A Vertical Mathematics Curriculum for Gifted Primary Students

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Introduction

Age lock-step progression as the basis for school organisation has long been a critical issue for proponents of educational reform, particularly for students at the extremes of intellectual development (Terman, 1916; Spearman, 1923; Cohen & Maxwell, 1985, Thorndike, Hagen & Sattler, 1986; Fardell & Geake, 2003). In particular, it has been strongly argued that age lock-step progression is inappropriate for gifted students (Hoekman, 1994; Braggett, 2002; Geake, 2003), where the "ill-fit" of the curriculum becomes increasingly apparent as a student's mental age moves further away from their chronological age (Hollingworth, 1926; Gross, 1993).

The automatic promotion of students by a grade level each year overlooks individual student's differing and asynchronous cognitive, physical and social development. One consequence is widespread learning difficulties which are directly attributable to this ubiquitous school organisation (Cohen & Maxwell, 1985). Some of the issues involved with mis-matching gifted students' stages of development with comprehensive curriculum provision (Van Tassel-Baska, 1994) include boredom from working below their zone of proximal development (Csikszentmihalyi, 1990), loneliness resulting from alienation from their intellectual peers and in extreme cases, alienation from their school communities, and a lowered self-esteem (Rimm, 1986), ultimately leading to student underachievement (Alsop, 1992; Silverman, 1993).

In contrast, a vertical curriculum structure can facilitate a programmatic (Tannenbaum, 1986), differentiated (Rogers, 1981) curriculum, which in turn can potentially encompass the asynchronous (Columbus Group, 1991) cognitive and affective characteristics and learning needs (Silverman, 1993) of gifted students. It has also been suggested that a vertical curriculum has the potential to cater effectively for the broad spectrum of individual student learning needs and intellectual ability levels normally found in a heterogeneous school setting (Maxwell, Marshall, Walton, & Baker, 1989), variance of the latter ranging up to seven years within a single age-grade cohort (Start, 1997).

A vertical curriculum structure allows students to be grouped according to levels or readiness rather than horizontally on a year and age basis (O'Neil, 1983; Beare, Caldwell, Millikan, 1989). The verticality of the curriculum structure should enable a continuity of education and a confluence of acceleration, consolidation, extension of curriculum and advanced learning to adapt to the changing needs of each student as they develop. A vertical curriculum is content based, providing students with the opportunity to move more slowly or more rapidly through the curriculum. Students are evaluated by their levels of academic proficiency and may choose to work above or below their chronological peers' academic levels after consultation with their teachers and parents. This vision of a vertical curriculum reflects the natural development progression, learning styles and intrinsic motivation of intellectually gifted students.

Study Design and Method

This study sought to evaluate the effectiveness of a vertical curriculum structure in a primary school to provide an effectively differentiated curriculum for a wide variety of student abilities. The syllabus chosen was mathematics. The vertical curriculum structure enabled the mathematical syllabus to be delivered to groups of Grades 5 and 6 (N = 88) students primarily based on their stage of development rather than their chronological age. The cohort was grouped into five 'Clinics' by intellectual ability, mathematical readiness, and teacher recommendation.

Intellectual ability was determined by non-verbal reasoning ability score measured by the Raven's Progressive Matrices (De Lemos, 1995) (Table 1). The Raven's Progressive Matrices has been used throughout the world over several decades, and is considered to be a valid and reliable instrument in its measurements of general intellectual ability (Jensen, 1987). Those students obtaining a standardised score of 130 or more, or two standard deviations above the mean, were identified as gifted.

