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THE SeMTAC PROJECT:

Factor Analysis, Reliability, Validity and Results Eventuating from the
Parent and Student Questionnaires

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Abstract

This paper reports on one aspect of a larger study into the factors which influence school leavers to consider, or not to consider, a career in secondary mathematics teaching. The study questioned Year 12 students, their parents, the mathematics teachers at their school, and the students from Charles Sturt University - Mitchell studying to be secondary mathematics teachers. This paper presents the results of a Factor Analysis carried out on the 45 Likert scale items in the student questionnaire and the 37 items of the parent questionnaire. Eight factors producing reliable subscales were identified for the student questionnaire. Seven factors were identified for the parent questionnaire. Attempts were made to validate both sets of factors against other variables gathered as part of the study. The validity of the scales in both cases is good and the scales can be used to investigate differences in the schools taking part in the study.

Four separate questionnaires were developed for the Secondary Mathematics teaching as a Career (SeMTAC) Project, one each for Year 12 students, their parents/guardians, their secondary mathematics teachers and, for mathematics teacher education students at Charles Sturt University - Mitchell.

Prior to the construction of the instruments, members of the Project Team met informally with the Mathematics teachers in two large Western Region secondary schools. From these meetings an extensive list of attractive and unattractive features of secondary mathematics teaching as a career was compiled. This list was recast into a "Key Factors" format .

The Key Factors list covered the following broad areas:

Salaries

Support for Teaching

Government Policies

Mathematics as a Discipline

Role of the Mathematics Teacher

Working Environment

Societal Influences

Students in Schools

Career Opportunities

This Key Factor list was used to construct Likert Scale Items for each of the four Project questionnaires. Each questionnaire also sought additional information from each respondent related to demographic variables, career choice, perceived status of secondary mathematics teaching, and reasons for choosing mathematics teaching as a career.

A factor analysis was conducted on the 45 Likert scale items in the year 12 students' questionnaire and the 37 items in the parents' questionnaire. The questionnaires were administered to 717 pupils and their parents. Of the 717 parents surveyed, 332 completed and returned the questionnaire. This represents a return rate of 46.3%. There were too few mathematics teacher responses (73) and mathematics teacher education students (69) to merit seeking a factor analytic solution.

The sampling adequacy in both the year 12 student and their parent's cases was sufficient to merit the search for a factor analytic solution. The sampling adequacy for the student questionnaire was 0.736, and for the parent questionnaire it was 0.710.

Results - Students

A Principal Components Factor Analysis with Oblimin rotation using SPSS PC+ version 4.0 was computed for scores on the 45 items in the pupil questionnaire.

Fourteen factors emerged accounting for 54.8% of the total variance. In a search for items that would provide interpretable scales, further 7, 8, and 9 forced factor solutions were investigated. It was found that the eight factor solution, accounting for 39.9% of the total variance, provided interpretable scales. The eight factor solution involving the inclusion of items with factor loadings greater than 0.35 is found in Table 1.

Table 1: The eight factor solution showing Items with factor loadings > 0.35 provides interpretable subscales.

	Fac 1	Fac 2	Fac 3	Fac 4	Fac 5	Fac 6	Fac 7	Fac 8
q31	0.629							
q21	0.545							

q13	0.512		
q12	-0.465		
q14	0.441	-0.385	
q29	0.408		
q26	-0.397		
q9	0.382		
q30			0.734
q32			0.685
q2			0.637
q16			0.555
q15			0.441
q37	0.394	0.433	
q33			0.655
q18			0.613
q38			0.596
q24			0.586
q22			0.371
q34			0.367
q10			0.748
q39			-0.744
q27			0.551
q36			0.724
q35			0.637
q23			0.602
q28			0.415
q40			0.372
q4			0.387
	-0.556		
q45			
			-0.549
q44			
			-0.520
q1			
	0.410		
q20			
			-0.580
q19			
			-0.575
q6			
			-0.547
q7			
			0.502
q3			
			-0.473

q5	-0.403	
q41	0.700	
q42	0.631	
q43	0.505	
q25	-0.374	0.379

It will be observed that this solution yields eight scales of 8, 6, 5, 3, 5, 4, 6, and 4 items respectively. Four of the items failed to load at greater than 0.35 on any of the eight factors and have been omitted from further analysis.

