Ministry of Education, Sports & Culture

National University of Samoa

Numeracy and Mathematics Development in Primary Schools (NaMDiPS) Study

Final Report
June 19, 2014

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Executive Summary

This report presents the results of a research study that was conducted to assess the extent of the implementation of the new primary mathematics curriculum in Samoan Years 1 to 4 primary classrooms and its effects on teachers' understandings and practices, and students' performance and to recommend ways to increase teachers' knowledge & skills, understandings and delivery of the new curriculum, and students' performance could be improved.

The study was a small scale, in-depth mixed methods study undertaken with a cross-section of eight primary schools, to examine the teaching and acquisition of initial numeracy and its development in the early grades soon after the roll-out of the new curriculum at the beginning of 2013. Data was collected through students' achievement tests, questionnaires and one-on-one interviews while students solved assessment tasks including teachers' diagnostic tests, questionnaires and one-on-interviews. Methods of analysis included, for the quantitative data, both the Dichotomous and Partial Credit Rasch Measurement Models using the QUEST software and a grounded theory approach for the qualitative interview data.

All results from the Rasch analyses of students' tests are included in the Appendices. The rest of the results are presented in the actual report. Two main findings are as follows.

1. There were progressively widening gaps between student achievement and each Year Level's Achievement Standards (as measured by Year Level Tests) as Year Level increased; all students interviewed did not achieve the assessed learning and working mathematically outcomes; consequently, the vast majority of students are 'at risk' of achieving their numeracy and mathematics learning and working mathematically outcomes as prescribed in the achievement standards.
2. All teachers (except one) did not demonstrate mathematical competence with the content knowledge of the primary mathematics curriculum; teachers' self-assessment of their 'preparedness' to teach the new curriculum showed they were not 'very well prepared' to teach more than half the prescribed topics, and as a result, lesser topics were 'actually taught' in 2013; implementing the new curriculum was challenging; and teachers requested more training, resources, support and assistance to improve their instructional practice and delivery of the student-focussed new strategies of the new curriculum and upgrade their mathematics content knowledge of the primary curriculum.

It is recommended that:

1. Primary teachers urgently need mathematics pedagogical content knowledge and skills training workshops and continuous support over the second and third year of classroom implementation of the new primary mathematics curriculum, informed by students' and teachers' common errors and areas of difficulty and findings from teachers' perceived 'lack of preparedness' and topics actually taught, to enable and empower them to transform their current teaching and assessment styles and practices to align more with a socio-cultural and student-focussed approach as envisaged in the new curriculum.
2. Practicing teachers should undertake: (a) the two foundation general mathematics papers (HMA071 and HMA072) offered at NUS to all preservice primary teachers to upgrade their mathematics content knowledge of the new primary mathematics curriculum and the (b) 'teaching primary mathematics' pedagogical course (HTE155) that is compulsory for all primary preservice teachers.
3. Given the vertical widening deviation of actual student achievement from the prescribed achievement standards, NAMDiPS study should be extended to Years 5, 6, 7, and 8 to provide baseline achievements for comparison purposes of the impact on student achievement if any, of any

future intervention strategies or as a result of two/three years of of the implementation of the new curriculum in Samoan classrooms.

4. Primary classrooms should be resourced with the necessary materials required to develop students' informal strategies in measuring length, area and volume (e.g. building blocks, measuring tape) and creating repeated patterns of objects.
5. An innovative and more empowering strategic approach to professional learning is needed to encourage communities of practitioners within and between schools in clusters and between clusters of schools as they develop, exchange and share resources amongst themselves.
6. The empirical evidence of students' common errors in the achievement tests and their poor performance with the interview assessment tasks demonstrate the need to cultivate and effectively implement a more socio-cultural approach in mathematics learning and assessment as encapsulated by the suite of Working Mathematically Processes in the early years.
7. Following on from Recommendation 6, MESC should consider revising SPELL 1 so that it also includes word problems using the appropriate Year 4 mathematical language to better align with the prescribed Year 4 Achievement Standards.

Background to the Research

MESC's *Strategic Policies and Plan 2006-2015*, and the *National Curriculum Policy Framework (2006),* indicate a clear sense of the importance of establishing and developing numeracy understandings from the early primary years. They recognise that soundly based numeracy and mathematical knowledge and skills are essential for successful learning achievement in many areas of the overall education programme and for effective performance in today's world.

The Education Sector Programme II (ESPII) has the goal of raising the quality of education throughout the school system but with a particular focus on primary schooling. ESPII objectives include primary curriculum reform, raised teacher effectiveness in primary classrooms, and improved levels of student performance, especially in numeracy and literacy.

The research reported here assessed the extent of the implementation of the new primary mathematics curriculum in Samoan Years 1 to 4 primary classrooms and its effects on teachers' understandings and practices, and students' performance. This report therefore presents the results of the final study that was conducted October 29 to November 15, 2013 with eight schools.

Research Focus

The study researched primary teachers' knowledge of, and skills for, the teaching and development of initial numeracy and student performance in the early years (Years 1-4)[1] soon after the roll-out of the new curriculum at the beginning of 2013.

Research Objectives

The research objectives guiding the NaMDiPS Study were as follows:

1. To analyse the current primary mathematics curriculum and supporting documentation to identify primary students' initial numeracy and mathematics major learning outcomes in terms of content (knowledge and skills) and working mathematically (WM) outcomes by Year Level in the early years.
2. To examine available, if any, whole-school, classroom, home and community wide practices, activities and strategies which, contribute to, and support, the development of primary students' initial numeracy and mathematical competence in the early grades.
3. To identify primary teachers' current knowledge of, and skills for, the teaching and development of initial numeracy and mathematical competence in the early years.
4. To identify primary students' current initial numeracy and mathematical knowledge and skills in relation to their Year Level's major learning and working mathematically outcomes

Timing

The research study was planned (after the signing of contract on July 15, 2013), to proceed for 12 weeks to be spread over the period up to December 1, 2013. Approval from the NUS Vice Chancellor for the NUS team members to engage with the study was received on July 26, 2013. As a consequence, the NaMDiPS formally began the study on July 29, 2013 with its first team meeting taking place on Friday August 2, 2013.

[1] Unless otherwise stated, early grades will be used throughout the document to refer to Years 1 to 4.

The start of NaMDiPS Study coincided with the middle of Term 3 of the school year with classes ending on September 20, 2013. Term 4 began on October 7 and ended on December 13, 2013.

The pilot study was conducted from September 3, 2013 to September 20, 2013 during the final week of Term 3, 2013 with the final study on October 29, 2013 to November 15, 2013

Methodology

Strategy

The study was a small scale, in-depth mixed methods study undertaken with a cross-section of eight primary schools, to examine the teaching and acquisition of initial numeracy and its development in the early grades. The NaMDiPS study had 4 main strategic goals:

1. To analyse the current primary mathematics curriculum and supporting documentation to identify the intended primary students' initial numeracy and mathematics major learning outcomes in terms of content (knowledge and skills) and working mathematically outcomes by Year Level in the early years to provide a *Years 1 to 4 Achievement Standards* to guide and inform the rest of the study's procedures.
2. To use a multiple-group research design to examine existing whole-school, classroom, home and community wide practices, activities and strategies which, contribute to, and support, the development of primary students' initial numeracy and mathematical competence in the early grades.
3. To identify primary teachers' current knowledge of, and skills for, the teaching and development of initial numeracy and mathematical competence in the early years.
4. To identify primary students' current initial numeracy and mathematical knowledge and skills in relation to their Year Level's achievement standards.

Final Sample for the Study

A sampling frame for the final study was derived based on the existing proportions of primary schools by Region and School Status in the population of 167 primary schools in Samoa. Table 1 provides the number of schools by Region (Apia Urban, Rest of Upolu and Savaii) and by School Status (Government, Private and Mission). Shown in Column D are the proportions (i.e., fractions) in the actual population (*N*=167) for each type while Column E provides the expected number per type for a representative national sample of 8 schools. Column F (Table 1) provides the rounded up numbers for the three biggest types.

For example, 4 schools were randomly selected from 73 government schools in the Rest of Upolu Region, 2 from 48 government schools in Savaii, and one from 21 government schools in the Apia Urban Region. For the Mission and Private Schools in Apia, Rest of Upolu and Savaii Regions, their respective numbers are relatively small with each representing expected number of less than one as shown in Column E (Table 2). Thus, they were all merged to represent a collapsed school status, namely, Non-Government. Hence the overall School Status types that will be used throughout the study are: *Government* and *Non-Government*. To complete the sample of 8 schools, one was randomly selected from the 25 non-government schools in Samoa. Provided in Table 2 are the population proportions which determined the final sample numbers by region and by school status.

Table 1: Population Proportions by Region and School Status

A	B	C	D	E	F
			N=167	n=8	n=8
Region	**School Status**	**Total**	**Fraction of Popn**	**Sample Expected Number**	**Sample**
Apia Urban	Government	21	0.13	**1.01**	**1**
	Mission	5	0.03	0.24	
	Private	7	0.04	0.34	
Rest of Upolu	Government	73	0.44	**3.50**	**4**
	Mission	8	0.05	0.38	
Savaii	Government	48	0.29	**2.30**	**2**
	Mission	5	0.03	0.24	
Grand Total		**167**			

Table 2: Sample Numbers by Region and School Status

A	B	C	D	E	F
			N=167	n=8	n=8
Region	**School Status**	**Total**	**Popn %**	**Sample Expected Number**	**Sample Final Numbers**
Apia Urban	Government	21	13	**1.01**	**1**
Rest of Upolu	Government	73	44	**3.50**	**4**
Savaii	Government	48	29	**2.30**	**2**
Apia-Rest of Upolu-Savaii	Non-Government	25	14	0.24	**1**
Grand Total		**167**	**100**	**1.00**	**8**

Before the random selection of 8 schools began, a second set of criteria was agreed upon to ensure that the sampled schools altogether can provide approximately or close to 5% of the total population of primary Years 1 and 4 students. Five percent is roughly the proportion of the 167 primary schools that is represented by the sample of 8 schools. As a result, if the random number generated is the code of a school with less than 30 Year 1 students then it is not accepted. This random selection continued until the eight schools were selected according to the numbers in Column F of Table 2. The final list of schools for the actual study's sample is listed in Table 3 with the recorded number of students per Year Level per school provided in Table 4 (MESC EMIS Database).

Pilot Study

A pilot study was conducted with three schools around the vicinity of Apia to validate the instruments especially the students' numeracy and mathematics achievement tests and interview assessment tasks. The pilot study also enabled the trialling of administrative operations and procedures for students' and teachers' tests, questionnaires and interviews to minimize any possible problems during the actual study. In addition, it allowed the project team and assisting research assistants to become familiar with the activities and to provide feedback on ways to improve the procedures for data collection during the actual study. The findings therefore informed the fine-tuning and finalisation of both data collection instruments and administrative procedures.

Table 3: Final Study Sample

A	B	n=8	Sample Primary Schools (PS)
Region	**School Status**	**Sample**	**School Names**
Apia Urban	Government	**1**	Vaimea
Rest of Upolu	Government	**4**	Faleasiu, Satapuala, Manono and Lotofaga (Lepa)
Savaii	Government	**2**	Salelavalu and Satupaitea
Apia-Rest of Upolu-Savaii	Non-Government	**1**	St Marys
Grand Total		**8**	

Table 4: Final Study Sampled Schools and Student Numbers by Year (from MESC EMIS Database)

A	B	C	D	E	F
Sample Primary School	**School Status / Region**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Lotofaga (Lepa)	Government / Rest of Upolu	31	29	22	26
St Marys	Non-Government	128	124	104	105
Vaimea	Government / Apia Urban	102	81	71	73
Faleasiu	Government / Rest of Upolu	102	78	83	80
Salelavalu	Government / Savaii	46	28	23	34
Satupaitea	Government / Savaii	57	64	38	59
Satapuala	Government / Rest of Upolu	41	38	40	41
Manono	Government / Rest of Upolu	44	41	26	35
Total		**551**	**483**	**407**	**453**

Data Collection Procedures

The data collection procedures, described below, were designed to obtain the most relevant data to answer each of the four research objectives as follows:

(1) To obtain answers to the first research objective, a desk analysis of the existing primary mathematics syllabus and supporting documentations made available for both teachers and students in Samoan primary schools was conducted to construct a learning progression scope and sequence continuum (i.e., *Years 1 to 4 Achievement Standards*) by strand, subtopic and WM sub-process.

(2) For the second research objective, a students' background questionnaire was developed to seek information about their existing classroom and home practices and strategies they perceive are contributing to, or supporting, the achievement of their initial numeracy and mathematics learning outcomes.

(3) To provide answers to the third research objective, teachers were asked to undertake the field-tested diagnostic numeracy and mathematics test we had been using with our preservice and foundation students to gauge their mathematical competence in relation to the primary and early secondary mathematics curriculum from Years 1 to 9. A new version was developed and was pilot tested by our current final year primary preservice teachers and teachers from the pilot schools.

(4) Additional data for the third research objective were obtained from a teachers' background questionnaire to obtain information about teachers' academic and professional background, years of teaching experience at the current level and other levels, instructional teaching and

planning practices, and their current experiences in implementing the new 2013 primary mathematics curriculum. Furthermore, individual interviews of teachers in each school were also conducted to further probe teachers' questionnaire responses and/or discuss any other issues related to the teaching of the new primary mathematics curriculum. In addition, an attempt was made to obtain available information on MESC's EMIS Database to verify/confirm teachers' responses from their background questionnaires. Additional information, through a principal's background questionnaire, was also sought from the school principal regarding the school context and the resources available for mathematics instruction.

(5) Answers to the final and fourth research objective were student responses to a diagnostic test based on the prescribed *Achievement Standards* of the four years. Four diagnostic tests, one for each Year Level from Years 1 to 4, were finalised based on results from the pilot study. To enable test equating using the Rasch Model between the four tests, common items between consecutive year tests were included.

(6) Additional data from a smaller number of students (up to 24) from each school were obtained through one-on-one interviews as students solve assessment tasks based on their Year Level's achievement standards. Teachers were asked to select their requested number of students from his/her class based on his/her knowledge of their mathematical abilities to include some top, middle and/or lower ability students.

Development of Mathematics Test Items and Questionnaires

The literature was reviewed to determine whether or not there were available Years 1 to 4 mathematics tests, and students' and teachers' questionnaires that meet the purpose of NaMDiPS. Most relevant to this study were the released items from the 2007 international mathematics test: Trends in International and Science Study (TIMSS 2007) and its relevant questionnaires for identifying contextual factors surrounding the teaching and learning environment of students (Mullis, Martin, & Foy, 2008). Also useful were Australia's NAPLAN Numeracy tests for primary schools and those from a number of numeracy projects conducted at early primary up to Year 2 (Clarke, Sullivan, Cheeseman & Clarke, 2000) and others. These tests have published reliability and validity information. Selected items and questions were adapted from these sources to ensure alignment with Samoa's primary mathematics curricula (old and new). The diagnostic test items for all four tests, being deliberately developed by the research team to be valid for the purpose of the research, were critiqued and reviewed by some local mathematics teachers and educators for content validity in preparation for pilot testing. This was necessary in the development of each instrument to ensure relevance to local contexts and suitability for Samoan primary students. The final versions of the four tests were informed by the results of the pilot study.

The students' diagnostic numeracy and mathematics tests, students', teachers' and principals' questionnaires and teachers' mathematics diagnostic test were also pilot tested. The students' tests and questionnaires and teachers' test were available in both English and Samoan.

Student Numeracy and Mathematics Tests

To minimise cognitive overload and physical fatigue, each student test was divided into two Parts with each part comprising 17 questions which were primarily multiple choice items with a few open-response ones. The test questions were based on a *Years 1 to 4 Achievement Standards Framework* which had two dimensions, namely a content dimension and a cognitive dimension. The content dimension is defined and structured by the five Content Strands' Knowledge & Skills Learning Outcomes (K&SLO) of the relevant primary mathematics curriculum. The cognitive dimension as used in the study included the processes of knowing, applying and reasoning. Each test item was designed to assess at least one K&SLO from those of the respective Year Level and at least one of the three cognitive domains. Findings from

the pilot study informed the selection of items from the pilot study Tests 1 and 2 to form four separate tests (Tests 1 to 4) for each of the four Year Levels. The percentage distribution of test items in the final four tests by content domain and cognitive domain is provided in Table 5.

Table 5: Student Tests 1 to 4 Content and Cognitive Domain Percentages

TEST 1 CONTENT DOMAIN	**TEST 1 COGNITIVE DOMAIN**			**TOTAL (%)**
	KNOWLEDGE	**APPLYING**	**REASONING**	
NUMBERS & OPERATIONS (NR)	A5, A8, A12, A17, E24, E25, E31	A1, A2, A3, A7, A10, A11, A13, E18, E27,	A4, A6, A9, E28, E30	**21 (61)**
PATTERNS & ALGEBRA (PA)	A15,	A14, A16, E26		**4 (12)**
DATA ANALYSIS (DA)		E19, E20		**2 (6)**
MEASUREMENT (MS)		E21,E23, E33		**3 (9)**
SPACE & GEOMETRY	E22,	E29, E32, E34,		**4 (12)**
TOTAL (%)	**9 (26%)**	**20 (59%)**	**5 (15%)**	**34**
TEST 2 CONTENT DOMAIN	**TEST 2 COGNITIVE DOMAIN**			**TOTAL (%)**
	KNOWLEDGE	**APPLYING**	**REASONING**	
NUMBERS & OPERATIONS (NR)	A10, A13,A17,A4, E24, E25, E31	A6, A1, A8, A12, A15, A16, A3, A7, A5, E27,	A2, A11, A14,E20, E28, E30	**23 (67)**
PATTERNS & ALGEBRA (PA)		A9, E26		**2 (6)**
DATA ANALYSIS (DA)				**0**
MEASUREMENT (MS)		E18, E22, E23,E33,		**4 (12)**
SPACE & GEOMETRY	E21	E19, E29, E32, E34		**5 (15)**
TOTAL (%)	**8 (23%)**	**20 (59%)**	**6 (18%)**	**34**
TEST 3 CONTENT DOMAIN	**TEST 3 COGNITIVE DOMAIN**			**TOTAL**
	KNOWLEDGE	**APPLYING**	**REASONING**	
NUMBERS & OPERATIONS (NR)	A1, A4, A9, E20, E23, E32	A5, A11, E19, E21, E25	A8, A10, A14, E26, E29, E30	**17 (52)**
PATTERNS & ALGEBRA (PA)		A6, E24, E31		**3 (9)**
DATA ANALYSIS (DA)		A16		**1 (3)**
MEASUREMENT (MS)	A12	A2, A3, A13,E27, E33	A15, E34	**8 (24)**
SPACE & GEOMETRY		A7, A17, E18, E28		**4 (12)**
TOTAL (%)	**7 (21%)**	**18 (55%)**	**8 (24%)**	**33**
TEST 4 CONTENT DOMAIN	**TEST 4 COGNITIVE DOMAIN**			**TOTAL**
	KNOWLEDGE	**APPLYING**	**REASONING**	
NUMBERS & OPERATIONS (NR)	A1, A13, A15, E19, E27,	A4, A6,A8,E18, E20, E23, E34,	A5, E24	**14 (42)**
PATTERNS & ALGEBRA (PA)		A11, E22, E26, E31		**4 (12)**
DATA ANALYSIS (DA)		A10, E28,		**2 (6)**
MEASUREMENT (MS)		A2, A12,E25, E29, E33,	A9, E30,	**7 (21)**
SPACE & GEOMETRY	A3, A17	A14, A16, E21, E32,		**6 (18)**
TOTAL (%)	**7 (21%)**	**22 (67%)**	**4 (12%)**	**33**

For example, for the content dimension, 42% up to 67% of test items for all four tests were from the Number & Operations strand with 9% up to 24% of the items from the Measurement strand, 12% up to 18% of the items from the Space & Geometry strand, 6% up to 12% from the Patterns & Algebra strand and up to 6% of the items from the Data Analysis strand. For the cognitive domain, the majority (55% up to 67%) of the items are the 'Applying' type with 21% up to 26% of the items classified as the 'Knowledge' type and 12% up to 24% as 'Reasoning' type items.

Student Questionnaires

The student questionnaire consisted of 17 questions of various types from open response to multiple choice and filter questions.

Student Assessment Tasks

Assessment tasks for one-on-one student interviews were based on a selection of activities currently made available in Years 1 to 4 Teachers' Manuals. Each task comprised multiple parts; the first part assessed a K&SLO while the other parts assessed at least two Working Mathematically Outcomes. For example, for most tasks, the second part requested students to explain or illustrate the strategy they used to get their answers in the first part with the other parts asking the student to provide a different strategy, use an empty number line to illustrate, their, or, a different, strategy to solve the problem, pose their own question using the given situation or solve an extension/variation of the given context.

Teacher Numeracy and Mathematics Diagnostic Test

The teachers' diagnostic test consisted of 38 open response questions selected from the content of the primary mathematics and early secondary curriculum.

