
2.6.1 Policy, Practice, and Evaluation .....	28
2.6.2 Acceleration .....	30
2.6.3 Enrichment .....	35
2.6.4 Getting-it-Together .....	36
2.6.5 Differentiation and Challenging Tasks .....	38
2.6.6 Ability Grouping .....	40
2.6.7 Classroom Strategies .....	42
2.6.8 School-Wide Strategies .....	44

2.7	Supporting Gifted Students .....	49
2.7.1	Teachers of the Gifted .....	49
2.7.2	Resources .....	51
2.7.3	Parental Involvement .....	53
	Homework .....	56
	Theoretical Frameworks .....	57
2.8	Transition or Transfer .....	59
2.8.1	Conceptual Framework for Examining Transfer .....	64
2.9	Conclusion .....	64

### **Chapter Three: Methodology**

3.1	Introduction .....	67
3.2	Research Questions .....	68
3.3	Epistemological, Ontological, and Methodological Considerations .....	68
3.3.1	Interpretivism .....	69
3.3.2	Qualitative Research .....	70
3.3.3	Naturalistic Inquiry .....	70
3.3.4	Grounded Theory .....	71
3.3.5	Qualitative Research in Gifted Education .....	72
3.4	Case Study .....	72
3.4.1	Different Types of Case Study .....	74
3.4.2	Multiple-Case Studies .....	74
3.4.3	Longitudinal Studies .....	75
3.4.4	Generalizability .....	75
3.4.5	Roles of the Researcher .....	76
3.4.6	Sampling .....	77
3.5	Data Gathering Methods .....	78
3.5.1	Interviews .....	78
3.5.2	Observations .....	81
3.5.3	Questionnaires .....	82
3.5.4	Documents .....	83
3.6	Data Analysis .....	84
3.7	Reliability and Validity .....	86
3.7.1	Triangulation .....	87
3.7.2	Reflexivity .....	88

3.8	Ethical Considerations .....	88
	3.8.1 Ethics in Theory .....	88
3.9	Summary .....	90

#### **Chapter Four: Methodology in Practice**

4.1	Introduction .....	93
4.2	Research Design .....	93
	4.2.1 Case Studies .....	94
	4.2.2 The Researcher .....	94
	4.2.3 Research Sample .....	95
4.3	Data Gathering Methods .....	98
	4.3.1 Interviews .....	98
	4.3.2 Questionnaires .....	100
	4.3.3 Documents .....	101
	4.3.4 Observations .....	101
	4.3.5 Research Diary .....	102
4.4	Data Analysis .....	102
4.5	The Pilot Study .....	105
4.6	Ethics in Action .....	106
4.7	Evaluation .....	108
	4.7.1 Evaluating the Process .....	108
	4.7.2 Evaluating the Product .....	110
4.8	Summary .....	110

#### **Chapter Five: Background Findings: School Policies**

5.1	Introduction .....	113
5.2	School Policies (Phase One) .....	114
	5.2.1 School A .....	114
	5.2.2 School B .....	117
	5.2.3 School C .....	118
5.3	Policies (Phase Two) .....	120
	5.3.1 School D .....	120
	5.3.2 School E .....	123
	5.3.3 School F .....	124
	5.3.4 School G .....	125
	5.3.5 School H .....	127



5.3.6	School I .....	127
5.3.7	School J .....	129
5.3.8	School K .....	131
5.4	Summary and Discussion of the Policies .....	132
5.4.1	Rationale and Purpose .....	132
5.4.2	Definition and Identification .....	133
5.4.3	Provisions .....	134
5.4.4	Professional Development .....	135
5.4.5	Community and Parent Involvement .....	136
5.4.6	Resources .....	137
5.4.7	Evaluation .....	138
5.5	Conclusion .....	138

### **Chapter Six: Characteristics and Identification**

6.1	Introduction .....	141
6.2	Characteristics of the Mathematically Gifted .....	142
6.2.1	Early Interest and Ability in Mathematics .....	142
6.2.2	Characteristics as Evidenced in ‘School Mathematics’ .....	144
6.2.3	Students’ Interests and Hobbies .....	147
6.2.4	Students’ Mathematical Interests and Attitudes .....	148
6.3	Identification .....	151
6.4	Summary and Discussion .....	155