Table 1: Raven's Standard Progressive Matrices Classification of Subjects' General Intellectual Ability

Classification of Raven's Groups	Raven's Standardised Scores	n	$\bar{x}$	SD
Gifted	≥ 130	11	133.64	3.64
Bright	110-129	33	116	6.46
Average	90-109	30	100.70	5.32
Low Average	70-89	12	83.33	5.37
Low	69 or less	2	66	2.83

Mathematical readiness (and progress in learning throughout the study) was measured by the Progressive Achievement Tests in Mathematics (PATMath) (Australian Council for Educational Research, 1997) Test 2. The primary aim of the PATMath is to provide information for teachers regarding the levels of achievement attained by their students in the skills and understandings of mathematics. Whereas PATMath Test 2 was designed to measure levels of achievement expected in Grades 5 and 6, and Year 7, there were both ceiling and basement effects within the cohort. However, it was decided against multiple testing, more for the sake of the students as incurring invalid scores from test familiarity. In any case, there is a considerable overlap in achievement range between adjacent PATMath tests. The relationships between PATMath scores on Tests 1 to 3 with comparable Curriculum Standard Frameworks (CSF) or National Profiles levels and the usual associated grade levels are presented in Table 2, where Rasch calibrations of test item difficulty allows PATMath raw scores to be compared across tests (CSF Teacher Manual, 1997). That is, from a teacher's perspective, the difficulty level of test items, and what is a 'high' or 'low' score on a particular test, is determined with reference to the norms.

Table 2: PATMath Criteria for Classification into Grade and CSF Levels

PATMath Scaled Scores Test 1	PATMath Scaled Scores Test 2	PATMath Scaled Scores Test 3	Classification CSF Level / National Profiles Level	Grade Classification
		70 -78	CSF 5 consolidating	Yr. 8
		60 - 69	CSF 5 emerging	Yr. 7
	63 -72	50 - 59	CSF 4 consolidating	Grade 6
60 - 69	53 - 62	40 - 49	CSF 4 emerging	Grade 5
50 - 59	43 - 52	0 - 39	CSF 3 consolidating	Grade 4
40 - 49	33 - 42		CSF 3 emerging	Grade 3
30 - 39	0 - 32		CSF 2 consolidating	Grade 2
0 -29			CSF 2 emerging	Grade 1

Teachers' qualitative assessments were also used to place students in appropriate vertical curriculum Clinics. These assessments included anecdotal records and observations, and teachers' past and current experiences with each student.

Thus, each of the five vertical curriculum mathematics Clinics, labeled by the Clinic teacher's initial (R, O, M, H or C), had a mix of students from each of the five Ability Groups (Table 3). However, the gifted students were concentrated in the top R Clinic whose curriculum was accelerated by one to two years.

Table 3: Vertical Curriculum Mathematics Clinics

Mathematics Clinic	CSF Level	Equivalent Grade	Number	Ability Groups
5. R. Clinic	5 emerging	Year 7	20	10 Gifted, 9 Bright, 1 Average
4. O. Clinic	4 consolidating	Grade 6	17	1 Gifted, 10 Bright, 5 Average, 1 Low
3. M. Clinic	4 emerging	Grade 5	22	10 Bright, 9 Average, 2 Low Average, 1 Low
2. H. Clinic	3 consolidating	Grade 4	17	3 Bright, 10 Average, 4 Low Average
1. C. Clinic	2 consolidating	Grade 4 & below	12	1 Bright, 5 Average, 6 Low Average

The curriculum selected for each clinic was based on ability, interest and mathematical knowledge. After consultation with the teacher, parents and student themselves, any student could move between groups if it was agreed that (s)he was not working in the most appropriate level.

The study focused on individual academic achievement and progress. *Achievement* was assessed in terms of the levels articulated in the Curriculum Standard Frameworks guidelines (1997). Relative achievement or *Progress* was determined by comparisons of these achievement levels across the school year. These two foci were necessary because some students may achieve at a high level, although their actual growth or progress may be small. Other students may have a low achievement level, although their growth or improvement from the start of the year may be considerable. The time period of the study was one full school year, with initial scores taken in February, and final scores in December. Progress was measured in three ways:

Absolute Gain (AG): Final (December) PATMath Scaled Score – Initial (February) PATMath Scaled Score

Initial Gain (IG): Absolute Gain divided by Initial Score (expressed as a percentage)

Relative Gain (RG): Absolute Gain divided by Maximum Possible Gain Score (100% - February score) (expressed as a percentage)

These measures were adopted following Start (2000) who argues that Relative Gain is less corruptible by possible ceiling effects of gifted students.