Teacher Questionnaire

The teacher questionnaire comprised 27 items requesting background information on teachers' academic and teaching qualifications and major areas of study, school environment, instructional practices in mathematics, their preparedness to teach the prescribed mathematics topics for that Year Level, resources for teaching mathematics, whether or not topics for that Year Level's achievement standards have been taught or not, homework practices and participation in professional development activities.

Principal Questionnaire

The principals' questionnaires consisted of 16 items requesting background information on school characteristics in terms of school enrolment and Years 1 to 4 enrolments, the distribution of their time between various activities in their role as school principal, parental involvement in the school, school climate for learning, instruction in mathematics, the professional development of Years 1 to 4 teachers, student behaviour and available resources and technology.

Ethical Consideration and Participants' Consent Forms

Permission to enter sample schools was obtained from the Ministry of Education, Sports and Culture. Consent forms were given to participating students including an overview information sheet about the NaMDiPS Study for their consideration. The return of the signed consent form indicated that participants have read the information sheet and understood the procedures, that their questions were answered to their satisfaction, that they understood they may withdraw from the study at any time, and that they freely chose to participate in the study. Also, at all times, the privacy, confidentiality and respect for participants were observed.

Data Analysis

Quantitative Analysis of Responses to the Diagnostic Tests

Student responses to the respective diagnostic test were treated and coded two different ways. First, responses were marked Correct, Incorrect or Blank in preparation for analysis using the Dichotomous Rasch Measurement Model (DRMM) and the QUEST software (Adams & Khoo, 1996; Rasch, 1980) to provide estimates of students' initial numeracy and mathematics abilities and achievement of the

relevant K&SLO of the primary mathematics curriculum. Second, student's responses (i.e. selected choice) were coded using a rating scale of 1 up to 4, and analysed using the Partial Credit Rasch Measurement Model (PCRMM) (Adams & Khoo, 1996; Rasch, 1980) to determine students' extent of endorsement of the four response categories of the multiple choice items. A quantitative analysis of students' selected choices for multiple choice items enabled the identification of common and persistent error types across the early years.

Rasch analysis results and graphic outputs (item-person maps and kidmaps) provided evidence from which to develop a nuanced understanding of primary students' achievement of their initial numeracy and mathematics learning outcomes (as a group and as individuals respectively) for comparison purposes. Likewise, teachers' test responses were similarly analysed (as in the first part for student responses) to determine teachers' competence levels with the primary and early secondary level (PESM) mathematics curriculum.

Quantitative Analysis of Responses of Student Questionnaires

Student responses to questionnaire items that use a rating scale were coded (i.e. selected choice or actual answer) as presented in the questionnaire then analysed using the Partial Credit Rasch Measurement Model (PCRMM) (Adams & Khoo, 1996; Rasch, 1980) to determine students' extent of endorsement of the response categories and to determine item difficulty to endorse estimates. More relevant details are provided in the Results section for each of the latent traits/variables measured such as mathematics attitudes, frequency of lesson practices and amounts of time spent on selected home activities.

Qualitative Analysis of Interview Responses

All interview responses were transcribed and analysed utilising a grounded theory approach where interviewees' responses were qualitatively examined and analysed in-depth to identify initial categories. Thereafter, much broader categorizations were progressively developed (by collapsing some related categories) to provide a more concise range of themes demonstrated by the interviewees as a cohort.

Triangulation of Findings

Triangulation from the Rasch analyses of quantitative data and qualitative analyses of interview data enabled the identification of (a) students' initial numeracy and mathematical ability estimates, (b) areas of achievement and identified common/ persistent areas of difficulties across the early years, (c) primary teachers' knowledge and skills of initial numeracy and mathematical competence of the content of the primary and early secondary mathematics curriculum and the achievement standards of the current primary mathematics curriculum. Collectively (a) to (c) were used to formulate answers to the project's research objectives.

Results

The data collected from the final study and subsequent analyses are organized and presented in three main parts. Part 1 presents quantitative data and cohort results from student tests and questionnaires and Part 2 includes those from teachers' tests and questionnaires including principals' questionnaires. The qualitative data collected from student and teacher interviews and subsequent analyses are presented in Part 3.

Part 1: Student Tests and Questionnaires

Students' test results are organised by Year Level followed by cohort results from students' questionnaires. Provided in Table 6 are the actual number of participating students from the eight schools. Note that pseudonyms will be used to refer to each of the schools throughout the report.

Table 6: Participating Schools and Actual Student Numbers by Year Level

A	B	C	D	E	F
Primary School (PS)	**CODE**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Lotofaga	LOT	24	27	22	30
St Marys	STM	102	105	89	75
Vaimea	VAM	64	65	69	68
Faleasiu	FLS	54	49	58	59
Salelavalu	SLV	38	19	19	31
Satupaitea	STP	40	57	32	52
Satapuala	SPU	19	26	30	33
Manono	MAN	13	22	22	24
Total		**354**	**370**	**341**	**372**
Total Questionnaires					

Student Test 1 Year 1 Results

A total of 354 Year 1 students took Test 1. Student test responses in the first part of the analysis were coded Correct, Incorrect or Blank and analysed using the DRMM for each of the four student tests (Test 1). The second part is the analysis of students' endorsement of the four response categories of the multiple choice items, using the PCRMM, to identify common and persistent error types across the early years. The Test 1 cohort Rasch statistics for the first part of the analysis are provided in Table 7.

Fit of Data to the Model

Yu (2006) recommended that evaluation of person-fit to the model should be done first before evaluating item-fit to the model.

Person Fit to the Model – Yu (2006, p. 23) and others (Bond & Fox, 2001) define misfits among the cases (persons) as those who have an estimated ability level that does not fit into the overall pattern as predicted by the Rasch Model. Subsequently, the initial analysis of responses from 354 cases showed that all person infit mean square (ms) values were within the recommended range of 0.50 to 1.50 logits. This is further corroborated by the mean infit ms value of 1.00 logit (standard deviation [SD] of 0.16 logit) as being equal to the expected value of 1 logit (see Table 7). No case had zero score or perfect.

Item Fit to the Model – An items' mean infit ms value of 1.00 (also around the expected mean value of 1.00) with a SD of 0.04 logit, was produced by the Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Table 7: Cohort Student Test 1 Rasch Statistics

```
Student Test 1 Year 1
-----------------------------------------------
Item Estimates (Thresholds) all on all (N =
354 L = 34  Probability Level=0.50)
-----------------------------------------------
 Summary of item Estimates
=========================
Mean                          0.00
SD                            0.80
SD (adjusted)                 0.79
Reliability of estimate       0.98

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    1.00             Mean    1.01
    SD      0.04             SD      0.09

      Infit t                  Outfit t
    Mean   -0.04             Mean    0.10
    SD      0.93             SD      0.85

   0 items with zero scores
   0 items with perfect scores
===============================================
```

```
Student Test 1 Year 1
-----------------------------------------------
Case Estimates all on all (N = 354 L = 34
Probability Level=0.50)
-----------------------------------------------
Summary of case Estimates
=========================
Mean                         -0.35
SD                            0.71
SD (adjusted)                 0.60
Reliability of estimate       0.70

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    1.00             Mean    1.01
    SD      0.16             SD      0.26

      Infit t                  Outfit t
    Mean   -0.03             Mean    0.04
    SD      1.12             SD      0.85

   0 cases with zero scores
   0 cases with perfect scores
===============================================
```

```
Internal Consistency   0.70
```

Test 1 Reliability Indices and Mean Estimates

Item and person separation indices are also part of the statistics generated by a Rasch analysis using QUEST. Theoretically, if the objective is to measure a latent construct such as numeracy and mathematics achievement, then the focus is on how reliable the cases measured have been separated by the items in the achievement test. From the Rasch analysis of students' Test 1 responses, the person reliability index of the instrument (i.e., 0.70) (and the traditional Cronbach's alpha value of 0.70) were closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the items in the test. The item reliability index of Test 1 (i.e. 0.98, see Table 7) was relatively higher (than the 0.70 person reliability index) and much closer to one indicating that the items were reliably and sufficiently separated by the cases into a hierarchical order along the logit continuum. The high item reliability index also means that we can reliably rely on this order of item estimates to be replicated when we give the test to other samples for whom it is suitable.

For Test 1, the mean ability estimate is –0.35 logit (SD 0.60) which is about 0.35 logit below that of mean item difficulty (0 logit) with a relatively lesser spread out distribution of persons around mean ability compared to that of items around its zero logit mean difficulty (SD 0.79). The cohort mean ability estimate would be closer to zero logit for a well-matched test. It appears that the test was slightly harder for this group by approximately 0.35 logit. In fact, there is, statistically, a significant difference between the two means (t = 3.1525, df = 386, p = 0.001) and Cohen's effect size value (d = 0.50) suggests a moderate practical difference. This statistically significant and moderate practical difference also

suggest the sample cases were not well-matched and the achievement standards which form the basis of the Test 1 items were not attained, on average by the cohort.

Student Test 1 Item- Person Map

With Test 1 Rasch statistics provided in Table 7, the Test 1 cohort item-person map is in Figure 1. The items on the item-person map are indicated by the item number on the right of the middle dotted line in the map and each individual person's performance is represented by an 'X' with each X representing two students. The logit scale, which is the measurement unit common to both person ability and item difficulty, is displayed in the middle of the item-person map. Because the logit scale is an interval scale, the equal distances anywhere up and down that scale are of equal size. For example Item 20 (1.35 logits) is approximately as much more difficult than Item 12 (0.36 logit) as Item 12 is more difficult than Item 2 (−0.65 logits). The distance between are approximately equal (≈ 1 logit). The same principle applies to differences in person locations as well. Persons and items are located on the map according to their ability and difficulty estimates, respectively. A complete list of ranked item estimates is provided later on.

The mean of the item difficulties is adopted by default as zero logit. For Test 1, its standard deviation is about 0.79 logits, indicating a spread of items around the mean that is approximately a four-fifth logit on both sides. The location of difficulty estimate for Item 17 was calculated to be at 0.00 logit hence its location on the item-person map. Person locations on an item-person map are plotted so that any person has a 50% probability of succeeding on items located at the same point on the logit scale, less than 50% probability of succeeding on items located above the ability estimate and more than 50% for items located below the ability estimate.

The Test 1 median ability estimate of the cohort is located at −0.39 logits with the upper and lower quartiles at −0.02 and −0.82 logits respectively resulting in the middle 50% of the cohort abilities distributed over an ability interquartile range of 0.80 logits. The median item estimate is 0.18 logit (Item 28) with the upper quartile estimate at 0.47 logit (Item 31) and lower quartile estimate at −0.65 logit (Item 2) providing a 1.12 logit interquartile range of item difficulty estimates for the middle 50% of items. The two most difficult items (#29 and #20) were on viewing a cone from the top and reading and interpreting quantitative information displayed in a table. The easiest item (Item 21) was visually identifying from pictures the tallest tree. See item descriptions provided below in Table 8.

Test 1 Ranked Item Difficulties and Descriptions

Provided in Table 9 are the ranked items with a summary of brief item descriptions[2], number of students who scored the item correctly, total number from the cohort (*n*=354) that attempted the item, percentage of students who answered the item correctly and the item's difficulty estimate. For example, for the most difficult Item 29, out of the 306 that attempted the item, only 57 (equivalent to 16.1% of cohort, *n* = 354) got it correct and the item's difficulty estimate is 1.42 logits. For the median item (#28), 135 out of 316 got it correct (38.1%) and the difficulty estimate is 0.18 logits and with the easiest item (#21), 297 out of 340 that attempted it were correct (84.1%) and the difficulty estimate is -2.12 logits. Also note that in Table 9, only the last 9 items showed a majority percentage (i.e. >50% of the cohort) correct, namely Items 32, 2, 18, 19, 5, 22, 1, 16 and 21. Provided in Table 10 is a list of the ranked items and the corresponding Knowledge & Skills Learning Outcomes from the relevant Year Level Curriculum that the item is purported to be assessing.

[2] Without pictures, graphs and diagrams as provided in the actual test.

Student Test 1 Year 1

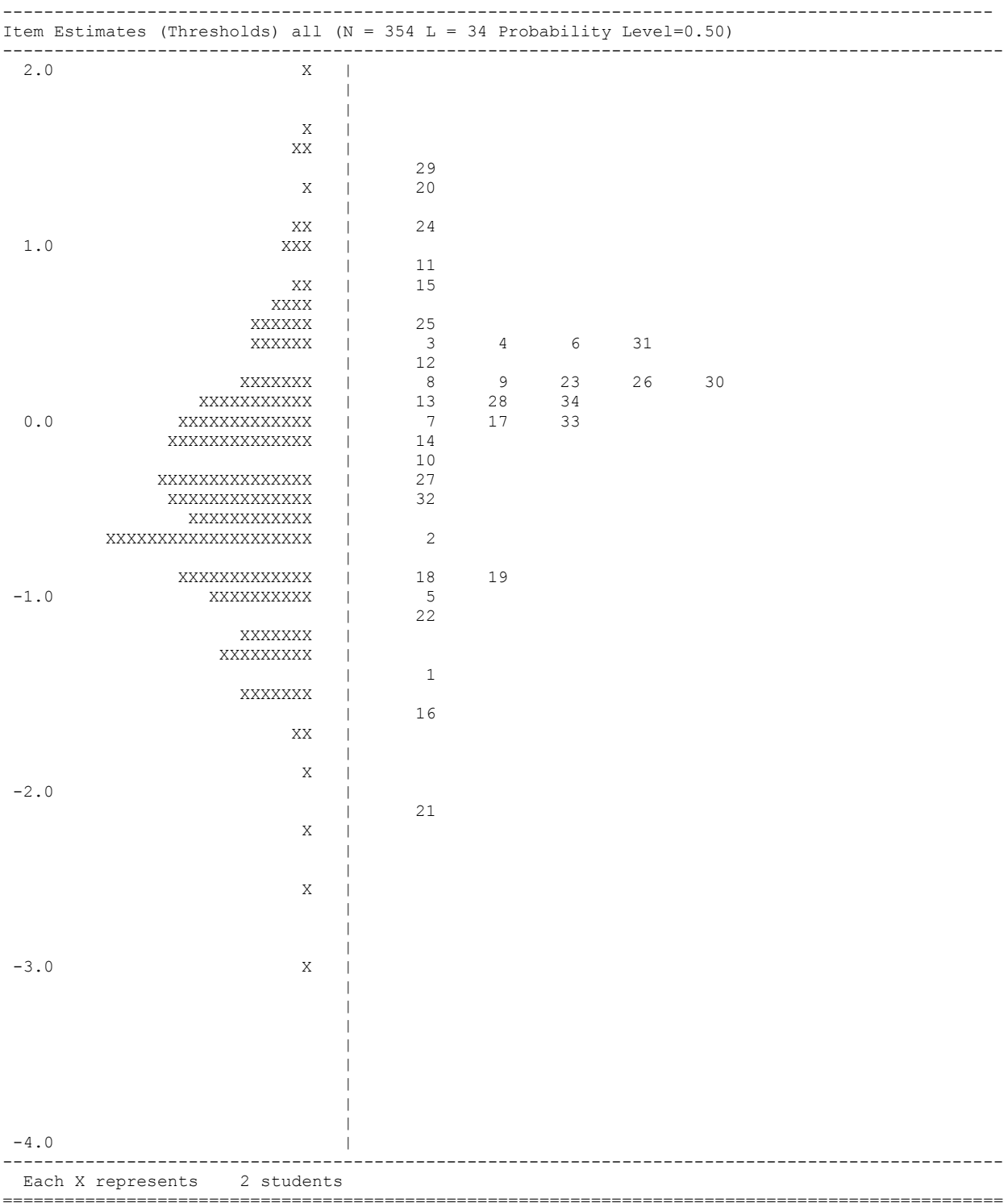
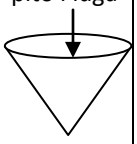
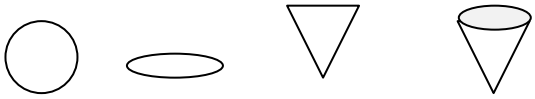


Figure 1: Cohort Year 1 Test 1 Item-Person Map

Student Test 1 School Results

Provided in Table 11 are the relevant Test 1 statistics for each of the eight schools including their respective mean ability estimates. Ranking the eight Year 1 groups by their Test 1 mean ability estimates, the graph in Figure 2 showed the highest ranked Year 1 group to be STP PS (n=40) with mean ability of -0.13 logits (SD 0.59) indicating that the students found the test, on average, difficult by approximately 0.13 logits while the Iowest ranked group was SPU PS (n=19) with mean ability of -0.93 logits (SD 0.04) suggesting that SPU students found the test difficult by approximately 1 logit. All eight group mean abilities are all below zero logit. In addition, the respective item-person maps in Figures 3 show the distribution of cases and items along the logit continuum for each school.

Table 8: Item Descriptions of the Test 1 Cohort Most Difficult and Easiest Items

<table>
<tr><th>Item</th><th>Item Descriptions - Most Difficult Items</th><th>Knowledge & Skills Learning Outcomes</th></tr>
<tr><td>29</td><td>Tagai i le ata o le kone.
pito i luga
 
O fea o ata nei e tutusa ma foliga o le pito i luga o le kone
  </td><td>SG1.1 – K&SLO 2

Difficulty Estimate = 1.42 logits</td></tr>
<tr><td>20</td><td>O le ā le vasega e pito i laiti le aofai o tamaiti?
<table><tr><td colspan="4">Aofai o Tamaiti I le Vasega</td></tr><tr><td>Year 1</td><td>Year 2</td><td>Year 3</td><td>Year 4</td></tr><tr><td>35</td><td>31</td><td>40</td><td>26</td></tr></table></td><td>DA2.1 – K&SLO 5, 6

Difficulty Estimate = 1.35 logits</td></tr>
<tr><td>Item</td><td>Item Description – Easiest Item</td><td>Knowledge & Skills Learning Outcomes</td></tr>
<tr><td>21</td><td>O fea le laau e pito umī?
  </td><td>MS1.1 – K&SLO 6

Difficulty Estimate = -2.12 logits</td></tr>
</table>

Table 9: Ranked Year 1 Test 1 Items and Item Analysis Results

Rank	ITEM	Item Description	SCORE	MAXSCR	% Correct	Difficulty Estimate
1	29	siepi pe a vaai mai i luga o le koge tusa'o ile pito maai	57	306	16.1	1.42
2	20	piki le vasega pito laiti tamaiti mai aofaiga o loo avatu I se teipolo (siata)	60	298	16.9	1.35
4	24	atigipusa moomia mo 20 fagu pe afai e 4 fagu le pusa e tasi	73	299	20.6	1.10
3	11	o le ata o loo vaevaeina tutusa ile a? (kuata)	87	327	24.6	0.86
5	15	faaauau pateni numera 25, 20, 15, mo nisi numera se lua	89	314	25.1	0.83
	25	Numera e 10 e tele ai nai lo le 278	104	278	29.4	0.60
6	3	e lona fia le taavale ile faasologa	111	334	31.4	0.50
7	6	44 - ? = 31 o le a le numera o loo misi	113	327	31.9	0.47
8	31	fuaiupu numera e tutusa ma le 16	113	307	31.9	0.47
9	4	aofai atoa o mapu e sefulu fa ma le lua sefulu tolu	115	321	32.5	0.44
10	12	o le vaegamea a le tamaititi pe a vaevae apu e lua I tamaiti e toafa	121	328	34.2	0.36
12	9	e fia moli a le tama toatasi pe a faasoa tutusa moli e valu mo tama e toafa	125	331	35.3	0.31
13	30	Fea le numera e tutusa ma le 300 + 70 + 6	126	314	35.7	0.29
14	8	o le numera e tutusa ma le faatelega faatasi o le 2 ma le 5	128	322	36.2	0.27
15	26	faaauau pateni mo le pusa lona lima	130	292	36.8	0.24
16	23	O le a le tele o le susu i totonu o le fagususu	131	322	37.1	0.22
17	**28**	piki le pusa e tele ai le avanoa e maua ai le kuki mai ata e fa	135	316	38.1	0.18
18	13	Fea fagu e tele le avanoa e filifili mai ai se mapu	136	335	38.4	0.16
19	34	Fea le siepi e 12 pito	137	320	38.7	0.15
20	7	ata o faaputuga e 4 ma siepi tai 3. Fesili: 3+3+3+3 e tutusa ma le a?	144	332	40.7	0.06
21	33	fea le uati e tau mai ai le kuata e tea ai le iva	146	329	41.4	0.03
22	17	2+4 e tutusa lona tali ma le tali o le fea (fuaiupu numera?)	149	326	32.1	0.00
23	14	O le a le ata e sosoo ile pateni o siepi	151	343	42.7	-0.03
24	10	vaegamea o loo valivaliina ile ata (afa)	164	344	46.3	-0.19
25	27	fea le vili e tele le avanoa e tu ai ile lanu paepae	175	338	49.4	-0.32
26	32	o le a le sitika o loo i le tulaga A4 i luga ole siata	183	322	51.7	-0.42
27	2	o a numera I le va o le 14 ma le 17	202	195	57.1	-0.65
28	18	e tutusa le aofai o foliga ole ata ma le fea ata	212	331	60.1	-0.79
29	19	O ai e pito tele ane taimane ile kalafi e fa poutu	214	319	60.5	-0.80
30	5	E toe fia li'o atoa le sefulu (1)?	225	332	63.6	-0.94
31	22	O le a le siepi I le ata? (piramita)	233	325	65.8	-1.05
32	1	E fia le aofai o foliga i totonu o le li'o	260	350	73.4	-1.43
33	16	O le a le tulaga o le faafetu i le pateni i le ata	269	346	76.0	-1.58
34	21	O fea le laau e pito umi i le ata?	297	340	84.1	-2.12