Table 2: Interpretation of the Factors

Factor 1 may be interpreted as pupils' perceptions of mathematics teachers and the way they go about their work. The strongest loading items are "Most secondary mathematics teachers are innovative in their teaching" and "Compared with other subject teachers in schools, the mathematics teachers use a greater variety of teaching resources" .

Factor 2 may be interpreted as pupil perceptions of the working conditions of secondary mathematics teachers. The strongest loading items are "Teachers have good conditions of employment (pay, holidays, hours, job security)" and "Mathematics teachers salaries compare favourably with other professions requiring tertiary mathematics" .

Factor 3 may be interpreted as a factor that addresses gender issues and mathematics and mathematics teaching. The strongest loading items are "I prefer my mathematics teacher to be the same sex as myself" and "I would prefer to be taught mathematics by a male teacher" .

Factor 4 may be interpreted as a factor relating to the pupils' perceptions of the parental support they would receive if they undertook further studies. The strongest loading items are "My parents have encouraged or would encourage me to pursue tertiary studies" and "My parents do not want me to leave home to pursue tertiary studies" .

Factor 5 may be interpreted as pupils' attitudes towards mathematics as a subject. The strongest loading items are "I would like to work in a

profession that uses mathematics" and "Mathematics is one of the most important school subjects".

Factor 6 may be interpreted as the pupils' perceptions of the encouragement they have received to consider secondary mathematics teaching. The strongest loading items are "My parents have encouraged or would encourage me to become a secondary school teacher" and "I would like to be a secondary mathematics teacher" .

Factor 7 may be interpreted to be pupils' perceptions of the classroom conditions teachers experience. The strongest loading items are "Increasingly students are challenging the authority of teachers in mathematics classrooms" and "Maintaining a good working is a real problem in most secondary mathematics classrooms" .

Factor 8 may be interpreted as reasons why pupils would not consider secondary mathematics teaching as a career. The strongest loading items are "I would not like to become a teacher because of the possibility of being sent to a remote area to teach" and "I would not become a secondary mathematics teacher because of the amount of extra mathematics I would have to learn" .

RELIABILITY OF THE SUBSCALES

Analyses of the subscales derived from the factor analysis revealed that particular questions did not contribute substantially to their reliability. In an attempt to construct scales with maximum reliability those items with low correlations were deleted from the scales. In the search for reasonably reliable scales, a further seven variables were dropped from the factors. Table 3 shows the items included in the new scales together with means, standard deviations, and their alpha reliabilities.

Table 3:
 Modified Scale reliabilities for each of the Factors- Student Questionnaire

FACTOR	SCALE QUESTIONS	VARS	MEAN	STD DEV	ALPHA
1	Q31 Q21 Q13 Q12 Q29 Q26	6	18.210	3.576	0.6301
2	Q30 Q32 Q2 Q16 Q15	5	14.447		0.6661
3	Q33 Q18 Q38	3	6.648	2.263	0.5422
4	Q10 Q39 Q27	3	12.142		0.6164

5	Q36	Q35	Q23	Q28	4	11.512	3.255
		0.6055					
6	Q4	Q45	Q44	Q1	4	7.941	
2.593		0.4812					
7	Q20	Q19	Q6	Q7	Q5	5	15.948 3.314
0.5718							
8	Q41	Q42	Q43	Q25	4	11.494	3.311
		0.5172					

VALIDATING MEASURES

The validity of the scales was further investigated by examining the mean factor scores for those students who indicated that they had considered or were considering secondary mathematics teaching as a career. The correlations between the factors and the students' rating of the status of secondary mathematics teaching were also examined.