Three main research questions were of interest.

1. Did the vertical curriculum cohort make significant progress in mathematics during the year?
2. Did any of the vertical curriculum Clinics make relatively greater progress compared with the other Clinics?

3. Did the Gifted students across the Clinics make relative greater progress compared with the students in the other Ability Groups?

All students were tracked over the one-year period to see how they did or did not benefit from the vertical curriculum in comparison to the progress through the mathematical curriculum that is normally expected over a one-year period in Grades 5 or 6. The appropriate PATMath Tests (1, 2 or 3) were administered as pre-test (February) and post-test (December) to evaluate the progress that was made over the year.

Results

The cohort (N = 88) comprised 51 boys and 37 girls, this difference not being significant ($p = .166$). The chronological age of the subjects ranged from 9 years to 12 years 7 months. This cohort age range of 3 years 7 months was replicated (to a close approximation) in each of the Clinics and within each of the Ability Groups. The mean age within each Clinic and within each Ability Group was also found to be close to the mean age of the cohort, 11 years 8 months (SD = 9.4 months), with the students in the Gifted and Bright Groups being slightly younger than the others.

The intellectual ability of the students, as indicated by the Raven's Standard Progressive Matrices, ranged from a standardized score of 60 to 145; one quarter of the subjects had a standardised score between 60 and 96, another quarter of the subjects had standardised scores between 97 and 108, a third quarter had standardised scores between 109 and 119, and one quarter of the subjects had standardised scores between 120 and 145. In terms of Mental Age, the range was extremely broad, ranging from 6 years and 5 months to 17 years and 5 months. This eleven-year range of intellectual abilities is even larger than the seven years suggested by Start (1997), and obviously has direct implications for the very different educational needs of this cohort and the most appropriate ways of providing adequately for those needs.

The range of academic standards in mathematics within the cohort prior to their experience of the vertical curriculum was indicated by the range of initial PATMath scores at the beginning of the study in February. These were within the expected ranges for Grades 5 and 6 according to the norms provided in the PATMath Manual (ACER, 1997). The distributions of pre- and post-test PATMath scores were checked for normality and found to be acceptable.

For the analysis of the results, the Dependent Variables were the measures of progress (AG, IG, and RG), while the Independent Variables were either Clinic (R, O, M, H, C) or Ability Group (G, B, A, LA, L) depending on the research question.

The first Research Question concerning the progress in mathematics of the vertical curriculum cohort during the year was tested by a Chi-Square analysis of the distribution of stanines of the December post-test PATMath scores (Figure 2) compared with the February pre-test PATMath scores (Figure 1).