Table 10: Ranked Year 1 Test 1 Items and Knowledge & Skills Learning Outcomes

Rank	ITEM	Item Description	Knowledge & Skills Learning Outcome Reference Number
1	29	siepi pe a vaai mai i luga o le koge tusa'o ile pito maai	SG1.1 – K&SLO 2
2	20	piki le vasega pito laiti tamaiti mai aofaiga o loo avatu I se teipolo (siata)	DA2.1 – K&SLO 5, 6
4	24	atigipusa moomia mo 20 fagu pe afai e 4 fagu le pusa e tasi	NR1.3 – K&SLO 1, 2, 4
3	11	o le ata o loo vaevaeina tutusa ile a? (kuata)	NR 2.4 – K&SLO 1, 5
5	15	faaauau pateni numera 25, 20, 15, mo nisi numera se lua	PA1.1a – K&SLO 5, 6
	25	Numera e 10 e tele ai nai lo le 278	NR2.1 – K&SLO 2, 8
6	3	e lona fia le taavale ile faasologa	NR1.1 – K&SLO 1, 8
7	6	44 - ? = 31 o le a le numera o loo misi	NR1.2 – K&SLO 8; NR2.2 – K&SLO 1, 2, 5
8	31	fuaiupu numera e tutusa ma le 16	NR1.3 – K&SLO 6; PA2.2b – K&SLO 4
9	4	aofai atoa o mapu e sefulu fa ma le lua sefulu tolu	NR1.2 – K&SLO 1, 5, 6, 8
10	12	o le vaegamea a le tamaititi pe a vaevae apu e lua I tamaiti e toafa	NR1.4 – K&SLO 1, 2 NR1.3 – K&SLO 8
12	9	e fia moli a le tama toatasi pe a faasoa tutusa moli e valu mo tama e toafa	NR1.3 – K&SLO 2, 3, 7 NR2.3 – K&SLO 8, 9
13	30	Fea le numera e tutusa ma le 300 + 70 + 6	NR 2.2/3.2 – K&SLO 1
14	8	o le numera e tutusa ma le faatelega faatasi o le 2 ma le 5	NR2.3 – K&SLO 3
15	26	faaauau pateni mo le pusa lona lima	PA1.1a – K&SLO 5, 6
16	23	O le a le tele o le susu i totonu o le fagususu	MS1.3 – K&SLO 1, 2, 3
17	**28**	piki le pusa e tele ai le avanoa e maua ai le kuki mai ata e fa	NR1.5 – K&SLO 5 – 6
18	13	Fea fagu e tele le avanoa e filifili mai ai se mapu	NR1.5 – K&SLO 5
19	34	Fea le siepi e 12 pito	SG2.1 – K&SLO 5
20	7	ata o faaputuga e 4 ma siepi tai 3. Fesili: 3+3+3+3 e tutusa ma le a?	NR1.3 – K&SLO 1, 4; NR2.3 – K&SLO 6
21	33	fea le uati e tau mai ai le kuata e tea ai le iva	MS1.5/2.5 – K&SLO 9; MS3.5 – K&SLO 1, 5
22	17	2+4 e tutusa lona tali ma le tali o le fea (fuaiupu numera?)	PA1.2b – K&SLO 1; PA2.2b – K&SLO 1, 4
23	14	O le a le ata e sosoo ile pateni o siepi	PA1.1a – K&SLO 1, 2, 3
24	10	vaegamea o loo valivaliina ile ata (afa)	NR1.4 – K&SLO 1, 2, 4, 5
25	27	fea le vili e tele le avanoa e tu ai ile lanu paepae	NR1.5 – K&SLO 1, 2, 3
26	32	o le a le sitika o loo i le tulaga A4 i luga ole siata	SG3.3 – K&SLO 6, 7
27	2	o a numera I le va o le 14 ma le 17	NR1.1 – K&SLO 3, 4
28	18	e tutusa le aofai o foliga ole ata ma le fea ata	NR1.1 – K&SLO 8, 10
29	19	O ai e pito tele ane taimane ile kalafi e fa poutu	DA1.1 – K&SLO 2, 6, 7
30	5	E toe fia li'o atoa le sefulu (1)?	NR1.2 – K&SLO 5
31	22	O le a le siepi I le ata? (piramita)	SG1.1 – K&SLO 6
32	1	E fia le aofai o foliga i totonu o le li'o	NR1.1 – K&SLO 1, 8, 10
33	16	O le a le tulaga o le faafetu i le pateni i le ata	SG1.3 – K&SLO 2; NR1.1 – K&SLO 1, 8
34	21	O fea le laau e pito umi i le ata?	MS1.1 – K&SLO 6

Table 11: School Student Test 1 Rasch Statistics

Primary School	Item			Case		
	Number	Mean	Std Dev	Number	Mean	Std Dev
LOT	34	0.00	1.76	24	-0.26	0.95
STM	34	0.00	1.02	102	-0.23	0.68
VAM	34	0.00	0.82	64	-0.33	0.81
FLS	34	0.00	0.80	54	-0.59	0.35
SLV	34	0.00	1.20	38	-0.68	0.19
STP	34	0.00	1.24	40	-0.13	0.59
SPU	34	0.00	0.79	19	-0.93	0.04
MAN	34	0.00	1.27	13	-0.20	0.35

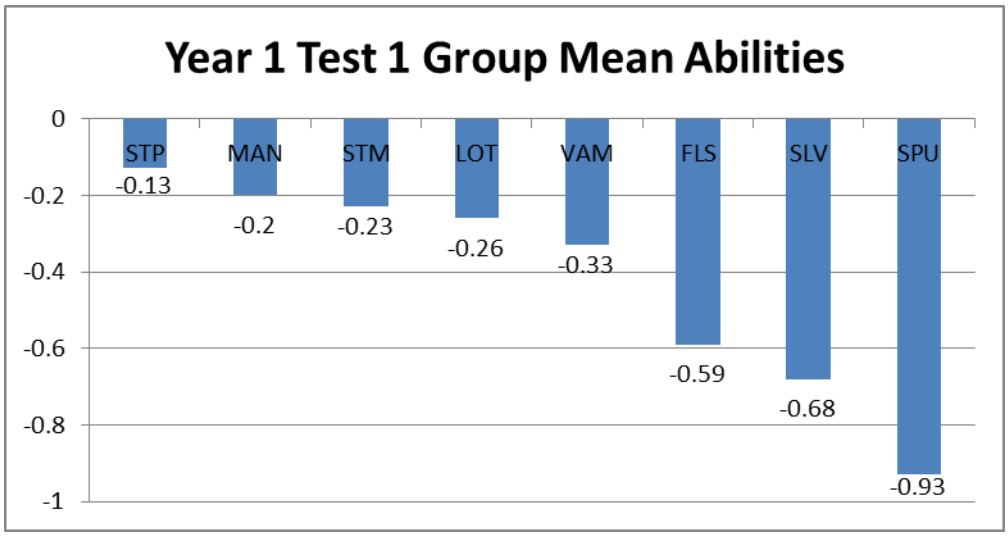


Figure 2: School Year 1 Student Test 1 Group Mean Ability Estimates

Year 1 Students' Levels of Achievement and Performance

Students' achievement levels for each year cohort were determined by the criterion-referenced tests and assessment tasks which, in turn, were based on each Year Level's Achievement Standards whereas students' performance levels compare each individual performance to those of the rest of the cohort. Therefore both levels indicate different things. First, achievement level indicates whether or not Year Level learning standards have been achieved (Proficient) or not (At-Risk) and second, performance levels indicate the relative positioning of individual performance compared to the rest of students in the year cohort in terms of five levels: Very High, Above Average, Average, Below Average and Very Low.

Achievement Levels

The goal of a criterion-referenced test or assessment is to obtain a description of the specific knowledge and skills each student can demonstrate in terms of learning outcomes. This information is useful for planning both group and individual instruction (Linn & Gronlund, 2000, p. 43). Criterion-referenced tests and assessment tasks were therefore designed to measure student against a fixed set of predetermined criteria or learning standards – i.e. concise, written descriptions of what students are expected to know and be able to do at a specific stage of their education such as those explicated by the Years 1 to 4 Achievement Standards.

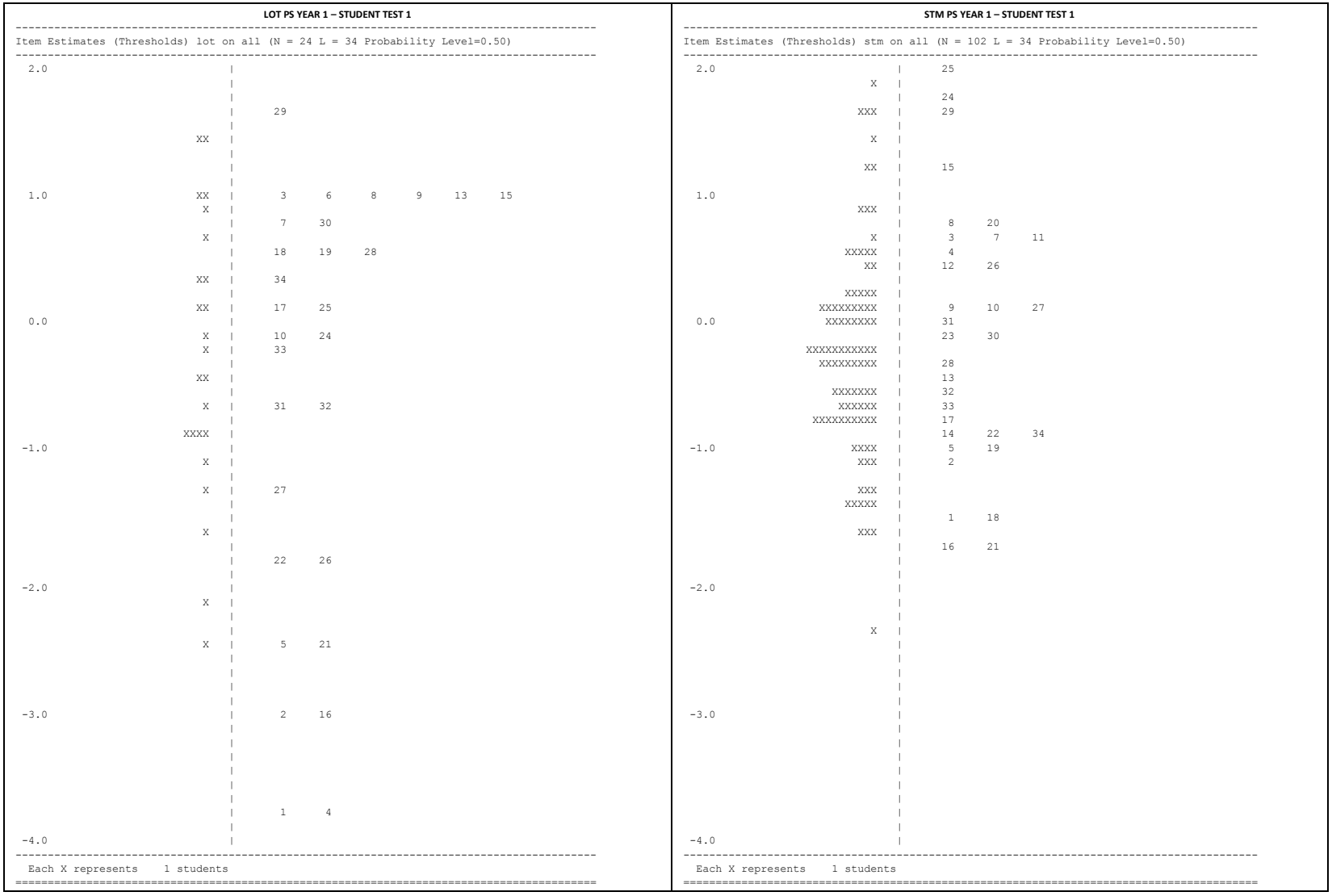


Figure 3: Schools' Student Test 1 Item-Person Maps

VAM PS Year 1 - Student Test 1

```
Item Estimates (Thresholds)vam on all (N = 64 L = 34 Probability Level=0.50)
  2.0                       X   |
                                |
                                |      29
                                |
                          X     |
                                |
                          X     |
                                |
                                |      15
  1.0                     X     |      20     30     31
                                |      34
                                |       4
                         XX     |      11     24
                        XXXX    |
                       XXXXX    |      14     33
                                |       6     12     13
                        XXX     |      25     32
                         XX     |      26
  0.0                   XXXX    |       3
                        XXXX    |      17     28
                                |
                        XXXX    |       8     10
                       XXXXX    |      23
                         XX     |       9
                                |       2      7     27
                     XXXXXXX    |       5
                      XXXXXX    |
 -1.0                           |      18
                         XX     |      16     19     22
                         XX     |
                                |
                        XXX     |
                          X     |      21
                                |
                          X     |
                                |
                                |
 -2.0                     X     |
                                |       1
                                |
                                |
                                |
                          X     |
                                |
                                |
                                |
 -3.0                           |
                          X     |
                                |
 -3.3                           |
  Each X represents    1 students
```

FLS PS Year 1 - Student Test 1

```
Item Estimates (Thresholdsfls on all (N = 54 L = 34 Probability Level=0.50)
  2.0                           |
                                |
                                |      20
                                |
                                |
                                |       3
                                |       9
                          X     |      29
  1.0                           |
                                |
                                |      11
                                |       6
                          X     |       4     23     24
                                |      15     31
                                |      12     25     34
                          X     |      17     26
                                |
  0.0                    XXX    |      13
                        XXXXXX  |       2     14     27
                                |
                         XXXXX  |       7
                           XXX  |       1      8     19     28     30     32
                         XXXXX  |
                                |      18     33
                    XXXXXXXXXX  |
                        XXXXXX  |       5
 -1.0                    XXXX   |
                                |
                          XXX   |      10
                                |
                         XXXX   |
                           XX   |
                                |      16     22
                                |
                                |
                                |
 -2.0                           |
                                |
                                |      21
                                |
                                |
                                |
                                |
                                |
                                |
                                |
 -3.0                           |
                                |
                                |
 -3.3                           |
  Each X represents    1 student
```

Figure 3: Schools' Test 1 Item-Person Maps

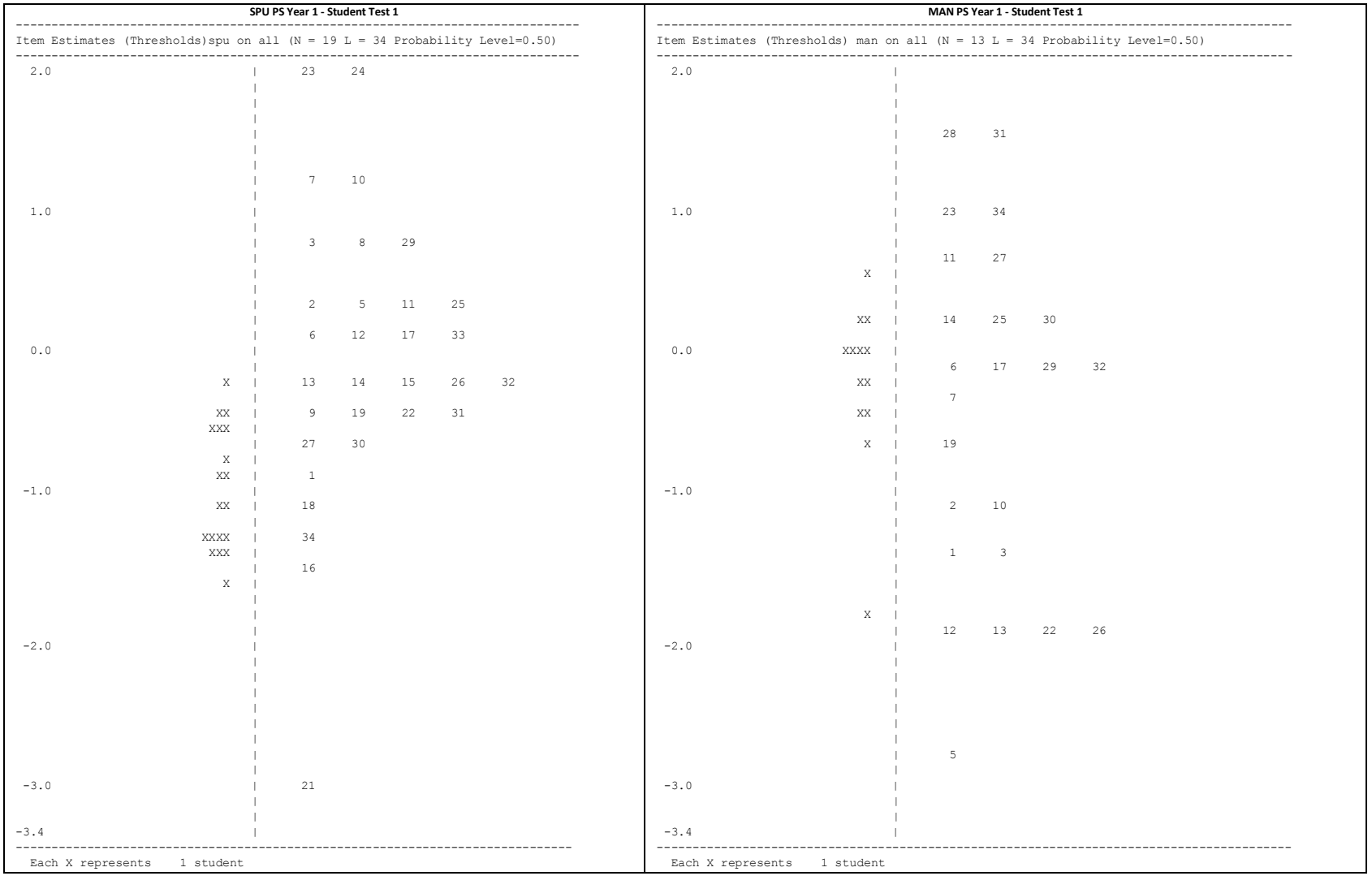


Figure 3: School Test 1 Item-Person Maps

STP PS Year 1 - Student Test 1

```
Item Estimates (Thresholds)stp on all (N = 40 L = 34 Probability Level=0.50)
  2.0                           |
                                |      11
                                |
                                |      28     31
                                |
                                |
                                |      20
                         XXX    |      29
                                |
  1.0                     X     |      13     33     34
                                |      24
                          X     |      12     30
                                |
                                |      15     26
                         XX     |
                          X     |      10
                        XXXXX   |      14     17
                                |
  0.0                   XXXXX   |      27
                         XXXX   |       8
                                |      23     25
                        XXXXX   |       3      7
                        XXXXX   |       4
                                |
                          X     |
                                |       6
                                |       2
 -1.0                    XX     |      18     32
                                |
                         XX     |      19
                                |
                                |
                          X     |
                                |       5     22
                         XX     |
                                |
                                |
 -2.0                           |
                                |
                                |
                                |
                                |       1     16
                                |
                                |
                                |
                                |
 -3.0                           |
                                |
                                |      21
                                |
                                |
                                |
                                |
                                |
                                |
 -4.0                           |
  Each X represents    1 students
```

SLV PS Year 1 - Student Test 1

```
Item Estimates (Thresholds slv on all (N = 38 L = 34 Probability Level=0.50)
  2.0                           |
                                |
                                |      17     26     29
                                |
                                |
                                |      24
                                |
                                |       4
                                |
  1.0                           |       3
                                |
                                |      13     18
                                |
                                |
                                |      30     34
                                |
                          X     |       9     11     31
                          X     |      23     33
  0.0                           |      15     25
                          X     |      14     28
                         XXXX   |       7
                          X     |       2
                         XXXX   |      10
                        XXXXXX  |      22
                                |      12
                        XXXXX   |
                         XXXX   |       5
 -1.0                           |
                        XXXXXX  |
                                |      16     32
                          XXX   |
                                |       1
                          X     |
                                |       6     27
                          X     |
                                |      19
                                |
 -2.0                           |
                                |
                                |
                                |
                                |
                                |
                                |
                                |
                                |
 -3.0                           |
                                |
                                |
                                |
                                |
                                |      21
                                |
                                |
                                |
 -4.0                           |
  Each X represents    1 students
```

Figure 3: School Test 1 Item-Person Maps

In this study, the criterion-referenced Tests 1 to 4 and interview assessment tasks evaluated whether students have learnt a specific body of knowledge or acquired a specific skill set as defined by the respective Years 1 to 4 Achievement Standards. If students performed at or above the established expectations – for example, by answering a certain percentage of questions correctly such as at least 80% - they have passed the test, have met the expected standards or are deemed "proficient." Theoretically therefore, on a criterion-referenced test, every student taking the exam could fail if they did not meet the expected standard; alternatively every student could earn the highest possible score. On criterion-reference tests, it is not only possible, but desirable, for every child to pass the test or earn a perfect score. It should also be noted that passing scores – or "cut-off" scores – on criterion-referenced tests are judgement calls made by either individuals, groups or the committee developing the tests for a specific purpose. (Great Schools Partnership, 2014). Scores on criterion-referenced tests indicate what individuals *can* do – not how they have scored in relation to the scores of particular groups of persons, as in norm-referenced tests. In this report, the two achievement levels used are 'Proficient Level' for those who have successfully answered at least 80% of the test items or 'At-Risk Level' for those who did not. Within the 'At Risk' level are further sub-divisions into 4 levels in terms of bands of 20% correct, namely, At-Risk Level 1 (60 up to <80%), At-Risk Level 2 (40 up to <60%), At-Risk Level 3 (20 up to <40%), and At-Risk Level 4 (0 up to <20%).