The first analysis presented is related to pupils' choice of secondary mathematics teaching as a career (SeMTAC). It would be expected that those students indicating that they were considering SeMTAC would have more positive perceptions of mathematics teachers and the way they go about their work (Factor 1), would have a more positive perceptions of the working conditions of SMTs (Factor 2), would have more positive attitudes towards mathematics as a subject (Factor 5), would perceive themselves as receiving more encouragement to become mathematics teachers (Factor 6), and would have more negative reactions to statements suggesting why they should not become mathematics teachers (Factor 8) than those who had not. It would also be expected that there should be little or no differences between these two groups on the remaining factors. Details of the analysis are presented in Table 4.

Table 4:
 Mean factor scores of students choosing and not choosing Secondary Mathematics Teaching as a Career

	Mean	Std Dev	Cases	Signif. of F
Factor 1 - pupils' perceptions of mathematics teachers and the way they go about their work				
SeMTAC	yes	18.2576	3.9664 66	0.9094
SeMTAC	no	18.2049	3.5377 649	

Factor 2 - pupil perceptions of the working conditions of SMTs

SeMTAC	yes	14.1667	3.9752	66	0.4410
SeMTAC	no	14.4760	3.0023	645	

Factor 3 - gender issues related to mathematics and mathematics teaching

SeMTAC	yes	6.8060	2.3628	67	0.5489
SeMTAC	no	6.6317	2.2536	649	

Factor 4 - pupils' perceptions of the parental support they would receive if they undertook further studies.

SeMTAC	yes		12.5522	2.3438	67
0.1528					
SeMTAC	no	12.0992	2.4777	645	

Factor 5 - pupils' attitudes towards mathematics as a subject

SeMTAC	yes	12.8507	3.3223	67	<
0.0004					
SeMTAC	no	11.3731	3.2189	646	

Factor 6 - pupils' perceptions of the encouragement they have received to consider secondary mathematics teaching

SeMTAC	yes	10.8507	3.0613	67	<
0.0001					
SeMTAC	no	7.6312	2.3358	629	

Factor 7 - pupils' perceptions of the classroom conditions teachers experience

SeMTAC	yes	15.3333	3.1978	66	0.1138
SeMTAC	no	16.0109	3.3218	644	

Factor 8 - reasons why pupils would not consider secondary mathematics teaching as a career

SeMTAC	yes	10.6716	2.6934	67	< 0.05
SeMTAC	no	11.5796	3.3583	647	

It will be observed that those students who considered SeMTAC had significantly more positive attitudes towards mathematics, significantly more positive perceptions of encouragement, and significantly more negative reaction to questions offering reasons why they should not become mathematics teachers than those not considering SeMTAC. It will also be observed that students considering SeMTAC do not have more positive perceptions of mathematics teachers and the way they go about their work or of the working conditions of SMTs. The factor scores for these two

groups is almost identical on each factor. As expected, however, the remaining factors showed no significant differences between these two groups.

The second analysis presented relates to the status that the students attached to secondary mathematics teaching compared with firstly, other professional occupations and secondly, other occupations. A correlational analysis of the factors was conducted with students' ratings of secondary mathematics teaching.

It would be expected that significant correlations (either positive or negative because of the way the scales have to be interpreted against the rating of SMT) would exist for all of the factors except the one involving gender issues.

Table 5:
Correlations of the eight Factors with the status of SMT rated against other professions (SASMT) and other occupations (SBSMT).