Figure 1: Progressive Achievement Tests in Mathematics February Stanine Scores

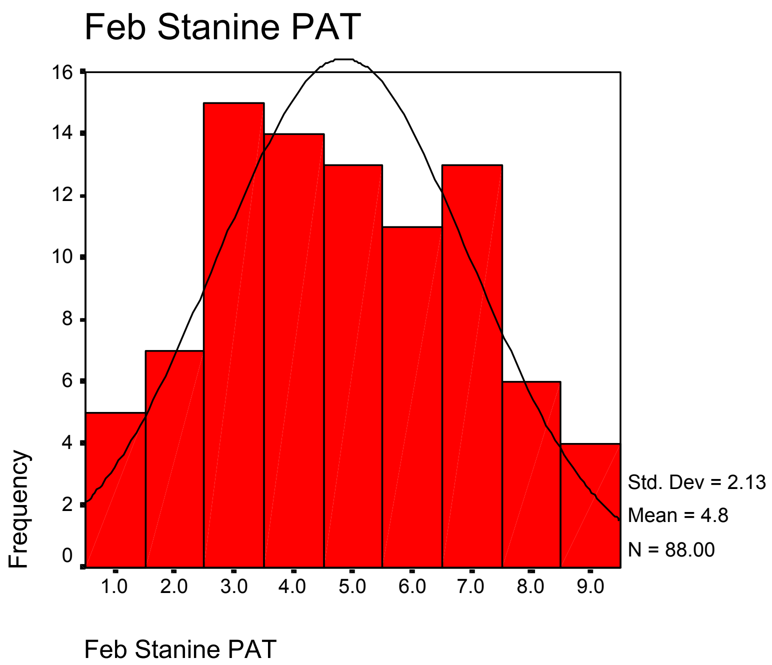
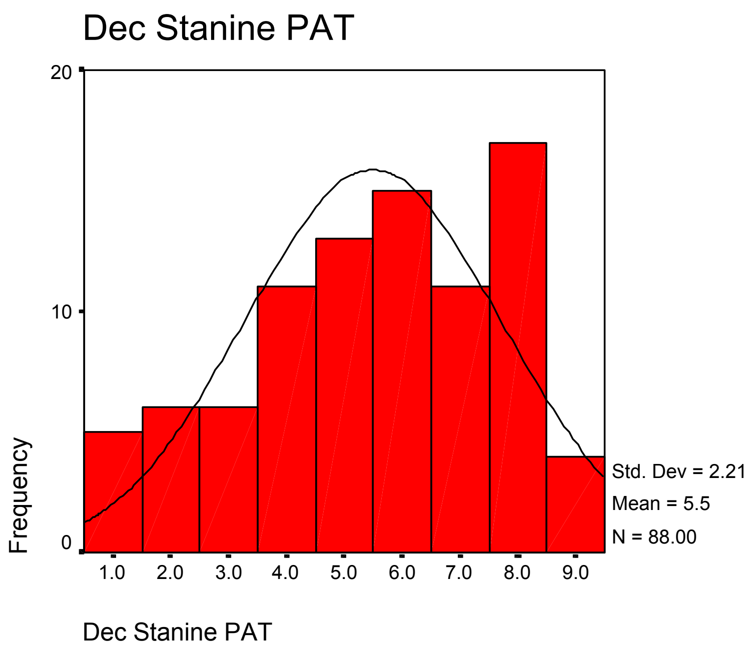


Figure 2: Progressive Achievement Tests in Mathematics December Stanine Scores



The difference in distributions was significant (χ^2 = 34.32, p = .000), mostly due to the decrease from 15 to three students at Stanine 3, and the increase from 6 to 17 students at Stanine 8, indicating that significant progress had been made by the vertical curriculum cohort as a whole during the February to December period of the study.

Unfortunately, the more interesting question of how this improvement compared to predicted normed improvements in CSF levels is not easily tractable, due in part to the difficulty in computing meaningful CSF norms for multi-aged cohorts.

The second Research Question concerning the relative progress in mathematics of each of the vertical curriculum Clinics during the year was tested by three 5-factorial ANOVAs of Clinic as the IV on AG, IG and RG as the respective DVs. There were significant differences between the Clinics on each of these three measures of progress (Tables 5a, 5b; 6a, 6b; 7a, 7b respectively).

Table 5a: PATMath Absolute Gains for Clinics

Clinic	$\bar{x}$	n	SD
R (Year 7)	5.15	20	4.22
O (Grade 6)	0.47	17	6.43
M (Grade 5)	1.45	22	6.96
H (Grade 4)	6.82	17	7.84
C (Gd 4 &below)	8.66	12	5.86
Cohort	4.12	88	6.91

Table 5b: ANOVA of PATMath Absolute Gain for Clinics

Source of Variation	SS	df	MS	F	p
Between groups	776.24	4	194.06	4.76	.002**
Within groups	3383.37	83	40.76		
Total	4159.62	87			

Table 5a shows the PATMath Absolute Gain mean scores for the five mathematics Clinics. The ANOVA of Clinic on AG scores (F (4,87) = 4.76, p = .002), Table 5b, indicated that there were significant differences among some of the AG means. Bonferroni multiple comparisons revealed that the Clinics at the extremities, R (highest), and H and C (two lowest), had significantly larger AG means than the other two Clinics.