Performance Levels

To indicate the relative performance of an individual compared to those in the cohort, a stanine score is used to indicate whether or not s/he scored near the cohort's mean, above the cohort's mean, or below the group's mean. Furthermore, it gives a sense for how far above-average or below-average a person scored if he/she did not score near the mean. A stanine score can be any number between 1 and 9 (inclusive). Typically, a person is said to be "average" (i.e., near the mean) if his/her stanine score is a 4, 5, or 6. Stanine scores of 7 or 8 are usually interpreted as indicating "above average" performance. And a stanine score of 9 is normally considered to reflect "very high" performance, for that is the highest score one can get. At the other end, stanine scores of 2 or 3 are usually interpreted to mean that someone is "below average," while a stanine score of 1 indicates a relative position that is "very low."

'Performance Level', as used in this study, is based on a case's stanine score which, in turn, is based on a case's percentile ranking of their ability estimate thus enabling comparison of individual cases' performance to other students in the cohort. Therefore, besides the Rasch generated individual ability estimates and percentage correct (out of a total possible score of 34), students' percentile rankings, stanine scores and z-scores were also determined. Z-scores are case ability estimates which have been normalised in terms of number of standard deviations each ability estimate is from the cohort mean ability.[3] As a result z-scores have positive or negative values. The percentiles are based on rankings of ability estimates and they indicate the percentages of the cohort scoring at or below that ability estimate. Both z-scores and percentile ranks relate the individual's result to those of all cases in the cohort.

While the performance level is a general descriptor of an individual's performance relative to the cohort, the achievement level indicates proficiency (or mastery) of the Year Level's prescribed achievement standards as measured by the test or whether the student is 'at-risk'.

Provided in Appendix A (Table T1.1) is each school's list of ranked cases including each cases' ability estimate, percentage correct, achievement level, z-score, percentile, stanine score and performance level. Shown in Table 12 is a summary of student numbers within each achievement and performance level for each of the eight schools.

The results show that only 2 (1%) students of the Year 1 cohort achieved the Proficient Achievement Level with the rest of the students distributed across the At Risk Achievement Levels. For example, 10% of the students were at At Risk Level 1, 44% at At Risk Level 2, 25% at At Risk Level 3 and

[3] Rasch analysis to determine performance levels recoded blank responses as incorrect responses.

20% at At Risk Level 4. In terms of individual performance relative to the rest of the cohort, 4% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 19% and 4% of the students were classified to be at the Below Average and Very Low Levels.

Whereas the performance levels are norm-referenced, the achievement levels indicate whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 1.

Table 12: School Distribution of Year 1 Achievement and Performance Levels

Year 1	Achievement Levels					Performance Levels					Total
School	Proficient	At-Risk Level 1	At-Risk Level 2	At-Risk Level 3	At-Risk Level 4	Very High	Above Average	Average	Below Average	Very Low	
LOT	0	5	9	6	4	0	7	12	4	1	24
STM	1	15	51	20	15	7	25	53	15	2	102
VAM	1	9	27	15	12	4	15	31	9	5	64
FLS	0	2	18	21	13	1	2	36	14	1	54
SLV	0	0	12	15	11	0	1	25	11	1	38
STP	0	5	27	3	5	2	9	23	5	1	40
SPU	0	0	1	6	12	0	0	7	8	4	19
MAN	0	1	11	1	0	0	8	4	1	0	13
Total Number	2	37	156	87	72	14	67	191	67	15	354
Percentage (N=354)	1	10	44	25	20	4	19	54	19	4	100

Year 1 Benchmark Descriptions

Provided in Table 13 are the benchmark descriptions that characterise the achievement of students located at each of the achievement levels, namely, Proficient, and At Risk Levels 1 to 4. The items categorised into each band was selected by a two layered process. First students located at each of the bands were extracted from the cohort and their performance on all the items were analysed for percentage correct. Those items with 60 to 70% percentage correct were retained for that band whilst those that were at least 70% were shifted down to the lower achievement level and those with less than 60% were shifted upwards to the next higher achievement level. This process was repeated for each of the 5 achievement bands (Proficient and the 4 At Risk Levels). The second process was to use the cohort item-person map to confirm the retention of items within bands or to provide a basis to shift items either upwards or downwards until all items were assigned. Shown in the last column of Table 13 are the benchmark descriptions of what students located at each of the achievement bands can do.

Conceptually, students located at an achievement level should have the capacity to successfully complete those items located in the lower achievement levels.

Table 13: Year 1 Benchmark Descriptions by Proficient and At Risk Levels

Benchmark & Range	Item Numbers and Descriptions	Benchmark Descriptions
Proficient (at least 80%)	**Item 11.** O le li'o ua vaevaeina tutusa i _____ e fa **Item 15.** Faaauau le pateni numera 25, 20, 15, … mo nisi numera se lua. **Item 20.** O le ā le vasega e pito i laiti le aofai o tamaiti? **Item 24.** Sa teu e Tau faguvai i le atigipusa. E tai 4 fagu i le atigipusa e tasi. Afai e 20 faguvai, e fia atigipusa e mo'omia **Item 29.** Tagai i le ata o le kone. O fea o ata nei e tutusa ma foliga o le pito i luga o le kone?	Students are able to identify and recognise quarters of an object; identify and extend decreasing number patterns; interpret and order quantitative information displayed in a table; model division by grouping objects into equal groups or repeated subtraction; and identify shapes found in pictures and the environment.
At-Risk - Level 1 (60 up to <80)%	**Item 3.** E lona fia le taavale i le faasologa o ata nei? **Item 4.** E sefulu fa mapu a Sione ae lua sefulu tolu mapu a Toma. E fia le aofai o mapu a Sione ma Toma? **Item 6.** 44 – = 31. O le a le numera o loo misi? **Item 8.** O le faatelega faatasi o le 2 ma le 5 e tutusa ma le **Item 9.** E valu moli sa faasoa tutusa i tama e toafa. E fia moli a le tama e toatasi? **Item 12.** A vaevaeina apu e lua i tamaiti e toafa. O le a le vaegamea a le tamaitiiti e maua? **Item 13.** O fea o fagu nei e telē le avanoa e filifiliina mai ai se mapu? **Item 23.** O le a le telē o le susu o lo o i totonu o le fagususu? **Item 25.** O le a le numera e 10 e tele ai nai lo le 278? **Item 26.** O le ata nei o le pateni a Pele. E fia faamau e mo'omia i le pusa mulimuli o le pateni? **Item 28.** Sa piki e Sione se siepi mai pusa nei e aunoa ma se vaai i ai. O fea o pusa nei e telē se avanoa e pikiina ai se kuki **Item 30.** O le numera 16 e tutusa ma le _____ **Item 31.** O fea o numera o i lalo e tutusa ma le 300 + 70 + 6? **Item 34.** O fea o siepi nei e 12 ona pito?	Students are able to identify the position of an object in a line of objects; combine sets of objects by applying a range of mental strategies to add two-digit numbers; record quantitative relationships involving subtraction number facts; use the term 'is the same as' to express equality of groups; represent division by sharing equally a collection of objects; sharing objects by dividing into four equal parts; identify and describe the element of chance in an event using words such as possible and certain; identify and read volume of milk in a calibrated bottle; use reference numbers to form numbers within a range; identify and extend increasing geometric patterns; recognize and describe the chance of events using everyday language; use the term 'is the same as' to express equality of groups; use addition number sentences and apply place value to add up to three-digit numbers; and identify attributes of 3D objects.

Table 13: Year 1 Benchmark Descriptions by Proficient and At Risk Levels - continued

At-Risk - Level 2 (40- up to <60)%	**Item 7.** 3 + 3 + 3 + 3 e tutusa ma le **Item 10.** O le vaegamea o loo valivaliina e tusa ma le __? **Item 14.** O le a le ata e soso'o i le pateni lea? **Item 17.** O le 2 + 4 e tutusa lona tali ma le tali o le **Item 27.** O fea o vili nei e tele se avanoa e tu ai i le lanu paepae? **Item 32.** Sa faapipii e Atamu ana sitika i le siata lena. O fea o sitika o lo'o i le A4? **Item 33.** O le aoga a Mata e amata i le kuata e tea ai le iva. O fea o uati nei o lo'o faailo mai ai le taimi lea?	Students are able to represent addition as the sum of 2 or more numbers; recognize that half is two equal parts; identify, copy and continue repeating geometric patterns; use the term 'is the same as' to express the equality of two groups; predict the outcome when spinning a wheel of colours; interpret simple maps showing object positions; and read quarter-hour time on digital clocks.
At-Risk - Level 3 (20 up to <40)%	**Item 2.** O a numera e i le va o le 14 ma le 17? **Item 5.** E toe fia li'o atoa le sefulu (10)? **Item 18.** E tutusa le aofai o foliga i le ata lea _____ ma le _____? **Item 19.** O ai e pito i tele ana taimane? **Item 22.** O le ā le siepi lenei? (piramita)	Students are able to identify the number before and after a given number(s); recognize a dot pattern instantly for numbers up to 10; make and recognize different visual arrangements for the same number; interpret information displayed in a given graph using objects; and recognise, visualise and name 3D objects.
At-Risk **Level 4** (0 up to <20)%	**Item 1.** E fia le aofai o foliga i totonu o le lio? **Item 16.** O le a le tulaga o le fa'afetu i le pateni o lo'o i lalo? **Item 21.** O fea le laau e pito i umī ?	Students are able to recognise and count number of objects up to three; describe the position of an object in a line of objects; and estimate and compare lengths informally to determine the longest.

Year 1 Students' Most Common Errors

Students' common errors are those choices (including blank responses) that had the two highest error rates according to the item analysis data for each of the 34 items. The results are presented in Table 14. The results show that errors which at least 30% of the students demonstrated include those about viewing 3D objects from different perspectives (e.g. top), identifying the number of equal groups given an amount, identifying the fraction (quarter) of a shape that is shaded, reading the volume of milk in a calibrated bottle, identifying the position (less than fifth) of an object in a line of objects, continuing a decreasing number pattern, ordering quantitative information displayed in a table, and equal distribution of objects that result in simple fraction equal shares (e.g. half).

Table 14: Test 1 Items' Two Most Common Errors

Rank	ITEM	Item Description	Correct Answer	Most Common Error	Second Most Common Error
1	29	siepi pe a vaai mai i luga o le koge tusa'o ile pito maai	Circle	cone (45%)	triangle (14%) and blank responses (14%)
2	20	piki le vasega pito laiti tamaiti mai aofaiga o loo avatu I se teipolo (siata)	Year 4	Year 1 (33%)	Year 2 (27%)
4	24	atigipusa moomia mo 20 fagu pe afai e 4 fagu le pusa e tasi	5	4 (44%)	Blank (16%)
3	11	o le ata o loo vaevaeina tutusa ile a? (kuata)	quarter	half (44%)	: one fifth (13%)
5	15	faaauau pateni numera 25, 20, 15, mo nisi numera se lua	10, 5	5, 0 (35%)	10, 1 (18%)
	25	Numera e 10 e tele ai nai lo le 278	288	Blank (24%)	227 (20%)
6	3	e lona fia le taavale ile faasologa	4	3rd (37%)	1st & 2nd (each 7%)
7	6	44 - ? = 31 o le a le numera o loo misi	13	12 (25%)	14 (17%)
8	31	fuaiupu numera e tutusa ma le 16	4+4+4+4	2+2+2+2 (26%)	6+6+6+6+6 (15%)
9	4	aofai atoa o mapu e sefulu fa ma le lua sefulu tolu	37	47 (24%)	31 (17%)
10	12	o le vaegamea a le tamaititi pe a vaevae apu e lua I tamaiti e toafa	½	¼ (25%)	⅓ (20%)
12	9	e fia moli a le tama toatasi pe a faasoa tutusa moli e valu mo tama e toafa	2	4 (32%)	1 (14%)
13	30	Fea le numera e tutusa ma le 300 + 70 + 6	376	313 (19%)	367 (18%)
14	8	o le numera e tutusa ma le faatelega faatasi o le 2 ma le 5	10	7 (23%)	25 (15%)
15	26	faaauau pateni mo le pusa lona lima	10	14 (20%)	Blank (20%)
16	23	O le a le tele o le susu i totonu o le fagususu	150	100 (42%)	50 (12%)
17	**28**	piki le pusa e tele ai le avanoa e maua ai le kuki mai ata e fa	4	2 (18%)	3 (14%)
18	13	Fea fagu e tele le avanoa e filifili mai ai se mapu	6	3 (22%)	2 (17%)
19	34	Fea le siepi e 12 pito	toothpaste	tin (25%)	pyramid (14%)
20	7	ata o faaputuga e 4 ma siepi tai 3. Fesili: 3+3+3+3 e tutusa ma le a?	4 groups of 3	3 groups of 4 (23%)	3 groups of 3 (14%)
21	33	fea le uati e tau mai ai le kuata e tea ai le iva	9:15	8:45 (23%)	9:14 (14%)
22	17	2+4 e tutusa lona tali ma le tali o le?	1+5	1+3 (22%)	1+2 (14%)
23	14	O le a le ata e sosoo ile pateni o siepi	square	circle (21%)	triangle (15%)
24	10	vaegamea o loo valivaliina ile ata (afa)	half	quarter (28%)	two thirds (17%)
25	27	fea le vili e tele le avanoa e tu ai ile lanu paepae	half	One third (15%)	Three eighths & quarter (13%)
26	32	o le a le sitika o loo i le tulaga A4 i luga ole siata	face	Star (16%)	Blank (10%)
27	2	o a numera I le va o le 14 ma le 17	15 & 16	19 & 20 (15%)	Blank (11%)
28	18	e tutusa le aofai o foliga ole ata ma le fea ata	4 objects	3 objects (14%)	2 objects (10%)
29	19	O ai e pito tele ane taimane ile kalafi e fa poutu	4	3 (21%)	Blank (11%)
30	5	E toe fia li'o atoa le sefulu (5 o loo aumai)?	5	4 (12%)	3 (7%)
31	22	O le a le siepi I le ata?	piramita	Tafatolu (16%)	Blank (8%)
32	1	E fia le aofai o foliga i totonu o le li'o	3	1 (13%)	2 (7%)
33	16	O le a le tulaga o le faafetu i le pateni i le ata	3	2 (10%)	1 (5%)
34	21	O fea le laau e pito umi i le ata?	3	2 (5%)	1 (3%)

Student Test 2 Year 2 Results

The Test 2 Rasch analysis used Test 1 item estimates for the 30 common items (Test 2 Items 1-2, 4-18, 21, 23-34) to anchor them thus enabling test equating between the two cohorts and two Year Levels.

Fit of Data to the Model

Person Fit to the Model –After the initial analysis of responses from 370 cases, all person infit mean square (ms) values fall within the recommended range of 0.50 to 1.50 logits. This is further corroborated by the mean of 0.97 logits (SD 0.12 logits) as being equal to the expected value of 1 logit, see Table 15. Also 1 case had zero score. This zero score case was excluded from the analysis.

Table 15: Cohort Student Test 2 Rasch Statistics

Student Test 2 anchored on 30 Test 1 common items --- Item Estimates (Thresholds) all on all (N=370 L=34 Prob Level=0.50) --- Summary of item Estimates ========== Mean -0.06 SD 0.74 SD (adjusted) 0.74 Reliability of estimate 1.00 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 0.96 / Mean 0.95 SD 0.18 / SD 0.23 Infit t / Outfit t Mean -0.81 / Mean -0.52 SD 3.19 / SD 2.04 0 items with zero scores 0 items with perfect scores ==========	Student Test 2 anchored on 30 Test 1 common items --- Item Estimates (Thresholds) all on all (N=370 L=34 Prob Level=0.50) --- Summary of case Estimates ========== Mean 0.08 SD 0.90 SD (adjusted) 0.80 Reliability of estimate 0.80 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 0.97 / Mean 0.95 SD 0.12 / SD 0.18 Infit t / Outfit t Mean -0.23 / Mean -0.13 SD 0.94 / SD 0.66 1 case with zero scores 0 cases with perfect scores ==========
Internal Consistency 0.81	

Item Fit to the Model – An items' mean infit ms value of 0.96 (also around the expected mean value of 1.00) was produced by the Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50. None of the items had zero or perfect scores.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Test 2 Reliability Indices and Mean Estimates

From the Rasch analysis of students' Test 2 responses, the person reliability index of the instrument (i.e., 0.80, see Table 15) was high with its traditional Cronbach's alpha value of 0.81, both of which are closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the items in the test. The item reliability index of Test 2 (i.e. 1.00) was relatively higher (than the 0.80 person reliability index) and ideal indicating that the items were reliably and sufficiently separated by the cases into a hierarchical order along the logit continuum.

The high item reliability index also means that we can reliably rely on this order of item estimates to be replicated when we give the test to other samples for whom it is suitable.

The Test 2 mean item difficulty estimate was lower than zero at −0.06 logits compared to that of Test 1, indicating that Test 2 was approximately 0.06 logit relatively easier for the Year 2 cohort than Test 1 was for the Year 1 cohort. The Test 2 mean ability estimate of 0.08 (SD 0.80) logits was higher than the Test 2 mean difficulty estimate (−0.06 logit) suggesting that, overall, the Test 2 cohort, on average, found Test 2 slightly easier by approximately 0.14 logit. Statistically, this difference (or mismatch between mean ability and mean difficulty) is not significant (t = 0.9824, df = 404, p = 0.33) with Cohen's effect size value (d=0.18) suggesting a small practical difference. This statistically insignificant and a small practical difference also suggests that the test items and sample cases were more or less well-matched and that the achievement standards which form the basis of the Test 2 items were attainable, on average, by the cohort.

Student Test 2 Item-Person Maps

With the Test 2 Rasch statistics provided in Table 15, Figure 4 shows the Test 2 cohort item-person map with each X representing 2 students. Forty cases (11%) had ability estimates that were above the most difficult item (Item 29, 1.42 logits) and 2 students (0.5%) had ability estimates that were below the easiest (cohort Test 2) item (Item 18, −2.12 logits). The distribution of ability estimates in Figure 4 is spread over approximately 6.29 logits from 3.66 down to −2.63 logits compared to a 3.54 logits spread of difficulty estimates from 1.42 to −2.12 logits.

Student Test 2 Ranked Item Difficulties and Descriptions

Provided in Table 16 are the ranked Test 2 items, brief item descriptions and supporting K&SLO while Table 17 provides the item analysis statistics for the ranked items, that is, number of students who scored the item correctly, total number of the cohort (n=370), percentage of the cohort who answered the item correctly and the item's difficulty estimate.

For the most difficult Test 2 item, Item 29 (a common item with Test 1), only 37 (10%) of the cohort got it correct and the item's difficulty estimate is 1.42 logits. For the easiest (cohort Test 2) item (#18, a common item with Test 1), 345 out of 370 (93%) got it correct. Sixteen of the 34 Test 2 items (47%) showed majority (>50) percentages correct (Items 13, 23, 28, 7, 3, 15, 22, 19, 27, 32, 1, 5, 10, 6, 9, and 18). See item descriptions of the most difficult and easiest items provided below in Table 18.

The cohort median person ability is −0.04 logits. The middle 50% of the person distribution lie between −0.43 (lower quartile) and 0.50 logit (upper quartile), an interquartile range of approximately 0.93 logit, as graphically displayed by the Cohort Student Test 2 item-person map in Figure 4.

The cohort median item estimate is 0.16 logit (Item 7, a common item between Tests 1 and 2) which 66% of the cohort got correct and the difficulty estimate is 0.16 logit. The upper quartile estimate is at 0.36 logit (Item 17) and lower quartile estimate at -0.32 logit (Item 27) providing a 0.68 logit interquartile range of item difficulty estimates for the middle 50% of items.

Student Test 2 School Results

Provided in Table 19 are the relevant Test 2 statistics for each of the eight schools, and their respective mean difficulty and ability estimates. Ranking the Year 2 groups by their Test 2 mean group ability estimates (Figure 5) showed that STM PS (n=105) had the highest (0.84, SD 0.95 logits) with MAN PS (n=22) at the lowest (−0.69, SD 0.28 logits). In Figure 6 are the individual schools' item-person maps which visually display both the distribution of students and that of items on a common logit scale.