FACTORS	SASMT	SBSMT
Factor 1 - pupils' perceptions of SMTs and 1409 ** the way they go about their work		-.1182 -.
Factor 2 - pupil perceptions of the working 1022 * conditions of SMTs		.0198 .
Factor 3 - gender issues related to mathematics 0725 .0797 and mathematics teaching		.
Factor 4 - pupils' perceptions of the parental -.1985 ** support they would receive if they undertook further studies.		-.0459
Factor 5 - pupils' attitudes towards mathematics -.2249 ** as a subject		-.1805 **
Factor 6 - pupils' perceptions of the encouragement -.2243 ** they have received to consider secondary mathematics teaching		-.2655 **
Factor 7 - pupils' perceptions of the classroom 1086 * conditions teachers experience		.0756 .
Factor 8 - reasons why pupils would not consider		.1732 **

.1346 ** SeMTAC

N of cases: 651 1-tailed Signif: * - .01 ** - .001

As expected, the ratings of secondary mathematics teaching does not correlate highly with the factor involving gender issues. In addition, there exists significant correlations between all of the other factors and the status of SMT as ranked against 'other occupations' and for four of the factors where SMT is ranked against 'professional occupations'.

The results of this investigation indicate that 34 of the 45 items in the student questionnaire have a useful role to play in assessing general attitudes towards SeMTAC. The eight sub-scales have been found to be reasonably reliable and can be used to discriminate between students electing to enter SeMTAC and those who do not.

Results - Parents

A Principal Components Factor Analysis with Oblimin rotation using SPSS PC+v4.0 was computed for scores on the 37 items in the parent questionnaire. Twelve factors emerged accounting for 62.9% of the total variance. In a search for items that would provide interpretable scales, further 6, 7, and 8 factor solutions were investigated. It was found that the seven factor solution accounting for 47.4% of the total variance provided interpretable scales. The seven factor solution involving the inclusion of items with factor loadings greater than 0.35 is found in Table 6.

Table 6:

The seven factor solution showing Items with factor loadings > 0.35 provides interpretable subscales.

	Fac 1	Fac 2	Fac 3	Fac 4	Fac 5	Fac 6	Fac 7
PQ7		0.685					
PQ8		0.634					
PQ25	0.587					0.388	
PQ17	-0.515		-0.433				
Q22			0.771				
PQ2			0.763				
PQ15			0.677				
PQ23			0.675				
PQ16			0.662				
PQ14			0.575				

PQ26			-0.752	
PQ31			-0.581	
PQ28			-0.529	
PQ12			-0.501	
PQ4			0.725	
PQ9			0.703	
PQ11			0.623	
PQ18			0.583	
PQ10			0.528	
PQ6			0.477	
PQ37				0.629
PQ36				0.616
PQ35				0.589
PQ29				-0.455
PQ30				-0.402
PQ33				0.373
PQ34				
	0.657			
PQ5		0.375		
	0.492			
PQ1			0.400	
	0.486			
PQ32			0.367	0.383
0.435				
PQ19				
		.674		
PQ24				
		.656		
PQ27				
		.508		
PQ20				
		.446		

It will be observed that this solution yields seven scales of 4, 6, 4, 6, 6, 4, and 4 items respectively. Three of the items failed to load at greater than 0.35 on any of the seven factors and have been omitted from further analysis.

Table 7:
Interpretation of the Factors

Factor 1 may be interpreted as perceived public image of mathematics by

parents. The strongest loading items are "Most parents are appreciative of the efforts secondary mathematics teachers make on behalf of their children" and "Secondary mathematics teachers' work is highly regarded in the community".

Factor 2 may be interpreted as parent's perceptions of the working conditions of secondary mathematics teachers. The strongest loading items are "Teachers have good conditions of employment (pay, holidays, hours, job security)" and "Secondary mathematics teaching is a well paid profession".

Factor 3 may be interpreted as a parental encouragement to consider secondary mathematics teaching and factors that influence that encouragement. The strongest loading items are "I have encouraged (or will encourage) my son/daughter to consider secondary mathematics teaching" and "The availability of NSW Department of School Education scholarships will lead me to encourage my son/daughter to become a secondary mathematics teacher".

Factor 4 may be interpreted to be parents' perceptions of the classroom conditions that teachers experience. The strongest loading items are "Students in most classrooms are hard to control" and "Maintaining a positive classroom atmosphere is a real problem in most secondary mathematics classrooms".