Table 6a: PATMath Initial Gain Scores for Mathematics Clinics

Clinic	$\bar{x}$	n	SD
R (Year 7)	8.61	20	6.855
O (Grade 6)	0.895	17	11.64
M (Grade 5)	3.00	22	13.42
H (Grade 4)	14.50	17	16.53
C (G 4 & below)	22.62	12	15.65
Cohort	4.125	88	14.60

Table 6b: ANOVA of PATMath IG Scores for Mathematics Clinics

Source of Variation	SS	df	MS	F	p
Between groups	4649.00	4	1162.25	6.933	.000***
Within groups	13913.36	83	167.63		
Total	18562.36	87			

Table 6a shows the PATMath Initial Gain mean scores for the five mathematics Clinics. The ANOVA of Clinic on IG scores (F (4,87) = 6.93, p <.001), Table 6b, indicated that there were significant differences among some of the IG means. Bonferroni multiple comparisons revealed that the lowest mathematics clinic C had a significantly higher IG mean than the other Clinics (whose IG means weren't significantly different from each other except H from O).

Table 7a: PATMath RG Scores for Mathematics Clinics

Clinic	$\bar{x}$	n	SD
R (Year 7)	28.51	20	32.06
O (Grade 6)	2.45	17	34.51
M (Grade 5)	4.23	22	38.37
H (Grade 4)	31.18	17	36.52
C (G 4 & below)	28.61	12	21.07
Cohort	17.94	88	35.64

Table 7b: ANOVA of RG Scores for Mathematics Clinics

Source of Variation	SS	df	MS	F	p
Between groups	14793.46	4	3698.36	3.206	.017
Within groups	9575609	83	1153.68		
Total	110549.56	87			

Table 7a shows the PATMath Relative Gain mean scores for the five mathematics Clinics. The ANOVA of Clinic on RG scores (F (4,87) = 3.206, p = .017), Table 7b, indicated that there were significant differences among some of the IG means. Bonferroni multiple comparisons revealed that the highest R and the two lowest mathematics clinics C and H had significantly higher RG means than the other Clinics (whose IG means weren't significantly different from each other).

The third Research Question concerning the relative progress in mathematics of the Gifted Ability Group during the year was tested by three 5-factorial ANOVAs of Group as IV on AG, IG and RG as DVs (Tables 8a, 8b; 9a, 9b; 10a, 10b respectively).

Table 8a: PATMath AG Scores for Ability Groups

Ability Groups	$\bar{x}$	n	SD
Gifted	4.46	11	5.28
Bright	3.85	33	6.16
Average	3.63	30	8.60
Low Average	6.42	12	6.097
Low	0.50	2	3.54
Cohort	4.125	88	6.915

Table 8b: ANOVA of PATMath AG Scores for Ability Groups

Source of Variation	SS	df	MS	F	p
Between groups	100.27	4	1162.25	.513	.727
Within groups	4059.35	83	167.63		
Total	4159.62	87			

Table 8a shows the PATMath Absolute Gain mean scores for the five Ability Groups. The ANOVA of Ability Group on AG scores (F (4,87) = 0.513, p = .727), Table 8b, indicated that there were no significant differences among the AG means.

Table 9a: PATMath IG Scores for Ability Groups

Ability Groups	$\bar{x}$	n	SD
Gifted	7.56	11	8.46
Bright	7.87	33	13.40
Average	7.78	30	17.28
Low Average	16.18	12	15.14
Low	0.76	2	7.09
Cohort	8.77	88	14.61

Table 9b: ANOVA of PATMath IG Scores for Ability Groups

Source of Variation	SS	df	MS	F	p
Between groups	860.719	4	215.18	1.009	.408
Within groups	17701.65	83	213.27		
Total	18562.36	87			

Table 9a shows the PATMath Initial Gain mean scores for the five Ability Groups. The ANOVA of Ability Group on IG scores (F (4,87) = 1.009, p = .408), Table 9b, indicated that there were no significant differences among the IG means.