Student Test 2 Year 2

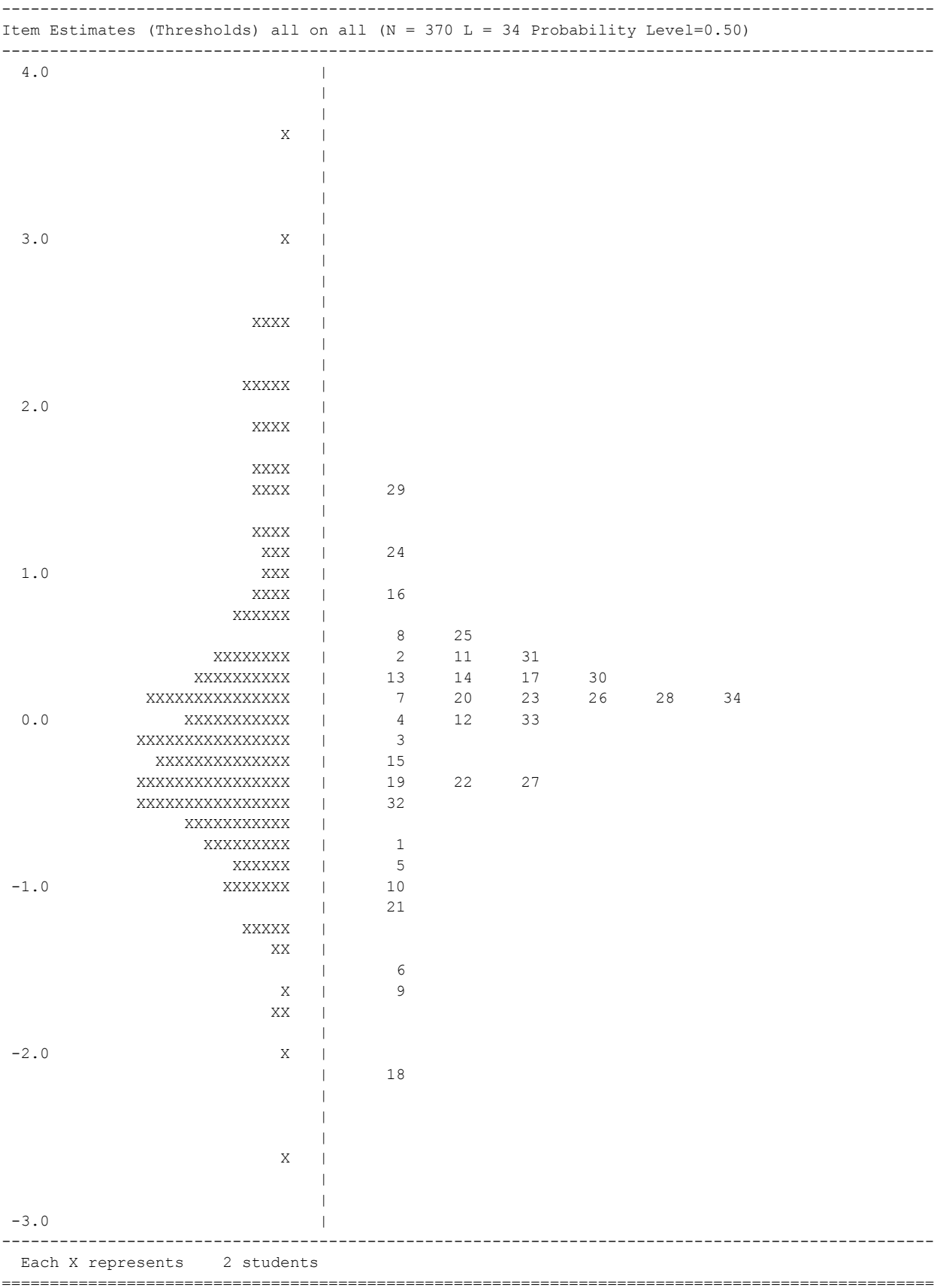


Figure 4: Cohort Year 2 Test 2 Item-Person Map

Table 16: Ranked Year 2 Test 2 Items and Knowledge & Skills Learning Outcomes

Rank	ITEM	Item Descriptions	K&S LO
1	29*	siepi pe a vaai mai i luga o le koge tusa'o ile pito maai	SG1.1 – K&SLO 2
2	24*	atigipusa moomia mo 20 fagu pe afai e 4 fagu le pusa e tasi	NR1.3 – K&SLO 1, 2, 4
3	16*	O le li'o ua vaevaeina tutua i _____ e fa (kuata)	NR 2.4 – K&SLO 1, 5
4	25*	Numera e 10 e tele ai nai lo le 278	NR2.1 – K&SLO 2, 8
5	8*	e lona fia le taavale ile faasologa	NR1.1 – K&SLO 1, 8
6	31*	fuaiupu numera e tutusa ma le 16	NR1.3 – K&SLO 6; PA2.2b K&SLO 4
7	11*	44 – _____ = 31. O le a le numera o loo misi?	NR1.2 – K&SLO 8; NR2.2 – K&SLO 1, 2, 5
8	2*	E sefulu fa mapu a Sione ae lua sefulu tolu mapu a Toma. E fia le aofai o mapu a Sione ma Toma?	NR1.2 – K&SLO 1, 5, 6, 8
9	17*	A vaevaeina apu e lua i tamaiti e toafa. O le a le vaegamea a le tamaitiiti e maua	NR1.3 – K&SLO 8
10	14*	E valu moli sa faasoa tutusa i tama e toafa. E fia moli a le tama e toatasi?	NR1.3 – K&SLO 2, 3, 7 NR2.3 – K&SLO 8, 9
11	30*	fea le numera e tutusa ma le 300 + 70 + 6	NR 3.2 – K&SLO 1
12	13*	o le numera e tutusa ma le faatelega faatasi o le 2 ma le 5	NR2.3 – K&SLO 3
13	26*	faaauau pateni mo le pusa lona lima	PA1.1a – K&SLO 5, 6
14	23*	o le a le tele o le susu o loo I totonu ole fagususu (ile ata)	MS1.3 – K&SLO 1, 2, 3
15	**28***	piki le pusa e tele ai le avanoa e maua ai le kuki mai ata e fa	NR1.5 – K&SLO 5 – 6
16	20	tupe moomia pe afai nao le $2 le tupe o iai ae $5 le tau ole ato	NR2.2 – K&SLO 15
17	7*	O fea o fagu nei e telē le avanoa e filifiliina mai ai se mapu?	NR1.5 – K&SLO 5
18	34*	fea le siepi e 12 ona pito	SG2.1 – K&SLO 5
19	12*	ata o faaputuga e 4 ma siepi tai 3. Fesili: 3+3+3+3 e tutusa ma le a?	NR1.3 – K&SLO 1, 4; NR2.3 – K&SLO
20	33*	fea le uati e tau mai ai le kuata e tea ai le iva	MS1.5/2.5 – K&SLO 9; MS3.5 – K&SLO 1, 5
21	4*	2+4 e tutusa lona tali ma le tali o le fea (fuaiupu numera?)	PA1.2b – K&SLO 1; PA2.2b – K&SLO 1, 4
22	3	sue le numera e leai se avanoa e maua ai ile vili	NR1.5 – K&SLO 3; NR2.5 – K&SLO 2
23	15*	vaegamea o loo valivaliina ile ata (afa)	NR1.4 – K&SLO 1, 2, 4, 5
24	22	fea le mea fuataga e fua ai le mamafa	MS2.4 – K&SLO 1 – 3
25	19	fea le siepi ile ata o le hesakone	SG1.2 – K&SLO 5, 6; SG2.2a – K&SLO 4, 5
26	27*	fea le vili e tele le avanoa e tu ai ile lanu paepae	NR1.5 – K&SLO 1, 2, 3
27	32*	o le a le sitika o loo i le tulaga A4 i luga ole siata	SG3.3 – K&SLO 6, 7
28	1*	O a numera e i le va o le 14 ma le 17?	NR1.1 – K&SLO 3, 4
29	5*	e tutusa le aofai o foliga ole ata ma le fea ata	NR1.1 – K&SLO 8, 10
30	10*	toe fia li'o atoa le sefulu I le ata o le siata ma li'o e lima	NR1.2 – K&SLO 5
31	21*	o le a le igoa ole siepi I le ata (piramita)	SG1.1 – K&SLO 6
32	6*	fia le aofai o foliga I totonu o le lio ille ata (3)	NR1.1 – K&SLO 1, 8, 10
33	9*	tulaga o le faafetu I le pateni o loo ile ata	SG1.3 – K&SLO 2; NR1.1 – K&SLO 1, 8
34	18*	fea le laau e pito umi o laau e fa o loo I le ata	MS1.1 – K&SLO 6

*common items with Test 1

Table 17: Ranked Test 2 Items and Item Analysis Results

Rank	ITEM	SCORE	MAXSCR	% Correct	ESTIMATE
1	29*	37	370	10	1.42
2	24*	114	370	31	1.10
3	16*	101	370	27	0.86
4	25*	175	370	47	0.60
5	8*	161	370	44	0.50
6	31*	117	370	32	0.47
7	11*	151	370	41	0.47
8	2*	84	370	23	0.44
9	17*	132	370	36	0.36
10	14*	157	370	42	0.31
11	30*	151	370	41	0.29
12	13*	199	370	54	0.27
13	26*	142	370	38	0.24
14	23*	250	370	68	0.22
15	**28***	206	370	56	0.18
16	20	169	370	46	0.18
17	7*	244	370	66	0.16
18	34*	172	370	47	0.15
19	12*	119	370	32	0.06
20	33*	158	370	43	0.03
21	4*	163	370	44	0.00
22	3	201	370	54	-0.12
23	15*	232	370	63	-0.19
24	22	218	370	59	-0.29
25	19	220	370	60	-0.31
26	27*	264	370	71	-0.32
27	32*	214	370	58	-0.42
28	1*	210	370	57	-0.65
29	5*	322	370	87	-1.43
30	10*	324	370	88	-0.94
31	21*	181	370	49	-1.05
32	6*	322	370	87	-1.43
33	9*	323	370	87	-1.58
34	18*	345	370	93	-2.12

* common items with Test 1

Table 18: Test 2 Cohort Most Difficult and Easiest Items

Item	Item Description - Most Difficult Item	Knowledge & Skills Learning Outcomes
29	Same item as Item 29 Test 1 in Table 8	SG1.1 – K&SLO 2 Difficulty Estimate = 1.42
Item	**Item Description – Easiest Item**	
18	Same item as Test 1 Item 21, see Table 8	MS1.1 – K&SLO 6 Difficulty Estimate = -2.12

Table 19: School Student Test 2 Rasch Statistics

Primary School	Item Estimates			Case Estimates		
	Number	Mean	Std Dev	Number	Mean	Std Dev
LOT	34	-0.12	0.71	27	0.79	0.60
STM	34	-0.02	0.74	105	0.84	0.95
VAM	34	-0.05	0.75	65	-0.05	0.63
FLS	34	-0.16	0.82	49	-0.19	0.40
SLV	34	-0.15	0.62	19	-0.30	0.46
STP	34	-0.09	0.76	57	-0.19	0.53
SPU	34	0.03	0.72	26	-0.46	0.22
MAN	34	-0.03	0.74	22	-0.69	0.28

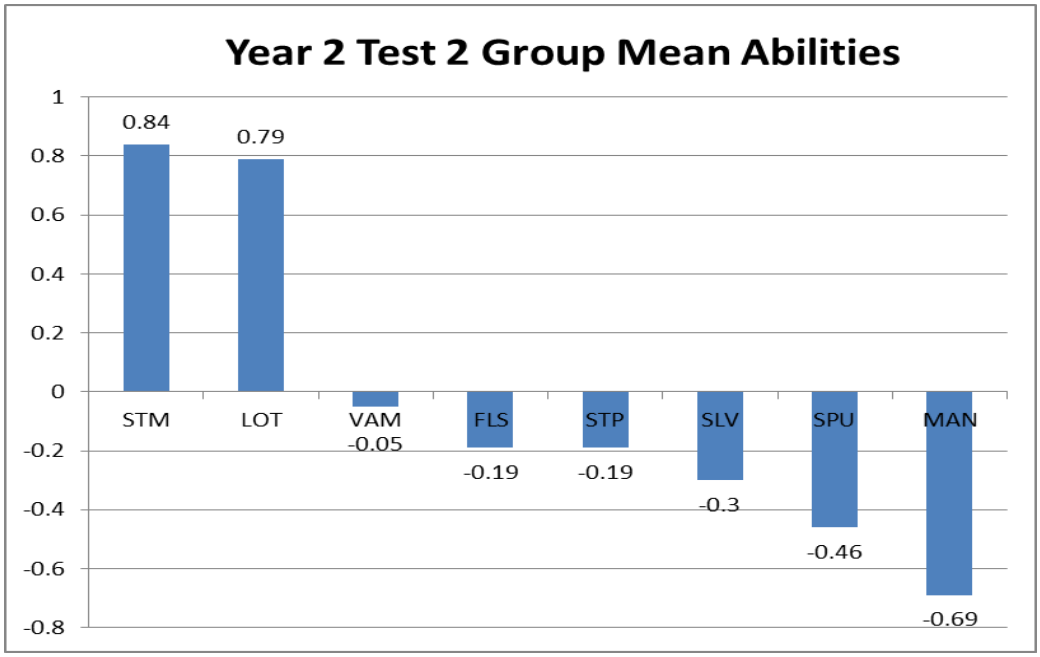


Figure 5: School Year 2 Student Test 2 Group Mean Ability Estimates

Year 2 Students' Level of Achievement and Performance

Students' Test 2 ranked ability estimates by school, including percentage correct out of a total possible score of 34, z-scores, percentile rankings, and stanine scores are provided in Appendix B Table T2.1. Z-scores are case ability estimates normalised in terms of number of standard deviations (0.80 logits) each ability estimate is from the mean ability (0.08 logit).[4]

Also provided are stanine scores and performance levels. While the performance level is a general descriptor of an individual's performance relative to the cohort, the achievement level indicates proficiency (or mastery) of the Year Level's prescribed achievement standards as measured by the test or whether the student is 'at-risk'. Provided in Table 20 is the distribution of students across the achievement and performance levels for each school.

The results show that only 33 (9%) students of the Year 2 cohort achieved the Proficient Achievement Level with the rest of the students distributed across the At Risk Achievement Levels. For example, 16% of the students were at At Risk Level 1, 52% at At Risk Level 2, 21% at At Risk Level 3 and 2% at At Risk Level 4. In terms of individual performance relative to the rest of the cohort, 4% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 19% and 4% of the students were classified to be at the Below Average and Very Low Levels.

Whereas the performance levels are norm-referenced, the achievement levels indicate whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 2.

[4] Rasch analysis to determine performance levels recoded blank responses as incorrect responses.

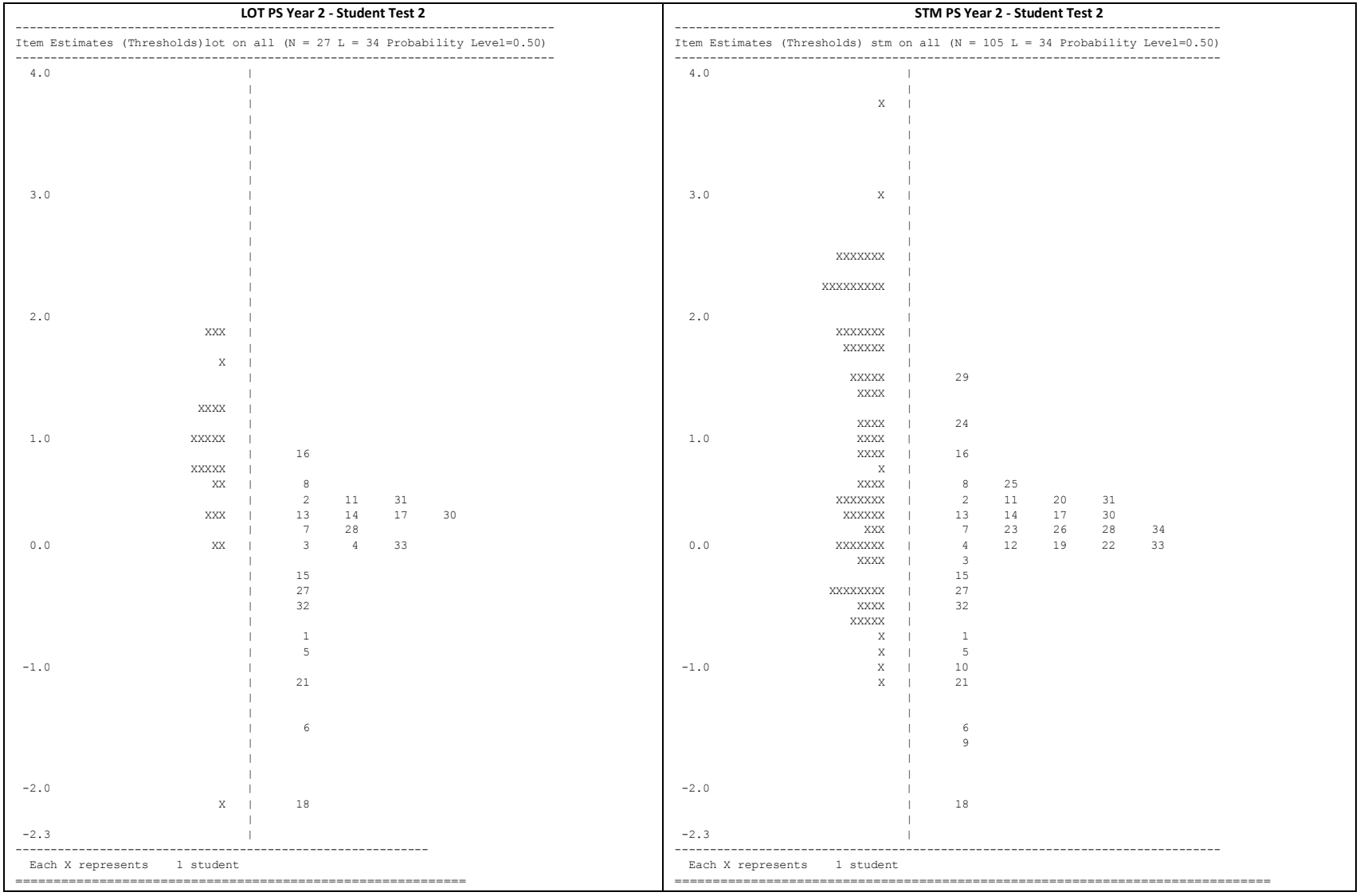


Figure 6: Schools' Year 2 Test 2 Item-Person Maps

VAM PS Year 2 - Student Test 2

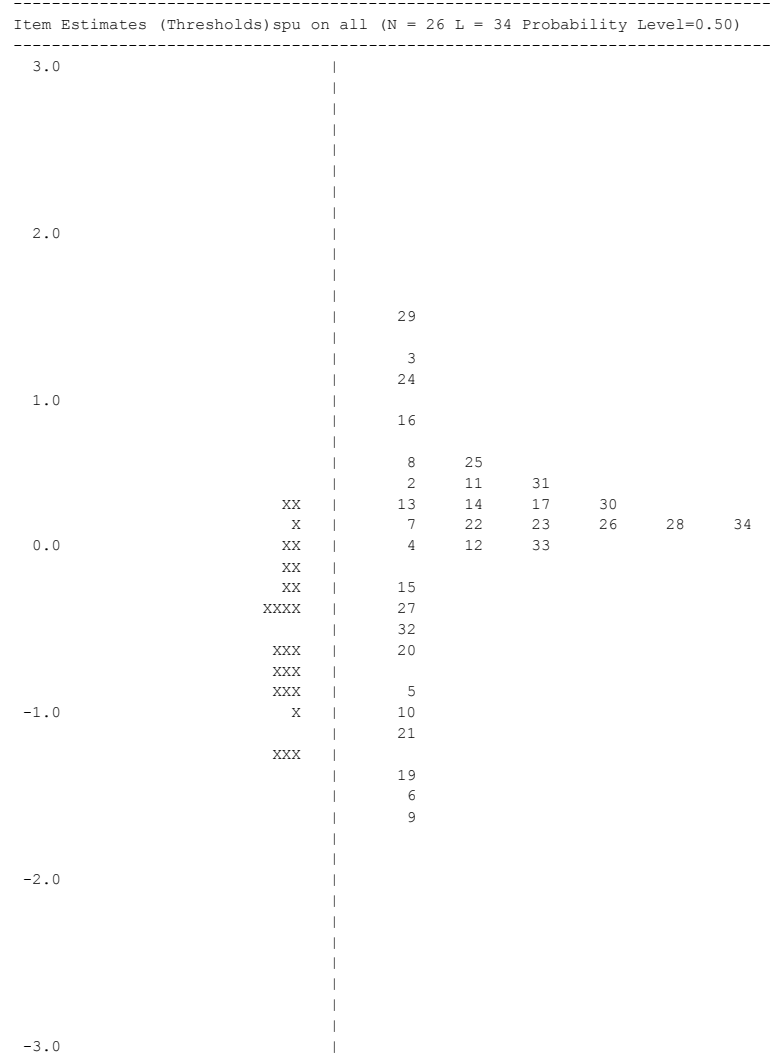
```
Item Estimates (Thresholds)vam on all (N = 65 L = 34 Probability Level=0.50)
  3.0                          |
                               |
                               |
                               |
                               |
                               |
                               |
                               |
  2.0                          |
                               |
                         XX    |
                               |
                         XX    |      29
                         XXX   |
                               |
                               |      24
  1.0                    XX    |
                               |      16
                         XXX   |
                               |       8     25
                               |       2     11      20      31
                         XXXX  |      13     14      17      30
                        XXXXXX |       7     23      26      28      34
  0.0                      X  |       3      4      12      33
                        XXXXXX |      19
                        XXXXXX |      15
                       XXXXXXX |      27
                       XXXXXXX |      32
                         XXXXX |
                          XXXX |       1     22
                             X |       5
 -1.0                     XXX  |      10
                               |      21
                             X |
                               |
                               |       6
                             X |       9
                             X |
                               |
 -2.0                          |
                               |      18
                               |
                               |
                               |
                               |
                               |
                               |
 -3.0                          |
  Each X represents    1 student
```

