

Trends in Year 5 Students' Mathematics and Science Achievement

*Results from a New Zealand study based on the
Third International Mathematics and Science Study*

Glenn Chamberlain
with the assistance of Megan Chamberlain and Maurice Walker

First published in 2001 by the:

Comparative Education Research Unit
Research Division
Ministry of Education
PO Box 1666
Wellington
New Zealand

Copyright © Ministry of Education

All rights reserved. Enquiries should be made to the publisher.

ISBN 0-477-04720-3

Opinions expressed in this report are those of the authors and do not necessarily coincide with those of the Ministry of Education.

Cover Design: Learning Media Ltd
Desktop Publishing: Christabel Dillon, Ministry of Education
Printed by: Lithoprint Ltd, Wellington.

Contents

CHAPTER 1: INTRODUCTION	1
Key Points	1
What was TIMSS-98?	2
A national version of TIMSS-98 at the middle primary level	2
The results of TIMSS-94 and the impact on TIMSS-98	2
Who carried out the administration of TIMSS-98?	4
Rationale for the study	4
Population definition	7
Sampling	7
Instrumentation	8
Data collection	8
Reporting student achievement results	8
Chapter Summary	9
CHAPTER 2: MATHEMATICS ACHIEVEMENT	11
Key points	11
Reporting student achievement results	12
Trends in mathematics achievement	12
Overall mathematics achievement	12
Ethnicity	15
Gender and ethnicity	15
Home language	16
Mathematics content reporting categories	18
Performance on a selection of mathematics items	22
CHAPTER 3: SCIENCE ACHIEVEMENT	27
Key points	27
Reporting student science achievement results	28
Trends in science achievement	28
Overall science achievement	28
Gender	30
Ethnicity	30
Gender by ethnicity	31
Home language	32
Science content reporting categories	33
Performance on a selection of science items	37
CHAPTER 4: THE STUDENTS	41
Key points	41
Demographic variables	42
Home background variables	44
Social and economic background	47
Out-of-school activities	50
Perceptions and attitudes	54
School environment	61
CHAPTER 5: SUMMARY	63
Year 5 student achievement in a national context	63
Year 5 student background characteristics, attitudes and beliefs	64

APPENDIX A: NOTES FOR CHAPTER 1	67
New Zealand's participation in IEA studies	67
New Zealand reports	67
International reports	67
APPENDIX B: REFERENCE TABLES FOR CHAPTER 2	69
Mathematics achievement	69
APPENDIX C: REFERENCE TABLES FOR CHAPTER 3	75
Science achievement	75
APPENDIX D: REFERENCE TABLES FOR CHAPTER 4	81
APPENDIX E: TECHNICAL NOTES	89
TN.1: Summary of the scaling process	89
TN.2: standard error and the jackknife Repeated replication method	90
TN.3: significance testing	90
TN.4: Multiple comparisons of means	91
TN.5 Effect Sizes	91
TN.6: Missing students	92
REFERENCES	93