Table 10a: PATMath RG Scores for Ability Groups

Ability Groups	$\bar{x}$	n	SD
Gifted	22.54	11	41.26
Bright	17.64	33	29.41
Average	15.77	30	44.88
Low Average	22.38	12	23.65
Low	3.50	2	16.26
Cohort	17.94	88	35.65

Table 10b: ANOVA of PATMath RG Scores for Ability Groups

Source of Variation	SS	df	MS	F	p
Between groups	1029.96	4	257.49	.195	.940
Within groups	109519.59	83	1319.51		
Total	110549.56	87			

Table 10a shows the PATMath Relative Gain mean scores for the five Ability Groups. The ANOVA of Ability Group on RG scores (F (4,87) = .195, p = .940), Table 10b, indicated that there were no significant differences among the RG means.

Discussion

This study investigated the effects of a vertical mathematics curriculum structure used in a combined Grade 5/6 primary classroom (N = 88), with particular interest on the performance of the gifted students in the cohort. Mathematical progress was measured by a nationally-normed objective mathematics test (PATMath) administered at the beginning of the school year in February, and at the end in December. Gifted students (N = 11) were identified by the Ravens Progressive Matrices test as having an IQ ≥ 130. For group teaching, the cohort was divided into five vertical mathematics Clinics operating at levels from below Grade 4 up to

Year 7 (secondary). Clinic membership was determined by IQ, PATMath February score, interest in mathematics, and teacher nomination.

The first question was whether or not this vertical organisation benefited the cohort as a whole. Of course, given the positive case made for vertical curriculum organisation in the literature (O'Neil, 1983; Cohen & Maxwell, 1985; Fardell & Geake, 2003) it would be very disappointing if that were not the case. Here there was a significant positive shift in the distribution across the stanines of the PATMath scaled scores between February and December. In December, less than 46% of the cohort achieved at Stanine 5 or below, whereas 19.3% achieved at Stanine 8, and 4.5% achieved at Stanine 9.

Of greater interest was the question of which sub-groups within the cohort might have benefited more than others. An analysis by Clinic showed that the Clinics operating at the lowest level (Grade 4 and below) and at the highest level (Year 7, i.e., at secondary school level) showed the most progress in terms of Absolute, Initial and Relative Gain scores. It is a widespread practice for teachers of Grade 6 to focus on getting all (or as many as possible) of their students "up to scratch" before they pass on to secondary school. In that context, those students furthest behind have the most to gain, and the significant progress of the lowest level Clinic might be seen in such a light. However, this puts the progress of the highest-level Clinic in stark contrast, as in a traditional Grade 6 these students would be "treading water" all year rather than building on their already considerable achievements to surge ahead, as they did here.

As the highest-level Clinic contained all but one of the Gifted Ability Group, it might be also conjectured that this result was ability-based. However, an analysis by Ability Group showed that this was not the case. Rather, there were no significant differences in any of the three measures of progress between any of the Ability Groups as such. This is not to say that the Gifted Group did not make impressive progress during the year, especially bearing in mind that the mathematical achievement level normally expected in Grades 5 or 6 is CSF Level 4. Of the eleven students in the gifted student group:

- One Grade 6 student progressed to CSF Level 5 *Established*, or what is considered to be Year 8 level.
- Eight Grade 6 students moved on to CSF Level 5 *Consolidating*, or what is normally considered to be at a Year 7 level.
- One Grade 5 student progressed to achieve CSF Level 5 *Consolidating*, or what is considered to be Year 7 level.
- One Grade 6 student progressed to CSF Level 4 *Consolidating*, or what is considered to be equivalent to Grade 6 level, which was chronologically age appropriate.