### **Chapter Seven: The Teacher of the Mathematically Gifted and the Mathematics Programme**

7.1	Introduction .....	159
7.2	Qualities of a Good Mathematics Teacher .....	159
7.3	The Mathematics Programmes .....	164
7.3.1	Acceleration .....	164
7.3.2	Enriching the Mathematics Programme .....	166
7.3.3	Differentiation and Challenging Tasks .....	167
7.3.4	Resources .....	170
	Textbooks .....	170
	Other Resources .....	173
	Issues .....	174

7.3.5	Group Versus Independent Work .....	175
7.3.6	Homework .....	177
7.3.7	Competitions .....	179
7.4	Tracking Progress .....	182
7.5	Out-of-School Provision .....	184
7.6	Summary and Discussion .....	186

## **Chapter Eight: Parental Involvement**

8.1	Introduction .....	195
8.2	Questionnaire Results .....	195
8.3	Types of Parental Involvement .....	199
8.3.1	Motivator .....	199
8.3.2	Resource Provider .....	200
8.3.3	Monitor .....	201
8.3.4	Mathematics Content Adviser .....	202
8.3.5	Mathematics Learning Counsellor .....	203
8.3.6	Parents as Advocates .....	204
8.4	Summary and Discussion .....	206

## **Chapter Nine: School Transfer**

9.1	Introduction .....	209
9.2	School Choice .....	210
9.3	Preparedness and Expectations .....	212
9.3.1	Systemic .....	213
9.3.2	Academic .....	214
9.3.3	Little Fish, Big Pond .....	216
9.4	Support .....	217
9.4.1	Peers, Friends, and Siblings .....	217
9.4.2	Parental Support .....	219
9.4.3	Teachers and School Support .....	220
9.5	Academic Progress .....	221
9.6	Looking Ahead and Pathways .....	222
9.7	Summary and Discussion .....	226

## **Chapter Ten: Conclusions and Implications**

10.1	Introduction .....	233
10.2	Influences and Limitations .....	234
10.3	Characteristics of the Mathematically Gifted .....	235
10.4	Identification of Mathematically Gifted Students .....	237
10.5	Provisions .....	239
10.6	Teacher Qualities .....	242
10.7	Parental Involvement .....	242
10.8	School Transfer .....	244
10.9	Theoretical Perspectives .....	246
10.10	Implications .....	247
10.11	Further Research .....	250
10.12	Final Words .....	251

<b>References</b> .....	253
-------------------------	-----

## **Appendices**

Appendix A: Student Interviews .....	275
Appendix B: Teacher Interviews .....	277
Appendix C: Parent Interviews .....	279
Appendix D: Transcriber Consent .....	280
Appendix E: Student Questionnaire .....	281
Appendix F: Parent Questionnaire .....	282
Appendix G: Information Sheet - Principal/Board of Trustees and Teacher .....	284
Appendix H: Information Sheet - Students .....	289
Appendix I: Information Sheet - Parents/Caregivers .....	292

## List of Tables

Table 4.1	Data Gathering Methods used in the Study .....	94
Table 4.2	Participants .....	96
Table 4.3	Phase One Schools, Teachers, and Organizational Provisions .....	97
Table 4.4	Phase Two Schools and Teachers after Students made a Transfer ...	97
Table 6.1	Students' Interests and Hobbies .....	147
Table 6.2	Mathematics Interest and Attitude Questions and Average Score for Year 6 and Year 8 .....	148
Table 6.3	Students' Mathematical Interests and Attitudes .....	149
Table 8.1	Number of Responses for each PIQ Item .....	196
Table 8.2	PIQ Scores for each Parent .....	198

## List of Figures

Figure 2.1	The six circles problem .....	23
Figure 2.2	Strategies for special provision for the mathematically gifted .....	30
Figure 2.3	Casual and specific model of parental involvement, focused on variables of major significance that are also subject to intervention and change .....	58
Figure 5.1	Parent letter .....	116