FLS PS Year 2 - Student Test 2

```
Item Estimates (Thresholds) fls on all (N = 49 L = 34 Probability Level=0.50)
  3.0                          |
                               |
                               |
                               |
                               |
                               |
                               |
                               |
  2.0                          |
                               |
                               |
                               |
                               |      29
                               |
                               |
                               |      24
  1.0                          |
                               |      16
                            XX |
                           XXX |       8     25
                          XXXX |       2     11      31
                          XXXX |      13     14      17      30
                         XXXXX |       7     23      26      28      34
  0.0                     XXX |       4     12      33
                         XXXXX |      20
                               |      15
                         XXXXX |      27
                           XXX |      32
                          XXXX |
                        XXXXXX |       1
                            XX |       5
 -1.0                          |      10
                               |      21     22
                               |       3
                            XX |
                               |       6
                               |       9
                               |      19
                             X |
 -2.0                          |
                               |      18
                               |
                               |
                               |
                               |
                               |
                               |
 -3.0                          |
  Each X represents    1 student
```

Figure 6: Schools' Year 2 Test 2 Item-Person Maps

SPU PS Year 2- Student Test 2



MAN PS Year 2 - Student Test 2

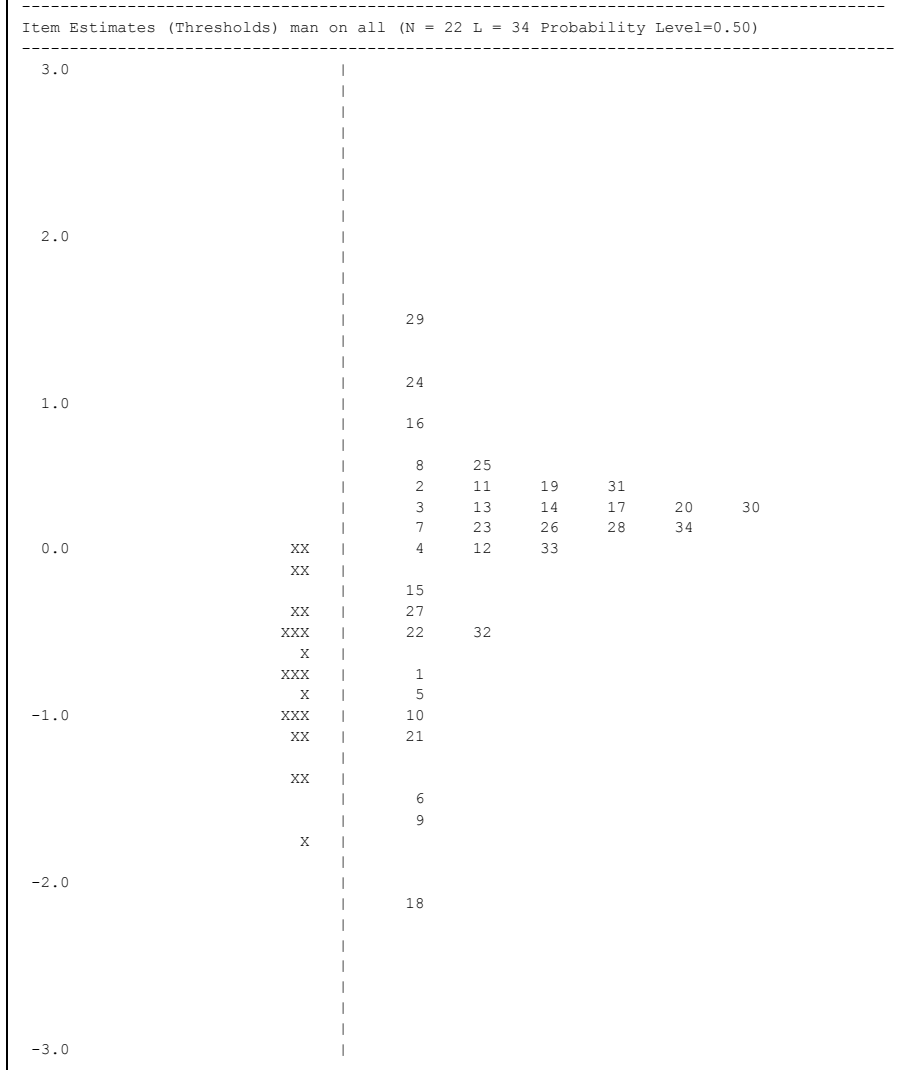


Figure 6: Schools' Year 2 Test 2 Item-Person Maps

STP PS Year 2 - Student Test 2

```
Item Estimates (Thresholds) stp on all (N = 57 L = 34 Probability Level=0.50)
  3.0                          |
                               |
                               |
                               |
                               |
                               |
                               |
                               |
  2.0                          |
                               |
                               |
                               |
                               |      29
                               |
                               |
                          X    |      24
  1.0                          |
                               |      16
                         XX    |
                        XXXX   |       8     25
                       XXXXX   |       2     11     31
                         XXX   |      13     14     17     30
                          XX   |       3      7     23     26     28     34
  0.0                  XXXXXX  |       4     12     33
                         XXX   |
                        XXXX   |      15
                       XXXXX   |      20     27
                      XXXXXXX  |      32
                          XX   |
                       XXXXX   |       1     22
                         XXX   |       5     19
 -1.0                          |      10
                           X   |      21
                           X   |
                               |
                               |       6
                           X   |       9
                               |
                               |
 -2.0                          |
                               |      18
                               |
                               |
                               |
                               |
                           X   |
                               |
                               |
 -3.0                          |
  Each X represents    1 students
```

SLV PS Year 42- Student Test 2

```
Item Estimates (Thresholds) slv on all (N = 19 L = 34 Probability Level=0.50)
  3.0                          |
                               |
                               |
                               |
                               |
                               |
                               |
                               |
  2.0                          |
                               |
                               |
                               |
                               |
                               |
                               |
                               |
  1.0                          |
                               |      16
                               |
                               |       8     25
                         XXXX  |       2     11     31
                               |      13     14     17
                           XX  |       7     23     26     28     34
  0.0                      X   |       4     12     33
                          XXX  |
                           XX  |      15
                               |      27
                               |      19     22
                               |
                               |       1      3
                           XX  |       5
 -1.0                      XXXX|      10
                               |      20     21
                               |
                             X |
                               |       6
                               |       9
                               |
                               |
 -2.0                          |
                               |
                               |
                               |
                               |
                               |
                               |
                               |
 -3.0                          |
  Each X represents    1 students
```

Figure 6: Schools' Year 2 Test 2 Item-Person Maps

Table 20: School Distribution of Year 2 Achievement and Performance Levels

Year 2	Achievement Levels					Performance Levels					Total
School	Proficient	At Risk Level 1	At Risk Level 2	At Risk Level 3	At Risk Level 4	Very High	Above Average	Average	Below Average	Very Low	
LOT	0	3	22	0	2	0	2	23	0	2	27
STM	31	26	39	9	0	14	42	40	8	1	105
VAM	2	10	37	15	1	0	12	37	13	3	65
FLS	0	9	29	10	1	0	7	31	10	1	49
SLV	0	0	12	7	0	0	0	12	6	1	19
STP	0	12	31	13	1	0	8	35	11	3	57
SPU	0	0	13	13	0	0	0	13	12	1	26
MAN	0	0	9	12	1	0	0	9	10	3	22
Total Number	33	60	192	79	6	14	71	200	70	15	370
Percentage N=370	9	16	52	21	2	4	19	54	19	4	100

Year 2 Benchmark Descriptions

Provided in Table 21 are the benchmark descriptions characterising the achievement of students' Year 2 K&SLO as measured by the Test 2 items, at each of the achievement levels, namely, Proficient and At Risk Levels 1 to 4. Conceptually, students located at an achievement level should have the capacity to successfully complete those items located in the lower achievement levels.

Year 2 Students' Most Common Errors

Students' common errors are those choices (including blank responses) that had the two highest error rates according to the item analysis data for each of the 34 items. The results are presented in Table 22. The results show that errors with at least 30% include those about viewing 3D objects from different perspectives (eg top), identifying the number of equal groups given an amount, identifying the fraction (quarter) of a shape that is shaded, equal distribution of objects that result in simple fraction equal shares (eg half), identifying the position (fourth) of an object in a line of objects, determining 'how much more' is needed for a simple money transaction involving whole tala amounts, and identifying the correct addition number sentence that equals a given number.

Table 21: Year 2 Benchmark Descriptions by Proficient and At Risk Levels

Benchmark & Range	Item Numbers and Descriptions	Benchmark Descriptions
Proficient (at least 80)%	**Item 16.** O le li'o ua vaevaeina tutusa i _____ e fa **Item 24.** Sa teu e Tau faguvai i le atigipusa. E tai 4 fagu i le atigipusa e tasi. Afai e 20 faguvai, e fia atigipusa e mo'omia **Item 29.** Tagai i le ata o le kone. pito i luga. O fea o ata nei e tutusa ma foliga o le pito i luga o le kone?	Students are able to identify and recognise quarters of an object; model division by grouping objects into equal groups or repeated subtraction; and identify shapes found in pictures and the environment.
At-Risk **Level 1** (60 up to <80)%	**Item 2.** E sefulu fa mapu a Sione ae lua sefulu tolu mapu a Toma. E fia le aofai o mapu a Sione ma Toma? **Item 7.** O fea o fagu nei e telē le avanoa e filifiliina mai ai se mapu? **Item 8.** E lona fia le taavale i le faasologa o ata nei? **Item 11.** 44 – = 31. O le a le numera o loo misi? **Item 13.** O le faatelega faatasi o le 2 ma le 5 e tutusa ma le **Item 14.** E valu moli sa faasoa tutusa i tama e toafa. E fia moli a le tama e toatasi? **Item 17.** A vaevaeina apu e lua i tamaiti e toafa. O le a le vaegamea a le tamaitiiti e maua **Item 20.** O le ato lenei e $5 lona tau. E na o le $2 le tupe a Ana o lo'o iai. E toe fia le tupe e mo'mia e Ana e faatau ai le ato lea? **Item 23.** O le a le telē o le susu o lo o i totonu o le fagususu? **Item 25.** O le a le numera e 10 e tele ai nai lo le 278? **Item 26.**O le ata nei o le pateni a Pele. E fia faamau e mo'omia i le pusa mulimuli o le pateni? **Item 28.** Sa piki e Sione se siepi mai pusa nei e aunoa ma se vaai i ai. O fea o pusa nei e telē se avanoa e pikiina ai se kuki? **Item 30.** O fea o numera o i lalo e tutusa ma le 300 + 70 + 6? **Item 31.** O le numera 16 e tutusa ma le **Item 34.** O fea o siepi nei e 12 ona pito?	Students are able to add two-digit numbers by applying a range of mental strategies; identify and describe the element of chance in an event using words such as possible and certain; identify the position of an object in a line of objects; record quantitative relationships involving subtraction number facts; use the term 'is the same as' to express equality of groups; represent division by sharing equally a collection of objects; sharing objects equally into four equal parts; perform simple calculations with money; read the volume of milk in a calibrated bottle; use reference numbers to form numbers within a range; identify, copy and continue geometric repeating patterns; identify the element of chance and describe chance using familiar language; use addition number sentences and apply place value to add up to three-digit numbers; use the term 'is the same as' to express equality of groups; and describe attributes of 3D objects.
At-Risk **Level 2** (40 up to <60)%	**Item 3.** O le numera _____e leai se avanoa e maua ai le vili **Item 4.** O le 2 + 4 e tutusa lona tali ma le tali o le **Item 12.** 3 + 3 + 3 + 3 e tutusa ma le **Item 15.** O le vaegamea o loo valivaliina e tusa ma le _____? (afa) **Item 19.** O fea o siepi o le hesakone? **Item 22.** O fea o mea nei e faaaoga e fua ai le mamafa? **Item 27.** O fea o vili nei e tele se avanoa e tu ai i le lanu paepae? **Item 32.** Sa faapipii e Atamu ana sitika i le siata lena. O fea o sitika lo'o i le A4? **Item 33.** O le aoga a Mata e amata i le kuata e tea ai le iva. O fea o uati nei o lo'o faailo mai ai le taimi lea?	Students are able to predict the outcome when spinning a wheel; use the term 'is the same as' to express the equality of two groups; represent addition as the sum of 2 or more numbers; recognise that halves is two equal parts and half is represented by ½; recognise, visualise and name 2D objects; identify tools used to measure mass; predict the outcome when spinning a wheel of colours; interpret simple maps showing object positions; and reading quarter-hour time on digital clocks.

Table 21: Year 2 Benchmark Descriptions by Proficient and At Risk Levels - *continued*

At-Risk - Level 3 (20 up to <40)%	**Item 1.** O a numera e i le va o le 14 ma le 17? **Item 5.** E tutusa le aofai o foliga i le ata lea ____ma le ___? **Item 10.** E toe fia li'o atoa le sefulu (10)? **Item 21.** O le ā le siepi lenei? (piramita)	Students are able to identify the number before and after a given number(s); make and recognize different visual arrangements for the same number; recognise a dot pattern instantly for numbers up to 10; and identify and name 3D objects.
At-Risk - Level 4 (0 up to <20)%	**Item 6.** E fia le aofai o foliga i totonu o le lio? **Item 9.** O le a le tulaga o le fa'afetu i le pateni o lo'o i lalo? **Item 18.** O fea le laau e pito i umī?	Students are able to recognise and count number of objects up to three; describe the position of an object in relation to other objects; and estimate and compare lengths informally using informal units to identify longest length.

Table 22: Test 2 Items' Two Most Common Errors

Rank	ITEM	Item Description	Correct Answer	Most Common Error	Second Most Common Error
1	29*	siepi pe a vaai mai i luga o le koge tusa'o ile pito maai	Circle	cone (51%)	Oval (28%)
2	24*	atigipusa moomia mo 20 fagu pe afai e 4 fagu le pusa e tasi	5	4 (45%)	7 (14%)
4	16*	O le li'o ua vaevaeina tutua i _____ e fa (kuata)	kuata	Afa (44%	Tasi o vaelima (15%)
3	25*	Numera e 10 e tele ai nai lo le 278	288	279 (18%)	280 (14%)
5	8*	e lona fia le taavale ile faasologa	4th	3rd (40%)	1st (9%)
	31*	fuaiupu numera e tutusa ma le 16	4+4+4+4	6+6+6+6 (30%)	2+2+2+2 (17%)
6	11*	44 – _____ = 31. O le a le numera o loo misi?	13	11 (23%)	14 (21%)
7	2*	E sefulu fa mapu a Sione ae lua sefulu tolu mapu a Toma. E fia le aofai o mapu a Sione ma Toma?	37	31 (29%)	47 (28%)
8	17*	A vaevaeina apu e lua i tamaiti e toafa. O le a le vaegamea a le tamaitiiti e maua	Afa	Kuata (42%)	Tasi vaetolu (18%)
9	14*	E valu moli sa faasoa tutusa i tama e toafa. E fia moli a le tama e toatasi?	2	4 (33%)	3 and 1 (14% each)
10	30*	fea le numera e tutusa ma le 300 + 70 + 6	376	313 (24%)	673 (17%)
12	13*	o le numera e tutusa ma le faatelega faatasi o le 2 ma le 5	10	7 (26%)	25 (12%)
13	26*	faaauau pateni mo le pusa lona lima	10	16 (20%)	12 (18%)
14	23*	o le a le tele o le susu o loo I totonu ole fagususu (ile ata)	150	200 (11%)	Blank (8%)
15	**28***	piki le pusa e tele ai le avanoa e maua ai le kuki mai ata e fa	4	2 (17%)	3 (10%)
16	20	tupe moomia pe afai nao le $2 le tupe o iai ae $5 le tau ole ato	$3	$2 (32%)	$7 (12%)
17	7*	O fea o fagu nei e telē le avanoa e filifiliina mai ai se mapu?	6	4 (14%)	2 (13%)
18	34*	fea le siepi e 12 ona pito	Toothpaste box	Tin (24%)	Pyramid (14%)
19	12*	ata o faaputuga e 4 ma siepi tai 3. Fesili: 3+3+3+3 e tutusa ma le a?	Fa faaputuga tai 3	tolu faaputuga tai 4 (39%)	Fa faaputuga tai 4 (13%)
20	33*	fea le uati e tau mai ai le kuata e tea ai le iva	9:15	9:14 (27%)	8:45 (16%)

Table 22: Test 2 Items' Two Most Common Errors - *continued*

21	4*	2+4 e tutusa lona tali ma le tali o le fea (fuaiupu numera?)	1+5	1+2 (17%)	1+3 and 1+4 (16% each)
22	3	sue le numera e leai se avanoa e maua ai ile vili	4	2 (17%)	3 (13%)
23	15*	vaegamea o loo valivaliina ile ata (afa)	½	¼ (13%)	¾ (12%)
24	22	fea le mea fuataga e fua ai le mamafa	Pan scale	Thermometer (14%)	Clock (14%)
25	19	fea le siepi ile ata o le hesakone	3	Quadrilateral (24%)	Blank (8%)
26	27*	fea le vili e tele le avanoa e tu ai ile lanu paepae	afa	Tasi vaetolu (16%)	3 vaevalu (9%)
27	32*	o le a le sitika o loo i le tulaga A4 i luga ole siata	face	Star (16%)	Sun (14%)
28	1*	O a numera e i le va o le 14 ma le 17?	15 & 16	16 & 18 (25%)	19 & 20 (12%)
29	5*	e tutusa le aofai o foliga ole ata ma le fea ata	fa	Tasi (9%)	Tolu (9%)
30	10*	toe fia li'o atoa le sefulu I le ata o le siata ma li'o e lima	5	3 (6%)	4 (4%)
31	21*	o le a le igoa ole siepi I le ata	piramita	Tafatolu (35%)	Li'o & tafafa (6%)
32	6*	fia le aofai o foliga I totonu o le lio ille ata (3)	3	4 (4%)	2 (4%)
33	9*	tulaga o le faafetu I le pateni o loo ile ata	3	4 (7%)	2 (3%)
34	18*	fea le laau e pito umi o laau e fa o loo I le ata	3	1 (1%)	2 (1%)

Student Test 3 Year 3 Results

The Test 3 Rasch analysis used Test 2 item estimates for the 9 common items (Test 3 Items 3-4, 24, 26, and 28-30) to anchor them thus enabling test equating between the two cohorts and two Year Levels.

Fit of Data to the Model

Person Fit to the Model –After the initial analysis of responses from 341 cases, all person infit mean square (ms) values fall within the recommended range of 0.50 to 1.50 logits. This is further corroborated by the mean of 1.04 logits (SD 0.17 logits) as being equal to the expected value of 1 logit, see Table 23.

Item Fit to the Model – An items' mean infit ms value of 1.03 (also around the expected mean value of 1.00) was produced by the Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50. None of the items had zero or perfect scores.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Test 3 Reliability Indices and Mean Estimates

From the Rasch analysis of students' Test 3 responses, the person reliability index of the instrument (i.e., 0.66, see Table 23) was average with its traditional Cronbach's alpha value also average (i.e. 0.65, both of which are closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the items in the test. The item reliability index of Test 3 (i.e. 0.99) was relatively higher (than the 0.66 person reliability index) and ideal indicating that the items were reliably and sufficiently separated by the cases into a hierarchical order along the logit continuum. The high item reliability index also means that we can reliably rely on this order of item estimates to be replicated when we give the test to other samples for whom it is suitable.