In sum, 10 out of 11 Gifted students achieved PATMath scores in December that were equivalent to or above CSF Level 5 or a Year 7 level of mathematics. Two students achieved the equivalent of 36 months mathematical progress, and 8 students achieved the equivalent of 24 months mathematical progress in the 11 months of the normal school program, a considerable accomplishment. [The one female student who did not progress beyond her normally expected level was later identified as having Short - Term Auditory processing (STAM) difficulties (Dembo, 1998)].

Moreover, the result that the progress of the Gifted Group was not significantly different from the other Ability Groups, taken together with the result that the highest level vertical mathematics Clinic made similar or significantly greater progress than the other Clinics, suggests that gifted students benefited from placement within a group of peers of similar mathematical readiness and interest (the selection criteria for the Clinics), where the curriculum was set an appropriately challenging level of difficulty (here, secondary school level), and proceeded at an appropriately challenging pace. The gifted students did not have to wait for the year to finish before they moved on to the next year's course; if they were able and motivated to attempt the next level of course work, they were given the chance.

In other words, when given the opportunity to work with a curriculum that challenges them within their advanced zone of proximal development (Vygotsky, 1991), gifted students learn at a similar rate to the other students. Thus, it could be reasonably inferred that the gifted students developed a sense of accomplishment in achieving advanced levels of mathematical competence and making demonstrable mathematical progress at a high level over the school year. These empowering experiences might, at times, enable these students to experience 'flow', described by Csikszentmihalyi as capturing students' intrinsic motivation to "engage in those tasks which are within their reach but developmentally just beyond their current level of ability" (cited in Hoekman, 1996, pp.33).

Importantly, the vertical curriculum mathematics program that operated in the study was part of the school's core sequenced curriculum, and not an *ad hoc* expendable enrichment program of the sort which have been severely criticised as not providing an acceptable approach to the education of gifted students in mathematics (Feldhusen, Van Tassel-Basks & Seeley, 1989; Borland, 1989; Gross, 1986; Tannenbaum, 1986).

The vertical curriculum organisation in this study was enthusiastically supported by the teachers involved, mostly because of the reduced range of abilities in each Clinic. It was also clearer which curriculum levels were required for each Clinic. Consequently, teaching the Gifted students was not 'an extra' job for the teacher as the gifted students were 'average' for CSF Level 5, as opposed to being the 'top students' in a traditional classroom.

The vertical curriculum does not automatically supplant good classroom teaching as the basic criterion for quality schooling, but it makes it more possible. It can offset criticisms of elitism of catering only for gifted students; it allows students who require more time to learn, or who need remedial assistance, opportunities for success they may not otherwise achieve; it is oriented towards student achievement of personal goals and it allows students to transfer to a higher level, repeat a level or move down a level in accordance with their individual learning needs (Cohen & Maxwell, 1985). The vertical curriculum in this study offered this flexibility, by organising the school curriculum so that it was more adaptive to the student's needs, whatever their chronological age, gender, general intellectual ability or their academic achievements.

The differentiated curriculum for the Gifted Group in this study encompassed advanced academic rigor and pace, enabling gifted students to work more in tune with their natural learning styles. An advantage of vertical curriculum organisation is that this was achieved without pejorative labelling of children that can be associated with gifted education or other ability-streamed programs. Notably in this study, the mathematical progress of the lowest level H and C Clinics was just as great as that of the highest level R Clinic, a finding which has been replicated in secondary school settings (Fardell & Geake, 2003). In sum, the vertical curriculum allowed all students in this primary cohort to work through the course on the basis of their readiness and ability (Winebrenner, 1992), rather than on their age or year group; their achievements were a reflection of this process.

References

ACER (1997). Progressive Achievement Tests in Mathematics (PATMath) Revised – Teacher's Manual. Australian Council for Educational Research Press.

Alsop, G. (1992). The gifted underachievers. *Our Gifted Children, 6,* 67-69.

Beare, H., Caldwell, B. J., & Millikan, R.H. (1989). *Creating an Excellent School.* London: Routledge.