FIGURES

Figure 2.1	Distribution of Year 5 students' mathematics scores for 1994 and 1998	13
Figure 2.2	Year 5 students' mean mathematics scores for 1994 and 1998, by gender	14
Figure 2.3	Year 5 students' mean mathematics scores for 1994 and 1998, by gender and ethnic grouping	16
Figure 2.4	Year 5 students' mean mathematics scores for 1994 and 1998, by the degree that English is spoken in the home	17
Figure 2.5	Year 5 students' mean mathematics scores for 1998, by the degree that English is spoken in the home and ethnic grouping	18
Figure 2.6a	Year 5 students' mean scores for each mathematics reporting category in 1994	19
Figure 2.6b	Year 5 students' mean scores for each mathematics reporting category in 1998	19
Figure 2.7	Year 5 students' mean scores for each mathematics reporting category in 1998, by gender	20
Figure 2.8	Year 5 students' mean scores for each mathematics reporting category in 1998, by ethnic grouping	21
Figure 3.1	Distribution of Year 5 students' science scores for 1994 and 1998	29
Figure 3.2	Year 5 students' mean science scores for 1994 and 1998, by gender	30
Figure 3.3	Year 5 students' mean science scores for 1994 and 1998, by gender and ethnic grouping	32
Figure 3.4	Year 5 students' mean science scores for 1994 and 1998, by the degree that English is spoken in the home	33
Figure 3.5	Year 5 students' mean science scores for 1998, by the degree that English was spoken in the home and ethnic grouping	33
Figure 3.6a	Year 5 students' mean scores for each science reporting category in 1994	34
Figure 3.6b	Year 5 students' mean scores for each science reporting category in 1998	34
Figure 3.7	Year 5 students' mean scores for each science reporting category in 1998, by gender	35
Figure 3.8	Year 5 students' mean scores for each science reporting category in 1998, by ethnic grouping	36
Figure 4.1	Proportion of Year 5 students in each main ethnic grouping for 1994 and 1998	43
Figure 4.2	Proportion of Year 5 students where English was spoken only rarely in the home for 1994 and 1998, by ethnic grouping	44
Figure 4.3	Proportion of Year 5 students by household structure for 1998	45
Figure 4.4	Proportion of Year 5 students by household structure and ethnic grouping for 1998	46
Figure 4.5	Year 5 students' mean mathematics and science scores by household structure for 1998	46
Figure 4.6	Year 5 students' mean mathematics and science scores for 1998, by the number of books in the home	48
Figure 4.7	Amount of time Year 5 students spent on leisure activities on a normal school day for 1998	50
Figure 4.8	Year 5 students' mean mathematics and science scores, by the level of television and video watching for 1998	52
Figure 4.9	Year 5 students' mean mathematics and science scores at each level of the Out-of-School Study Time (OST) Index in 1998	54
Figure 4.10	Year 5 students' perceptions of their mothers' and friends' views, as well their own, on the importance of doing well for 1998	55
Figure 4.11	Proportion of Year 5 students on the Positive Attitudes Towards Mathematics (PATM) Index and their mean mathematics scores for 1998, by gender	56
Figure 4.12	Proportion of Year 5 students on the Positive Attitudes to Mathematics (PATM) Index and their mean mathematics scores for 1998, by ethnic grouping	57
Figure 4.13	Proportion of Year 5 students on the Positive Attitudes Towards Science (PATS) Index and their mean mathematics scores in 1998, by gender	58
Figure 4.14	Proportion of Year 5 students on the Positive Attitudes to Science (PATS) Index and their mean science scores for 1998, by ethnic grouping	59