The Test 3 mean item difficulty estimate was higher than zero at 1.05 logits indicating that Test 3 was approximately 1.05 logits relatively harder for the Year 3 cohort than Test 1 was for the Year 1 cohort. The Test 3 mean ability estimate of 0.55 (SD 0.57) logits was lower than the Test 3 mean difficulty

estimate (1.05 logit) suggesting that, overall, the Test 3 cohort, on average, found Test 3 harder by approximately 0.50 logit. Statistically, this difference (or mismatch between mean ability and mean difficulty) is significant (t = 4.3716, df = 372, p = 0.00) with Cohen's effect size value (d = 0.80) suggesting a large practical difference. This statistically significant and practically large difference also suggests that the test items and sample cases were not well-matched and that the achievement standards which form the basis of the Test 3 items were not attained, on average, by the cohort.

Table 23: Cohort Student Test 3 Rasch Statistics

Student Test 3 anchored on 9 Test 2 common items --- Item Estimates (Thresholds) all on all (N=341 L=33 Prob Level=0.50) --- Summary of item Estimates ========== Mean 1.05 SD 1.07 SD (adjusted) 1.06 Reliability of estimate 0.99 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 1.03 / Mean 1.06 SD 0.14 / SD 0.23 Infit t / Outfit t Mean 0.55 / Mean 0.53 SD 2.74 / SD 1.96 0 item with zero scores 0 items with perfect scores ==========	Student Test 3 anchored on 9 Test 2 common items --- Item Estimates (Thresholds) all on all (N=341 L=33 Prob Level=0.50) --- Summary of case Estimates ========== Mean 0.55 SD 0.70 SD (adjusted) 0.57 Reliability of estimate 0.66 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 1.04 / Mean 1.06 SD 0.17 / SD 0.39 Infit t / Outfit t Mean 0.20 / Mean 0.15 SD 0.97 / SD 0.83 0 cases with zero scores 0 cases with perfect scores ==========
Internal Consistency 0.65	

Student Test 3 Item-Person Maps

With the Test 3 Rasch statistics provided in Table 23, Figure 7 shows the Test 3 cohort item-person map with each X representing two students. No case had ability estimate that was above the most difficult item (Item 33, 3.07 logits) and 7 students (2%) had ability estimates that were below the easiest (cohort Test 3) item (Item 4, -0.94 logits). The distribution of ability estimates in Figure 7 is spread over approximately 4.29 logits from 2.65 down to −1.64 logits compared to a 4.01 logits spread of difficulty estimates from 3.07 to -0.94 logits.

Student Test 3 Ranked Item Difficulties and Descriptions

Provided in Table 24 are the ranked Test 3 items, brief item descriptions and supporting K&SLO while Table 25 provides the item analysis statistics for the ranked items, that is, number of students who scored the item correctly, total number of the cohort (n=341), percentage of the cohort who answered the item correctly and the item's difficulty estimate.

Student Test 3 Year 3

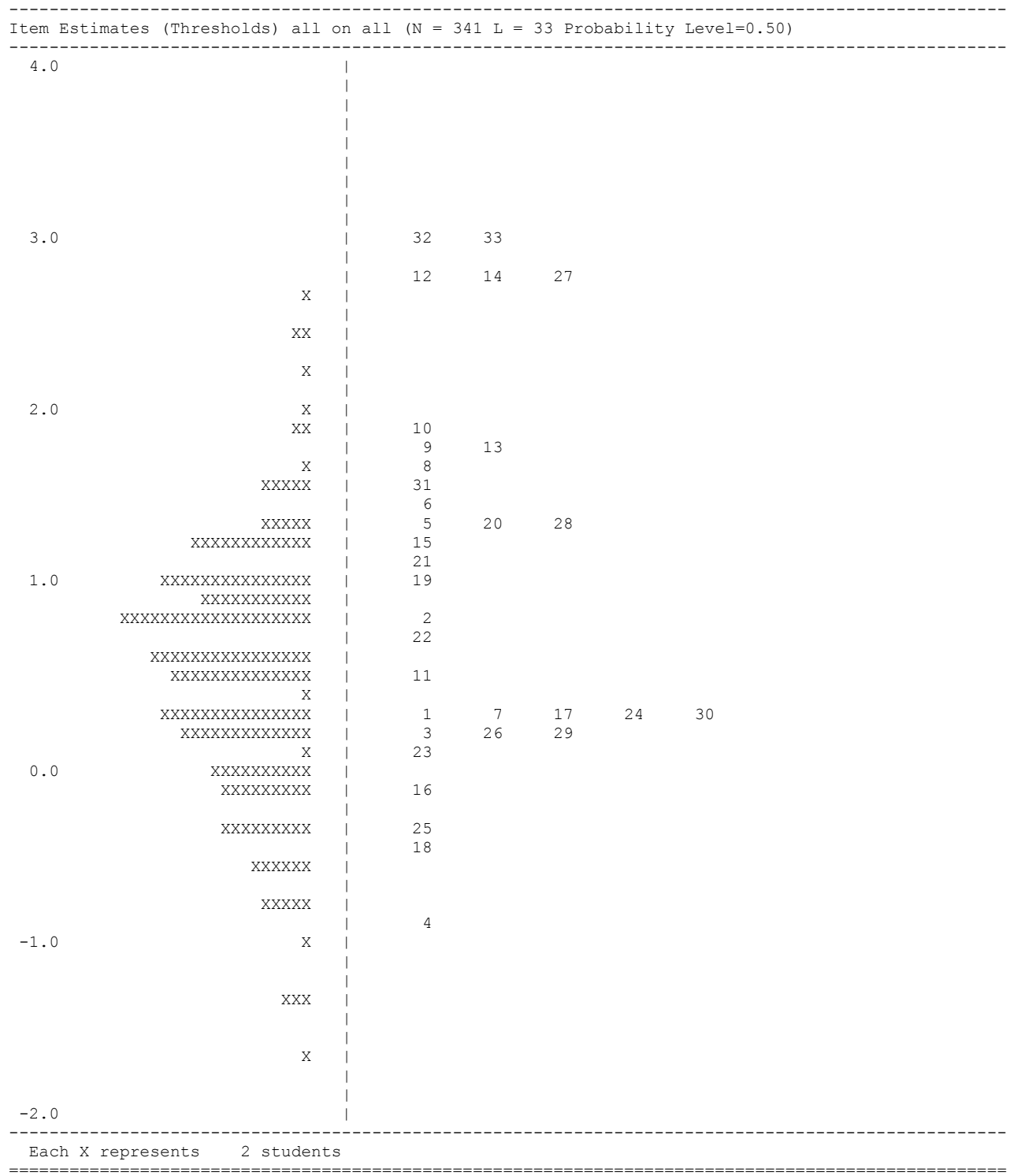


Figure 7: Cohort Year 3 Test 3 Item-Person Map

Table 24: Ranked Year 3 Test 3 Items and Knowledge & Skills Learning Outcomes

Rank	ITEM	Item Descriptions	K&S LO
1	33	E lua numera o lo o misi i le seti o numera o lo o i lalo, ma o lo o fa'ailoa mai ele fa'ailoga**?**	PA3.1b – K&SLO 6
2	32	O le pepa memori o le mea pu'eata o lo o i talaane o le vase. O le a le umī o le pepa memori i milimita?	MS3.1 – K&S LO1 – 3
3	27	siepi pe vaai mai I luga o le koge tusa'o ile pito maai	SG1.1 – K&SLO 2 SG3.1 – K&SLO 3
4	14	Na fa'atau e Foti pani e ta'i ono i le paketi … mo'omia pani e 27, fia paketi e tatau ona fa'atau e Foti?	NR3.3 – K&SLO 4-5, PA3.1b – K&SLO 4
5	12	O le fea o taimi nei o le 'toe 5 minute i le 11' ?	MS3.5 – K&SLO 6
6	10	O lē fea o galuega nei e sa'o?	PA3.1b – K&SLO 1
7	13	E fa siepi valivali o lo o i lalo. O fea le siepi valivali o lona eria (area) e lē 12 unit^2 ?	MS2.2 – K&SLO 8, MS3.2 – K&S LO1-2, SG1.2 – K&SLO 1, 2, 6
8	9	O le tau o le avoka i le maketi e $1.49. E fia ni avoka e maua i le $5.00?	NR3.4 – K&SLO 4
9	8	Afai o le a piki e Malia se pepa mai i pepa a Pita, o le a se avanoa na te pikiina ai se pepa e tutusa ma lana (Malia) pepa?	NR3.5 – K&SLO 5
10	31	54 - 17 =	PA3.1b – K&SLO 6, NR3.2 – K&SLO 5
11	6	Sa fai e Lake sana pateni o numera. Na amata lana pateni i le numera 5, ona fa'aopoopo tai 4 lea o numera agai i luma. O le fea o pateni o lo o i lalo o le pateni a Lake?	PA3.1a – K&SLO 1, 3
12	28*	tupe moomia pe afai nao le $2 le tupe o iai ae $5 le tau ole ato	NR2.2 – K&SLO 15
13	5	O le laina numera lenei. O lē fea o mata'itusi o lo o fa'asino i le 7/8?	NR3.4 – K&SLO 1
14	**20**	E tolu apu na vaevae tutusa e tamaiti e to'aono. O le a le vaega a le tagata e to'atasi?	NR1.4 – K&SLO 1, 2 NR1.3 – K&SLO 8
15	15	O le a le perimita o le siepi o lo o i luga?	MS3.1 – K&S LO1-5
16	21	O le a le vaegamea o le siepi o lo o valivaliina?	NR3.4 – K&SLO 1
17	19	valu pepa ua fa'anumeraina … O lē fea o numera o lo o i lalo e lē mafai ona maua ?	NR3.5 – K&SLO 1 – 3
18	2	O fea o mea faitino nei e fua ai le umi?	MS2.1 – K&SLO 7
19	22	O le a le numera e 10 e tele ai nai lo le 149?	NR2.1 – K&SLO 2, 8
20	11	E fia le eseesega o le tamaiitiiti umī ma le tamaitiiti pu'upu'u?	NR3.2 – K&SLO 5, MS3.1 – K&SLO 3
21	7	O lē fea o siepi nei e i ai pea e lua o laina sasa'o tutusa?	SG3.2a – K&SLO 9
22	17	Na gagau e Mari le pepa fa'a'afa ona tipi ese lea o le ata o le 'aū. Fea le ata pe a tatala le pepa?	SG3.2b – K&SLO 4
23	30*	o le a le numera e sosoo I le pateni 109, 119, 129, 139,	PA1.1 – K&SLO 5,6 PA2.1 – K&SLO 1, 2 PA3.1a – K&SLO 3
24	1	O lē fea o fuaiupu numera o i lalo o lo o fa'aali mai ai le aofa'i o vaiaso i le 14 aso?	NR3.3 – K&SLO 4, 5
25	24*	O fea o vili nei e tele se avanoa e tu ai i le lanu paepae?	NR1.5 – K&SLO 1, 2, 3 NR3.5 – K&SLO 5
26	3*	o le a le tele o le susu o loo I totonu ole fagususu (ile ata)	MS1.3 – K&SLO 1, 2, 3
27	29*	fea le numera e tutusa ma le 300 + 70 + 6	NR 3.2 – K&SLO 1
28	26*	O le ata lenei na pu'e i le 5.15pm. O le fea o uati i lalo o lo'o ta'u mai ai le taimi na pu'e ai le ata?	MS1.5/2.5 – K&SLO 9; MS3.5 – K&SLO 1, 5
29	23	E fia faamau e mo'omia i le pusa mulimuli o le pateni?	PA1.1a – K&SLO 5, 6
30	16	siata i lalo o lo o ta'u mai ai le aofa'i o ata tifaga sa matamata … fia e tele ai ata a Mane nai lo Kimi?	DA3.1 – K&S LO3, 5, NR3.2 – K&SLO 5
31	25*	Sa piki e Sione se siepi mai pusa … fea o pusa nei e telē se avanoa e pikiina ai se kuki?	NR1.5 – K&SLO 5 – 6
32	18*	Sa faapipii e Atamu ana sitika i le siata lena. O fea o sitika o lo'o i le A4?	SG3.3 – K&SLO 6, 7
33	4*	fia le aofai o foliga I totonu o le lio i le ata	NR1.1 – K&SLO 1, 8, 10

Table 25: Ranked Year 3 Test 3 Items and Item Analysis Results

Rank	ITEM	SCORE	MAXSCORE	% Correct	ESTIMATE
1	33	28	341	8	3.07
2	32	28	341	8	3.07
3	27	34	341	10	2.85
4	14	36	341	11	2.79
5	12	37	341	11	2.76
6	10	75	341	22	1.90
7	13	77	341	23	1.86
8	9	79	341	23	1.83
9	8	87	341	26	1.69
10	31	96	341	28	1.55
11	6	103	341	30	1.45
12	28*	205	341	60	1.42
13	5	105	341	31	1.42
14	20	111	341	33	1.33
15	15	113	341	33	1.31
16	21	124	341	36	1.16

Rank	ITEM	SCORE	MAXSCORE	% Correct	ESTIMATE
17	19	131	341	39	1.06
18	2	146	341	43	0.87
19	22	161	341	47	0.68
20	11	177	341	52	0.48
21	7	188	341	55	0.34
22	17	190	341	56	0.32
23	30*	184	341	54	0.29
24	1	196	341	58	0.24
25	24*	232	341	68	0.24
26	3*	264	341	77	0.22
27	29*	187	341	55	0.18
28	26*	150	341	44	0.18
29	23	210	341	62	0.06
30	16	227	341	67	-0.17
31	25*	172	341	50	-0.32
32	18*	197	341	58	-0.42
33	4*	273	341	80	-0.94

For the most difficult Test 3 item, Item 33, only 28 (8%) of the cohort got it correct and the item's difficulty estimate is 3.07 logits. For the easiest (cohort Test 3) item (#4, a common item with Test 2), 273 out of 370 (80%) got it correct. Fourteen of the 33 Test 2 items (42%) showed majority (>50) percentages correct (Items 8, 11, 17, 7, 30, 1, 24, 3, 29, 23, 16, 25, 18, and 4). See item descriptions of the most difficult and easiest items provided below in Table 26.

Table 26: Test 3 Cohort Most Difficult and Easiest Items

Item	Item Description - Most Difficult Item	Knowledge & Skills Learning Outcomes
33	E lua numera o lo o misi i le seti o numera o lo o i lalo, ma o lo o fa'ailoa mai ele fa'ailoga**?** 3 ? 2 + 6 5 = 4 3 ? O a numera o loo misi ?	PA3.1b – K&SLO 6 Difficulty Estimate = 3.07
Item	**Item Description – Easiest Item**	
4	E fia foliga o loo i totonu o le ata? 	NR1.1 – K&SLO 1, 8, 10 Difficulty Estimate = -0.94

The cohort median person ability is 0.65 logits. The middle 50% of the person distribution lie between 0.18 (lower quartile) and 1.10 logit (upper quartile), an interquartile range of approximately 0.92 logit, as graphically displayed by the Cohort Student Test 3 item-person map in Figure 7.

The cohort median item is Item 19 which 39% of the cohort got correct and the difficulty estimate is 1.06 logit. The upper quartile estimate is at 1.83 logit (Item 9) and lower quartile estimate at 0.24 logit (Item 24, a common item with Test 2) providing a 1.59 logit interquartile range of item difficulty estimates for the middle 50% of items.

Student Test 3 School Results

Provided in Table 27 are the relevant Test 3 statistics for each of the eight schools, and their respective mean difficulty and ability estimates. Ranking the Year 3 groups by their Test 3 mean group ability estimates (Figure 8) showed that STM PS (n=89) had the highest (0.98, SD 0.64 logits) with LOT PS (n=22) at the lowest (–0.15, SD 0.00 logits). In Figure 9 are the individual schools' item-person maps which visually display both the distribution of students and that of items on a common logit scale.

Table 27: School Student Test 3 Rasch Statistics

Primary School	Item			Case		
	Number	Mean	Std Dev	Number	Mean	Std Dev
LOT	34	0.71	1.14	22	-0.15	0.00
STM	34	1.10	0.99	89	0.98	0.64
VAM	34	1.09	1.47	69	0.41	0.53
FLS	34	0.91	1.07	58	-0.13	0.60
SLV	34	0.91	0.93	19	0.34	0.47
STP	34	0.68	1.39	32	0.37	0.01
SPU	34	0.83	1.87	30	0.65	0.60
MAN	34	1.17	1.24	22	1.03	0.33