Borland, J. (1989). *Planning and Implementing Programs for the Gifted.* Columbia, New York & London: Teachers College Press.

Braggett, E. (2002). Gifted profile: An interview with Eddie Braggett by Wilma Vialle. *The Australasian Journal of Gifted Education, 11(1).*

Columbus Group. (1991). Unpublished transcript of the meeting of the Columbus Group, Columbus, OH (July).

Csikszentmihalyi, M. (1990). *Beyond Boredom and Anxiety.* Oxford: Jossey-Bass Publishers.

Curriculum Standards Frameworks (1997). Board of Studies, Victorian Education Department

De Lemos, M. M. (1995). *Standard Progressive Matrices, Australian Manual.* Victoria, Australia: Australian Council for Educational Research.

Dembo, M. H. (1988). *Applying Educational Psychology in the Classroom.* (4^{th} ed.). New York: Longman.

Fardell, R. & Geake, J. G. (2003). Vertical semester organisation in a secondary school: Implications for gifted education (submitted).

Feldhusen, J., Van Tassel-Baska, J., & Seeley, K. (1989). *Excellence in Educating the Gifted.* U.S.A.: Love.

Geake, J. G. (2003). Adapting Middle Level educational practices to current research on brain functioning. *Journal of the New England League of Middle Schools,* (in press).

Gross, M. (1986). Planning defensible programs for gifted and talented students: rejecting the myths, accepting the realities, *Joint Conference of ACE and ACEA,* Adelaide.

Gross, M. (1993). *Exceptionally Gifted Children.* London: Routledge.

Hoekman, K. (1994). The tyranny of chronological age. *Gifted, 4,* 17-19.

Hoekman, K. (1996). The teacher as facilitator for independent learning. *Gifted, 7,* 31-34.

Hollingworth, L.S. (1926). *Gifted Children: Their nature and nurture.* New York: Macmillian.

Jensen, A. R. (1987). Psychometric *g* as a focus of concerted research effort. *Intelligence, 11,* 193 – 198.

Maxwell, T., Marshall, T., Walton, J. & Baker, I. (1989). Secondary School Alternative Structures: Semester courses and vertical grouping in non-state schools in New South Wales. *Curriculum Perspectives, 9*, (1).

O'Neil, L. N. (1983). *The Vertical Semester Organization of the Secondary School.* Final report to the Commonwealth Schools Commission, Canberra.

Rimm, S.B. (1986). *Underachievement Syndrome: Causes and cures.* Watertown, WI: Apple.

Rogers, K. B. (1991). *The relationship of grouping practices to the education of the gifted and talented learner.* Connecticut: National Research Centre on the Gifted and Talented.

Silverman, L. (1993). *Counselling the Gifted and Talented*. U.S.A.: Love Publishing

Spearman, C. (1923). *The Nature of Intelligence and the Principles of Cognition.* London: Macmillian.

Start, K. B. (2000). *The measurement of intellectual abilities,* Gifted Development Centre Seminar, University of Melbourne, 30 August.

Start, K. B. (1997). *Children of high intellectual potential,* Research Seminar, University of Melbourne, February.

Tannenbaum, A. (1986). Reflection and refraction of light on the gifted, *Roeper Review, 8,*

212-217.
Terman, L. (1916). *The Measurement of Intelligence.* Boston: Houghton Mifflin.
Thorndike, E., Hagen, E., & Sattler, J. (1986). *Stanford-Binet Intelligence Scale.* (4th ed.). Chicago: Riverside.
Van Tassel-Baska, J. (1994). *Comprehensive Curriculum for Gifted Learners.* (2nd ed.). Massachusetts: Allyn and Bacon.
Vygotsky, L.S. (1991). *Voices of the Mind: A sociocultural approach to mediated action.* Cambridge, MA: Harvard University Press.
Winebrenner, S. (1992). *Teaching Gifted kids in the Regular Classroom.* Minneapolis, MN: Free Spirit.