Factor 5 may be interpreted as a factors which influence the extent to which parents offer support to their offspring to consider teaching as a career. The strongest loading items are "I see secondary mathematics teaching as a profession more suited to females than males" and "I would not encourage my child to accept a NSW Department of School Education Scholarship because of the locations in which he/she would have to teach".

Factor 6 may be interpreted as the extent to which parents are aware of opportunities in careers involving mathematics and in mathematics teaching in particular. The strongest loading items are "I am fully aware of the range of university courses in mathematics and/or mathematics teaching available to my son/daughter" and "Secondary mathematics teachers are able to use the mathematical knowledge in their teaching qualification to enter other professions".

Factor 7 may be interpreted as the parents' perceptions of the nature of mathematics teaching and learning. The strongest loading items are "Mathematics is easier to learn than other school subjects" and "Mathematics is harder to teach than other school subjects".

Reliability of the Sub-scales

Analyses of the subscales derived from the factor analysis revealed that particular questions did not contribute substantially to their scale reliability. In an attempt to construct scales with maximum reliability those items with low correlations were deleted from the scales. In the search for reasonably reliable scales a further three questions were dropped from the factors. Table 8 shows the items included in the new scales together with means, standard deviations, and their alpha reliabilities.

Table 8:
Modified Scale reliabilities for each of the Factors - Parent Questionnaire

FACTOR	SCALE QUESTIONS	ALPHA	VARs	MEAN	STD DEV
1	Q7 Q8 Q17 Q25	4	12.554	2.172	0.6134
2	Q2 Q14 Q15 Q16 Q22 Q23	6	19.640	4.552	0.8024
3	Q12 Q26 Q28 Q31	4	11.125	2.946	0.6146
4	Q4 Q6 Q9 Q10 Q11 Q18	6	19.318		3.999
					0.7068
5	Q29 Q30 Q37 Q36 Q35	5	14.055	2.132	
					0.5125
6	Q34 Q32 Q1	3	9.109	2.118	0.6084
7	Q19 Q24 Q20	3	8.133		2.427
					0.5478

VALIDATING MEASURES

The validity of the scales was investigated by examining the mean factor scores for those parents whose daughters/sons had indicated that they had considered or were considering secondary mathematics teaching as a career. The correlations between the factors and the parents' rating of the status of secondary mathematics teaching were also examined.

The first analysis presented is related to those parents whose offspring had considered choosing pupils' choice of secondary mathematics teaching as a career (SeMTAC). It would be expected that those parents whose offspring had indicated that they were considering SeMTAC would:

- * have a more positive public image of mathematics teaching (Factor 1),
- * have more positive perceptions of the working conditions of teachers (Factor 2),
- * have played a more positive role in encouraging their children to

- * consider secondary mathematics teaching as a career (Factor 3), be more positively disposed to their child becoming a mathematics teacher (Factor 6).

In addition, it would be expected that they would have more negative reactions to statements about classroom conditions (Factor 4).

There should be little or no differences between these two groups on the remaining factors. Details of the analysis are presented in Table 9.

Table 9:
 Mean factor scores of parents of children choosing and not choosing Secondary Mathematics Teaching as a Career

	Mean	Std Dev	Cases	Signif. of F
Factor 1 - the perceived public image of mathematics by parents.				
SeMTAC 0.8989	yes	14.3333	2.6566	30
SeMTAC	no	14.3974	2.6289	302
Factor 2 - parent's perceptions of the working conditions of secondary mathematics teachers.				
SeMTAC	yes	19.9333	4.3066	30
SeMTAC	no	19.6107	4.5818	298
Factor 3 - parental encouragement to consider secondary mathematics teaching and factors that influence that encouragement.				
SeMTAC	yes	12.6000	3.1688	30
SeMTAC	no	10.9764	2.8868	297
Factor 4 - parents' perceptions of the classroom conditions that teachers experience.				
SeMTAC 0.2603	yes	18.5333	3.5886	30
SeMTAC	no	19.3960	4.0340	303
Factor 5 - factors which influence the extent to which parents offer support to their offspring to consider teaching as a career.				
SeMTAC 0.1333	yes	9.1034	2.8579	29

SeMTAC	no	9.8328	2.4547	299
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Factor 6 - the extent to which parents are aware of opportunities in careers involving mathematics and in mathematics teaching.