TABLES

Table 1.1	A summary of New Zealand's designed and achieved samples at Year 5 in TIMSS-98	7
Table 2.1	Year 5 students' mean mathematics scores for 1994 and 1998	12
Table 2.2	Year 5 students' mean mathematics scores for 1994 and 1998, by ethnic grouping	15
Table 3.1	Year 5 students' mean science scores for 1994 and 1998	29
Table 3.2:	Year 5 students' mean science scores for 1994 and 1998, by ethnic grouping	31
Table 4.1	Proportion of Year 5 girls and boys participating in 1994 and 1998	42
Table 4.2	Year 5 students' mean achievement scores in 1998, by country of origin	43
Table 4.3	Proportion of Year 5 students' estimates of the number of books in their homes for 1994 and 1998	47
Table 4.4	Year 5 students' mean mathematics and science scores, by a computer in the home for 1998	49
Table 4.5	Year 5 students' mean mathematics and science scores, by three educational possessions in the home for 1998	49
Table 4.6	Proportion of Year 5 students with the home possessions for 1994 and 1998	50
Table 4.7	Amount of time Year 5 students spent watching television and videos on a normal school day for 1994 and 1998, by ethnic grouping	51
Table 4.8	Amount of time Year 5 students read books for enjoyment on a normal school day for 1994 and 1998, by ethnic grouping	53
Table 4.9	Proportion of Year 5 students' level of agreement with reasons for success in mathematics and Science for 1998	59
Table 4.10	Proportion of Year 5 students reporting particular events occurring to themselves or their friends in 1994 and 1998	61
Table B.1	Distribution of Year 5 students' mathematics scores in 1994 and 1998	69
Table B.2	Mean percent correct scores for Year 5 students on trend and released mathematics items in 1994 and 1998	69
Table B.3	Year 5 students' mean mathematics scores in 1994 and 1998, by gender	69
Table B.4	Mean percent correct scores for Year 5 students' on trend and released mathematics items for 1994 and 1998, by gender	70
Table B.5a	Mean effect sizes in mathematics scores for Year 5 students in 1994, by ethnic grouping	70
Table B.5b	Mean effect sizes in mathematics scores for Year 5 students in 1998, by ethnic grouping	70
Table B.6a	Mean percent correct scores for Year 5 students' on trend mathematics items in 1994 and 1998, by ethnic grouping	70
Table B.6b	Mean percent correct scores for Year 5 students on released mathematics items in 1994 and 1998, by ethnic grouping	71
Table B.7	Year 5 students' mean mathematics scores in 1994 and 1998, by ethnic grouping and gender	71
Table B.8	Mean percent correct scores for Year 5 students on trend mathematics items in 1994 and 1998, by ethnic grouping and gender	71
Table B.9	Year 5 students' mean mathematics scores in 1994 and 1998, by the degree that English is spoken in the home	71
Table B.10	Proportion of Year 5 students in 1994 and 1998, by the degree that English is spoken in the home and ethnic grouping	72
Table B.11	Year 5 students' mean mathematics scores in 1994 and 1998, by the degree that English is spoken in the home and ethnic grouping	72
Table B.12	Mean percent correct scores for Year 5 students on trend and released mathematics items in 1994 and 1998, by the degree that English is spoken in the home	72
Table B.13	Year 5 students' mean scores for each mathematics reporting category in 1994 and 1998	73
Table B.14	Year 5 students' mean scores for each mathematics reporting category in 1994 and 1998, by gender	73
Table B.15	Year 5 students' mean scores for each mathematics reporting category in 1994 and 1998, by ethnic grouping	73
Table C.1	Distribution of Year 5 students' science scores in 1994 and 1998	75
Table C.2	Mean percent correct scores for Year 5 students on trend and released science items in 1994 and 1998	75
Table C.3	Year 5 students' mean science scores in 1994 and 1998, by gender	75
Table C.4	Mean percent correct scores for Year 5 students on trend and released science items in 1994 and 1998, by gender	76
Table C.5a	Mean effect sizes in science scores for Year 5 students in 1994, by ethnic grouping	76
Table C.5b	Mean effect sizes in science scores for Year 5 students in 1998, by ethnic grouping	76
Table C.6	Mean percent correct scores for Year 5 students on trend science items in 1994 and 1998, by ethnic grouping	76

Table C.7	Year 5 students' mean science scores in 1994 and 1998, by gender and ethnic grouping	77
Table C.8	Mean percent correct scores for Year 5 students on trend science items in 1994 and 1998, by gender and ethnic grouping	77
Table C.9	Year 5 students' mean science scores in 1994 and 1998, by the degree that English is spoken in the home	77
Table C.10	Year 5 students' mean science scores in 1994 and 1998, by the degree that English is spoken in the home and ethnic grouping	78
Table C.11	Year 5 students' mean scores for each science reporting category in 1994 and 1998	78
Table C.12	Year 5 students' mean scores for each science reporting category in 1994 and 1998, by gender	78
Table C.13	Year 5 students' mean scores for each science reporting category in 1994 and 1998, by ethnic grouping	79
Table D.1	Summary statistics of Year 5 students' ages for 1994 and 1998	81
Table D.2	Proportion of Year 5 students, by the degree that they speak English in the home for 1994 and 1998	81
Table D.3	Proportion of Year 5 students, by household composition for 1994 and 1998	81
Table D.4	Proportion of Year 5 students, by household composition and ethnic grouping for 1994 and 1998	82
Table D.5	Year 5 students' mean mathematics and science scores, by household structure for 1998	82
Table D.6	Year 5 students' estimates of the number of books in their homes for 1994 and 1998, by ethnic grouping	83
Table D.7	Year 5 students' mean mathematics and science scores, by the number of books in the home for 1994 and 1998	83
Table D.8	Amount of time per day Year 5 students spent watching television and videos on a normal school day for 1994 and 1998, by gender	83
Table D.9	Amount of time per day Year 5 students spent reading a book for enjoyment on a normal school day for 1994 and 1998, by gender	84
Table D.10	Amount of time per day Year 5 students spent on their homework for 1994 and 1998, by ethnic grouping	84
Table D.11	Year 5 students' perceptions on the importance of doing well based on the opinions of their mother, friends and self for 1994 and 1998	85
Table D.12	Year 5 students' perceptions on the importance of doing well based on the opinions of their mother, friends and self for 1994 and 1998, by ethnic grouping	85
Table D.13	Proportion of Year 5 students' attitudes towards mathematics for 1994 and 1998	86
Table D.14	Proportion of Year 5 students on the PATM index for mathematics in 1998, by ethnic grouping	86
Table D.15	Proportion of Year 5 students' attitudes towards science for 1994 and 1998	86
Table D.16	Proportion of Year 5 students on the PATS index and their science scores in 1998, by ethnic grouping	87
Table D.17	Proportion of Year 5 students level of agreement with reasons for success in mathematics and science in 1994	87
Table D.18	Proportion of Year 5 students or their friends who had something stolen in the last month for 1994 and 1998, by ethnic grouping	87
Table D.19	Proportion of Year 5 students or their friends who had been hurt in the last month for 1994 and 1998, by ethnic grouping	88
Table D.20	Year 5 students' mean mathematics and science scores, by whether or not another student might hurt them at school in the last month for 1998	88

Acknowledgements

This study involves a large number of people working together to provide the sorts of information and analyses that is presented in this report.

First and foremost, we would like to thank the students, teachers and principals for their cooperation in participating in the study. Specifically, the schools' study coordinators and test administrators deserve a special mention for their administrative efforts.

The administrative staff at the national study centre, open-response coders and data entry operators are also acknowledged for their crucial contributions to the project.

We would also like to thank the International Association for the Evaluation of Educational Achievement for agreeing to allow New Zealand to conduct the study on a national basis.

We would like to extend appreciation to the many individuals within and outside of the Ministry who gave important advice and support. In particular, thank you to the Research Division who assisted with the school briefings.

Finally, special thanks to Christabel Dillon who formatted this report, and to Jeremy Praat and Fiona Sturrock who assisted with the graphs and editing respectively.

Glenn Chamberlain
Research Analyst
Comparative Education Research Unit

Megan Chamberlain
Senior Research Analyst
Comparative Education Research Unit

Maurice Walker
Senior Research Analyst
Comparative Education Research Unit

Overview

This report summarises a New Zealand study based on the Third International Mathematics and Science Study (TIMSS-94) which involved mostly Year 5 students. Specifically, it provides comprehensive trend achievement information for Year 5 students in mathematics and science for two years – 1994 and 1998.

The focus of this report is on student achievement and their beliefs and attitudes towards mathematics and science, within a national context.

This report is comprised of five sections:

Chapter 1: presents a summary of the study design, key findings pertaining to New Zealand from TIMSS-94, and some technical information about sampling and the presentation of student achievement scores.

Chapter 2: Year 5 students' mathematics achievement in 1998 is viewed in a national context with a focus on comparisons with their Year 5 counterparts in 1994.

Chapter 3: Year 5 students' science achievement in 1998 is viewed in a national context with a focus on comparisons with their Year 5 counterparts in 1994.

Chapter 4: a brief description of the demographics of Year 5 students involved in TIMSS-98 and a comparison with their Year 5 student counterparts in TIMSS-94 is presented. In addition, their aspirations, beliefs, and attitudes towards mathematics and science are examined within a New Zealand context.

Chapter 5: a brief summary of the main findings highlighted in this report.