SeMTAC	yes	8.2500	2.4222	30
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<0.006

SeMTAC	no	6.9667	2.1891	300
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Factor 7 - parents' perceptions of the nature of mathematics teaching and learning.

SeMTAC	yes	9.0333	2.3706	30
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0.8376

SeMTAC	no	9.1167	2.0955	300
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It will be observed that those parents whose offspring had considered SeMTAC had played a significantly more positive role in encouraging their child to consider this as a career. Similarly, those parents who had offspring considering SeMTAC were significantly more aware of opportunities in the field. Also consistent with expectation, though not at a significant level, these parents reacted more negatively to statements about conditions in classroom. In addition, as also expected, the remaining factors showed no significant differences between these two groups.

The second analysis presented relates to the status that the parents attached to secondary mathematics teaching compared with firstly, other professional occupations and secondly, other occupations. A correlational analysis of the factors was conducted with parent's ratings of secondary mathematics teaching.

It would be expected that significant correlations (either positive or negative because of the way the scales have to be interpreted against the rating of SMT) would exist for those factors of which parent's might have some experience e.g., Factors 1, 3, 5 and 6. Small correlations might be expected which relate to the less public aspects of education such as working conditions, Factors 2, 4 and 7.

Table 10:

Correlations of the seven Factors with the status of SMT rated against other professions (PASMT) and other occupations (PBSMT).

FACTORS	SASMT	SBSMT
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Factor 1	the perceived public image of mathematics	-.1899	**
-.2430	** by parents.		
Factor 2	parent's perceptions of the working	-.0734	
	.0955 conditions of secondary mathematics teachers.		
Factor 3	parental encouragement to consider	-.2307	**
-.2290	** secondary mathematics teaching and factors that influence that encouragement.		
Factor 4	parents' perceptions of the classroom	.0277	
-.0227	conditions that teachers experience.		
Factor 5	factors which influence the extent to		
0801	.2938 ** which parents offer support to their offspring to consider teaching as a career.		
Factor 6	the extent to which parents are aware	.1966	**
.3296	** of opportunities in careers involving mathematics and in mathematics teaching.		
Factor 7	parents' perceptions of the nature of		
0180	.0537 mathematics teaching and learning.		

N of cases: 288 1-tailed Signif: * - .01 ** - .001

As expected, the parents' ratings of secondary mathematics teaching correlates highly with those factors with which they might be expected to have some experience, e.g., awareness of career opportunity.

It might be further hypothesised that there should exist significant correlations between some of the parent factors and student factors. Specifically, it would be expected that similar factors will correlate significantly, e.g., students' and parents' perceptions of the working conditions of teachers, the support offered by the parent and perceived to be offered by the student.

Table 11:
Correlations between Parent and Student Factors

	SFac 1	SFac 2	SFac 3	SFac 4	SFac 5
SFac 6	SFac 7	SFac 8			
PFac 1	.0518	.0567	.0070	.0368	-.0662
	.1169	.0221	.0365		
PFac 2	-.0075	.4047**	-.0326	.0359	.
0006	-.0103	-.0332	.0576		
PFac 3	.0461	.1312	.1356	.1019	-. .
0130	.0851	-.0412	-.0017		
PFac 4	.0225	-.1144	-.0236	-.0162	.
0612	-.0016	-.0981	.0856		
PFac 5	-.0678	.2593**	-.0767	-.0040	-.1029
-.3670**	.0355				
PFac 6	-.1144	-.0676	-.1212	-.0692	.
0823	-.1685*	-.0301	.0143		
PFac 7	.0003	.0353	.0515	-.0183	-. .
0285	.0966	.0881	-.0996		
N of cases:	289	1-tailed Signif:	* - .01	** - .001	

As expected, a number of significant correlations do exist and these are balanced by non-significant correlations where none are expected. For example, student perceptions of SMT's working conditions is significantly correlated with their parent's perceptions of those same working conditions (SFac 2 and PFac 2); this student factor is also significantly correlated with PFac 5, the factor which influences the extent to which parents offer support to their offspring to consider teaching as a career. Similarly, the extent to which pupils perceive themselves as receiving encouragement to pursue SeMTAC (SFac 6) is significantly correlated with parents level of awareness of career opportunities in the area. The students' perceptions of classroom conditions (SFac 7) is significantly correlated with the extent to which parents offer support to their offspring to consider teaching as a career (PFac 5).

The results of this investigation confirm that 28 of the 37 items in the parent questionnaire have a useful role to play in assessing general attitudes towards SeMTAC. The seven sub-scales have been found to be reliable and can be used to discriminate between parents whose offspring have elected to enter SeMTAC and those who do not. In addition, there are interesting correlations between student and parent factors which will be pursued in the main text.

Discriminating Power of the Factors

One might reasonably expect both students' and their parents' perceptions of secondary mathematics teaching to differ from school to school. One might therefore expect that in order to be useful, both the student and

parent factors should be capable of discriminating between schools. In an attempt to investigate the discriminating power of the parent and student factors a series of oneway analyses of variance with multiple comparisons (SNK), $p < 0.05$) were conducted.

These demonstrated that in 6 of the 8 student factors and in 5 of the 7 parent factors, the response patterns of the 10 schools were significantly different. Table 12 below shows one such multiple comparison test for the student factor - perception of classroom conditions.

Table 12:
 Oneway ANOVA with Multiple Comparisons on Student Perceptions of Classroom Conditions

Variable	SCLASCND	F	F	Sum of	Mean
	Source	D.F.	Squares	Squares	Ratio
Prob.					
Between Groups		9	483.8032	53.7559	5.1524 .
0000					
Within Groups		700	7303.2686	10.4332	
Total			709	7787.0718	

Multiple Range Test - Student Newman Keuls ($p < 0.05$)

Mean	Group	7	2	9	8	3	4	5	1	6	0
13.6429	Grp 7										
14.6304	Grp 2										
14.9206	Grp 9										
15.0526	Grp 8										
15.9612	Grp 3				*						
16.1442	Grp 4				*						
16.4500	Grp 5				*						
16.4557	Grp 1				*						
16.5000	Grp 6			*	*	*					
17.0357	Grp10			*	*	*					

The multiple comparisons test discriminates between students in schools 6 and 10 who have fairly positive views of conditions in their mathematics classrooms and schools 7, 2 and 9 who have significantly more negative perceptions. These differences merit further investigation.

In an attempt to investigate further the discriminating power of the factors, the factor z-scores were graphed for each school. These graphs produce interesting patterns whose differences have yet to be fully analysed. Figure 1 shows the student factor z-scores graphed for each factor for each school. It may be noted that factor scores for School 2 cluster tightly about 0 compared to the other schools, while the factor z-scores for schools 5 and 7 range from the very positive to the very negative. It appears that in some schools, some or all of the issues are relatively unimportant while in other schools some issues attract extreme responses.

From the second graph, Student Factors by school, it may be noted that one school has very low scores in comparison to the other schools on four factors: classroom conditions; why they would not consider mathematics teaching; attitudes towards mathematics; and, gender issues. In this case, the low score on the gender issue factor is not of major concern compared to the other three factors. The low scores on these three factors may be explainable in terms of the remoteness of the school and by its small size.

Figure 1a:
Student Factor z-scores by School

Figure 1b:
Student School by Factor z-scores

These graphical methods for interpreting what is happening in a school in relation to parents' and students' perceptions of secondary mathematics teaching have yet to be fully explored. They do, however, present interesting possibilities for interpreting what is going on in particular schools and may allow rapid identification of environments worthy of further investigation.