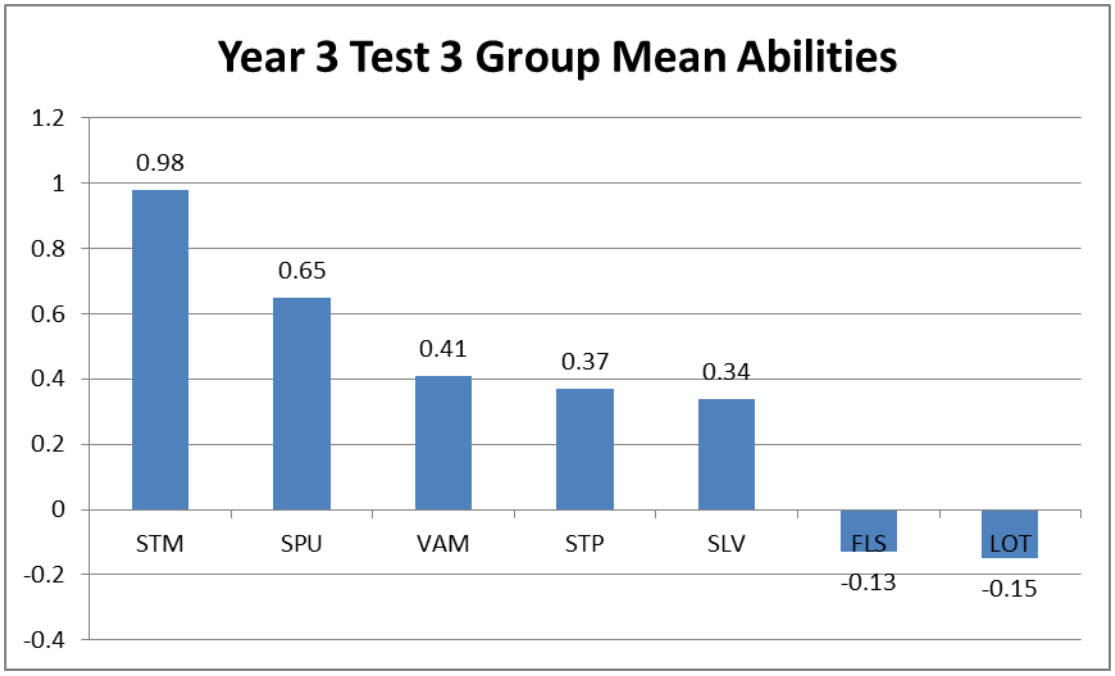


Figure 8: School Year 3 Student Test 3 Group Mean Ability Estimates

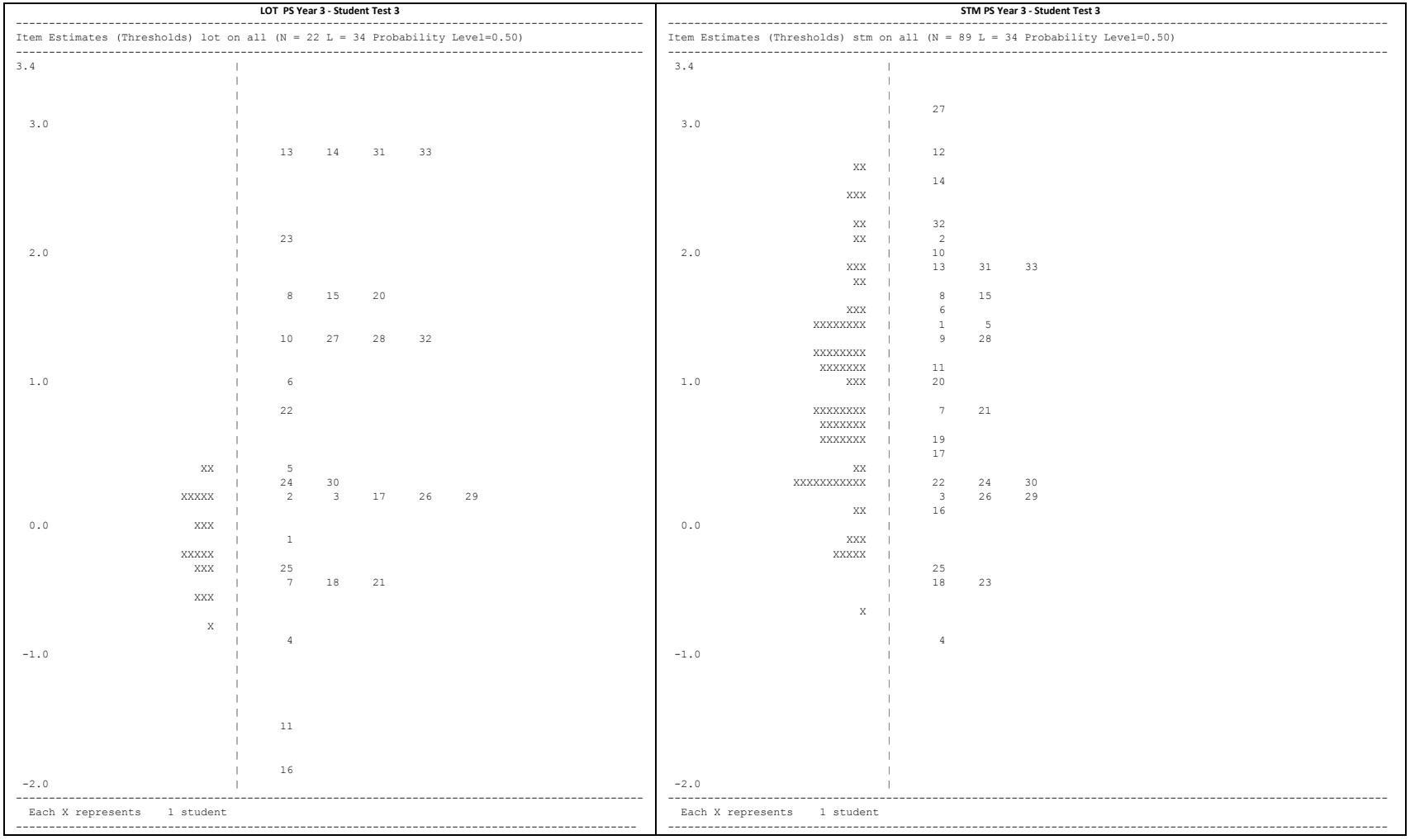


Figure 9: Schools' Year 3 Test 3 Item-Person Maps

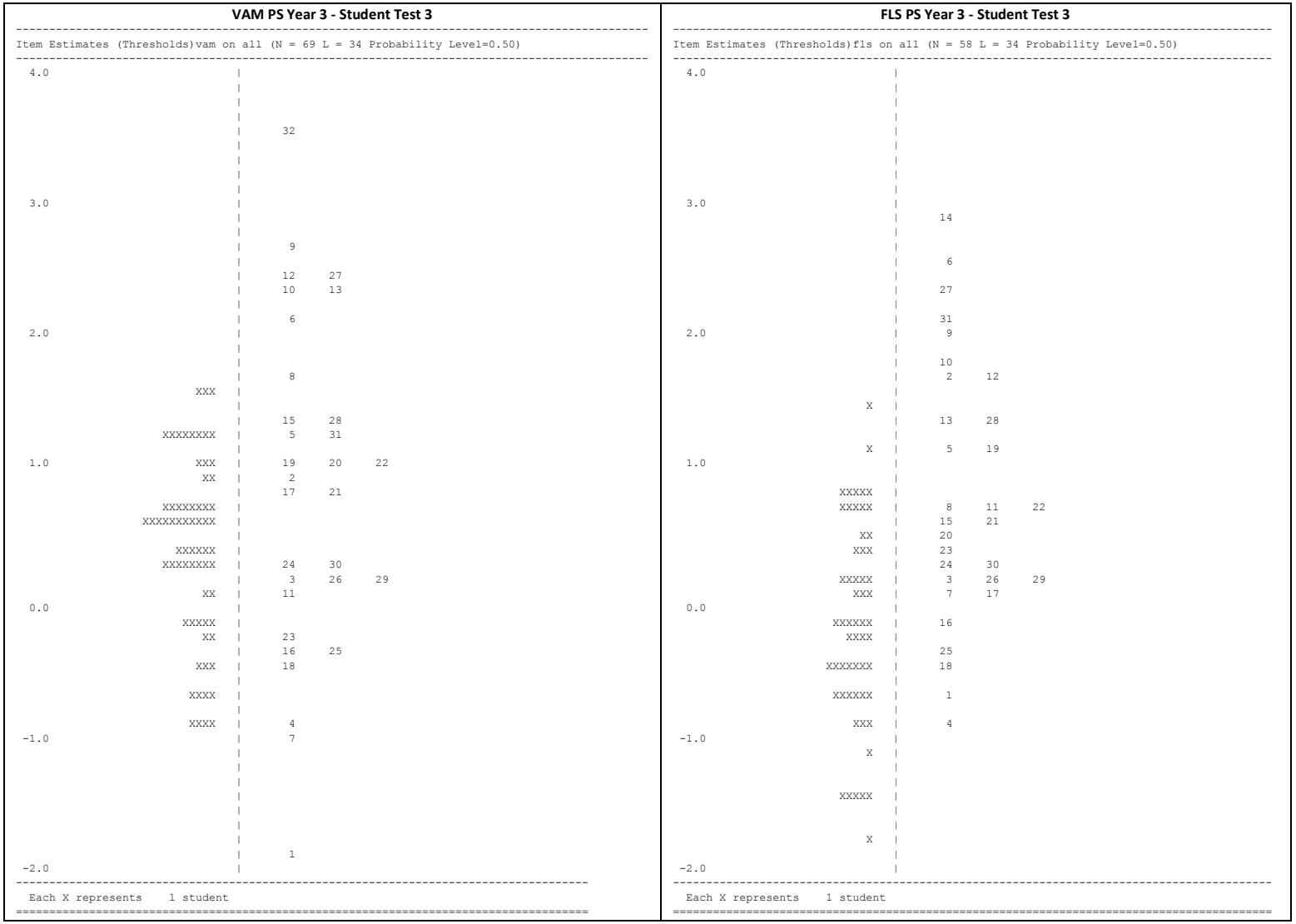


Figure 9: Schools' Year 3 Test 3 Item-Person Maps

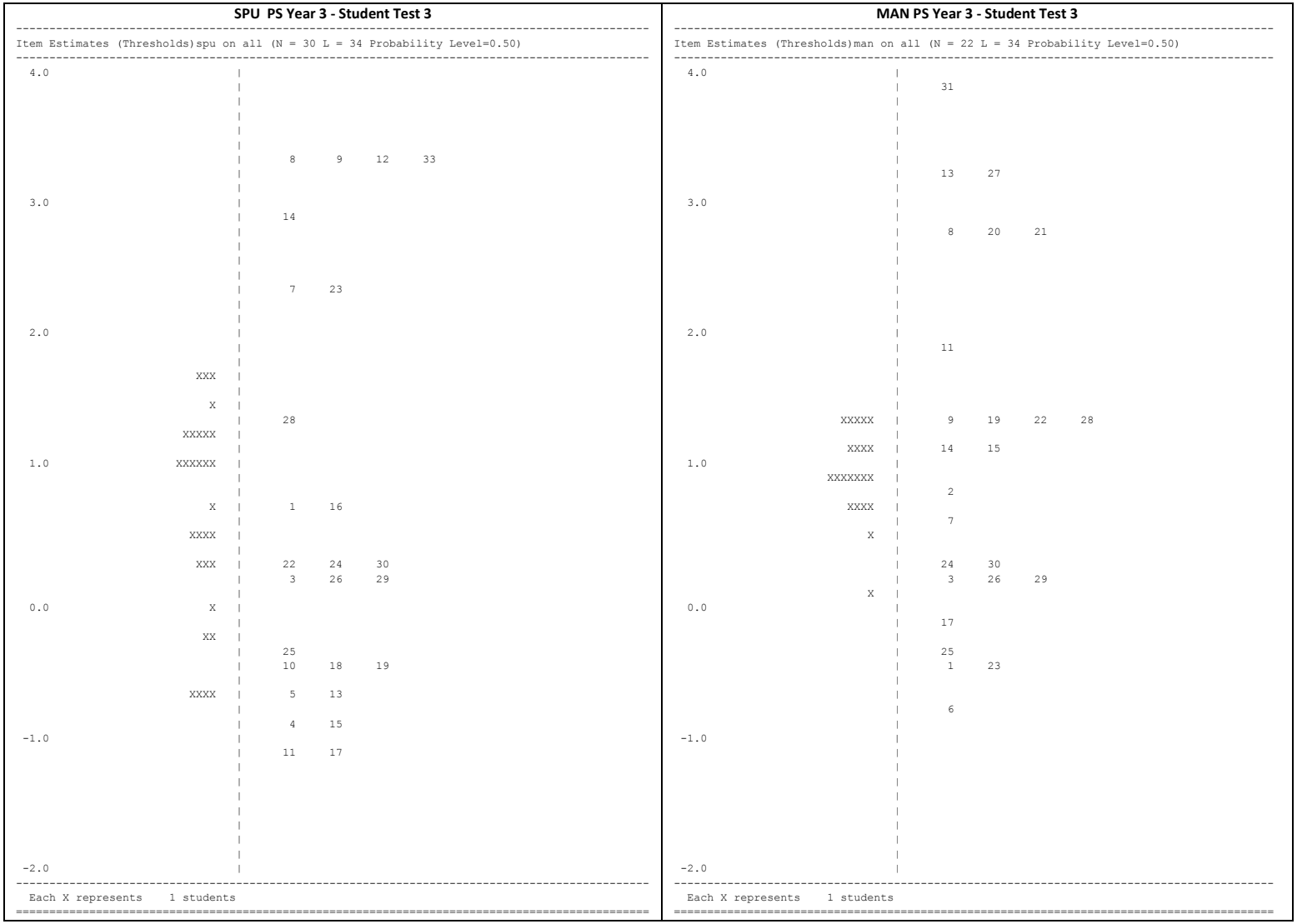


Figure 9: Schools' Year 3 Test 3 Item-Person Maps

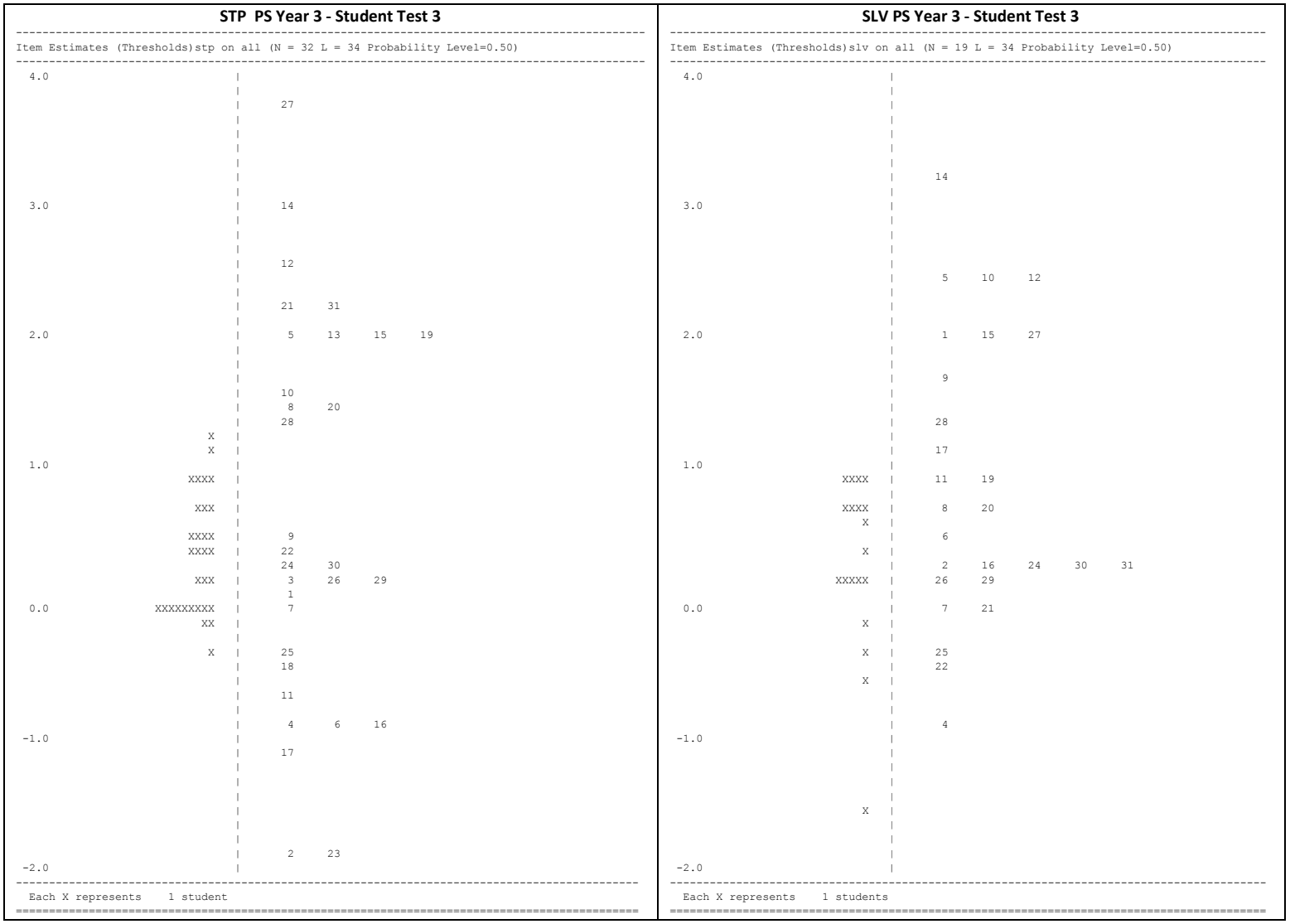


Figure 9: Schools' Year 3 Test 3 Item-Person Maps

Year 3 Students' Level of Achievement and Performance

Students' Test 3 ranked ability estimates by school, including percentage correct out of a total possible score of 33, z-scores, percentile rankings, and stanine scores are provided in Appendix C Table T3.1. Z-scores are case ability estimates normalised in terms of number of standard deviations (0.57 logits) each ability estimate is from the mean ability (0.55 logit).[5]

Also provided are stanine scores and performance levels. While the performance level is a general descriptor of an individual's performance relative to the cohort, the achievement level indicates proficiency (or mastery) of the Year Level's prescribed achievement standards as measured by the test or whether the student is 'at-risk'. Provided in Table 28 is the distribution of students across the achievement and performance levels for each school. None of the Year 3 students achieved proficient level as defined in this study and as measured by the Test 3 items.

The results show that none (0%) of the students of the Year 3 cohort achieved the Proficient Achievement Level with the students all distributed across the four At Risk Achievement Levels. For example, 7% of the students were at At Risk Level 1, 45% at At Risk Level 2, 43% at At Risk Level 3 and 5% at At Risk Level 4. In terms of individual performance relative to the rest of the cohort, 3% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 15% and 4% of the students were classified to be at the Below Average and Very Low Levels.

Whereas the performance levels are norm-referenced, the achievement levels indicate whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 3.

Table 28: School Distribution of Year 3 Achievement and Performance Levels

Year 3	Achievement Levels					Performance Levels					Total
School	Proficient	At Risk Level 1	At Risk Level 2	At Risk Level 3	At Risk Level 4	Very High	Above Average	Average	Below Average	Very Low	
LOT	0	0	0	22	0	0	0	11	11	0	22
STM	0	17	41	30	1	11	25	40	10	1	89
VAM	0	3	32	30	4	0	13	38	14	4	69
FLS	0	1	13	34	10	0	2	24	10	9	58
SLV	0	0	10	8	1	0	4	13	2	0	19
STP	0	0	17	15	0	0	6	25	1	0	32
SPU	0	3	20	7	0	0	14	13	3	0	30
MAN	0	0	20	2	0	0	1	21	0	0	22
Total Number	0	24	153	148	16	**11**	**65**	**185**	**51**	**14**	**341**
Percentage	0	7	45	43	5	**3**	**19**	**54**	**15**	**4**	**100**

Year 3 Benchmark Descriptions

Provided in Table 29 are the benchmark descriptions of students at each of the five achievement levels to indicate what students are able to do based on their performance in Test 3. Conceptually, students

[5] Rasch analysis to determine performance levels recoded blank responses as incorrect responses.

located at an achievement level should have the capacity to successfully complete those items located in the lower achievement levels.

Table 29: Year 3 Benchmark Descriptions by Proficient and At Risk Levels

Benchmark & Range	Item Numbers and Descriptions	Benchmark Descriptions
Proficient (at least 80%)	**Item 12.** O le fea o taimi nei o le 'toe 5 minute i le 11? **Item 14**. Faatau e Foti pani ta'i ono i le paketi. E moomia 27, e fia paketi … faatau e Foti? **Item 27**.O le a le siepi pe a vaai mai I luga ole koge? **Item 32** O le pepa memori o le meapueata … O le a le umi o le pepa memori? **Item 33**. E lua numera o loo misi ile seti … o a numera o loo misi?	Students are able to record digital time using the correct notation; determine the number of equal groups for a given amount; recognize views of 3D objects from the top, bottom and side; measure, and compare lengths of objects, using cm and mm; and find missing numbers in an addition number sentence.
At Risk **Level 1** (60 up to<80)%	**Item 8**. O le pepa lenei a Malia … O le a se avanoa na te pikiina se pepa e tutusa ma lana pepa? **Item 9**. O le tau o le avoka e $1.49. E fia ni avoka e maua i le $5.00? **Item 10**. O le fea o galuega ia e sa'o? **Item 13.**E fa siepi valivali o lo o i lalo … O le fea siepi valivali o lona eria e le 12 unite^2? **Item 31**. Tusi le tali sa'o ole 54 – 17 =	Students are able to predict and record all possible outcomes in a simple experiment; add and subtract decimals with the same number of decimal places as in money transactions; identify correct number sentences that use two operations; estimate the area of shapes drawn on grid paper; and use formal written algorithm to solve subtraction problem involving two digit numbers.
At Risk **Level 2** (40 up to <60)%	**Item 1**. O le vaiaso e 7 ona aso … fea le fuaiupu numera e faaali mai ai aofai o vaiasoi le 14 aso? **Item 2**. O le fea o mea faitino nei e fua ai le umi? **Item 5**. O le laina numera lenei. … O le fea o mataitusi o lo o faasino I le 7/8? **Item 6** .Sa fai e Lake sana pateni amata i le 5 ona faaopoopo tai 4 Lea o numera agai i luma. O le fea o pateni o le pateni a Lake? **Item 7**. O le fea o siepi nei e I ai pea e lua o laina sasa'o tutusa? **Item 11**. Sa tusi e tamaiti I luga o le laupapa lo latou uumi …. **Item 15**. O le a le perimita o le siepi o lo o I luga? **Item 17**. Na gagau e Mari le pepa …. **Item 19**.E 8 pepa ua faanumeraina I le ata …. **Item 20**.E tolu apu na vaevae tutusa I tama e toa ono. O le a le vaega a le tagata e toatasi? **Item 21**. O le a le vaegamea o le siepi o lo o valivaliina? **Item 22**. O le a le numera e 10 e tele ai nai lo le 149? **Item 24**. E fia faamau e moomia I le pusa mulimuli o le pateni? **Item 28**. O le a le tupe e moomia pe afai nao le $2 o iai ae $5 le tau o le ato?	Students are able to use mental strategies to divide by a one-digit number multiplication facts up to 100; recognize, identify appropriate measuring devices for length; model, compare and represent fractions with denominators 2, 4, 8 and positioning them on a number line; identify and describe patterns when counting forward by 4s; identify and describe 2D shapes using their attributes; interpret and compute quantitative information in a display; estimate, measure and compare lengths and distances using centimeters; create designs by folding, flipping and/or cutting; distinguish between certain and uncertain events in a simple experiment; determine equal shares that are fractions; model, compare and represent fractions by modeling halves, quarters, eighths of whole objects; counting forward by 10 from a given 3-digit number; extending an increasing geometric pattern; and compute money transactions involving only dollar amounts.

Year 3 Students' Level of Achievement and Performance

Students' Test 3 ranked ability estimates by school, including percentage correct out of a total possible score of 33, z-scores, percentile rankings, and stanine scores are provided in Appendix C Table T3.1. Z-scores are case ability estimates normalised in terms of number of standard deviations (0.57 logits) each ability estimate is from the mean ability (0.55 logit).

Also provided are stanine scores and performance levels. While the performance level is a general descriptor of an individual's performance relative to the cohort, the achievement level indicates proficiency (or mastery) of the Year Level's prescribed achievement standards as measured by the test or whether the student is 'at-risk'. Provided in Table 28 is the distribution of students across the achievement and performance levels for each school. None of the Year 3 students achieved proficient level as defined in this study and as measured by the Test 3 items.

The results show that none (0%) of the students of the Year 3 cohort achieved the Proficient Achievement Level with the students all distributed across the four At Risk Achievement Levels. For example, 7% of the students were at At Risk Level 1, 45% at At Risk Level 2, 43% at At Risk Level 3 and 5% at At Risk Level 4. In terms of individual performance relative to the rest of the cohort, 3% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 15% and 4% of the students were classified to be at the Below Average and Very Low Levels.

Whereas the performance levels are norm-referenced, the achievement levels indicate whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 3.

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VAM	0	3	32	30	4	0	13	38	14	4	69
FLS	0	1	13	34	10	0	2	24	10	9	58
SLV	0	0	10	8	1	0	4	13	2	0	19
STP	0	0	17	15	0	0	6	25	1	0	32
SPU	0	3	20	7	0	0	14	13	3	0	30
MAN	0	0	20	2	0	0	1	21	0	0	22
Total Number	0	24	153	148	16	**11**	**65**	**185**	**51**	**14**	**341**
Percentage	0	7	45	43	5	**3**	**19**	**54**	**15**	**4**	**100**

Year 3 Benchmark Descriptions

Provided in Table 29 are the benchmark descriptions of students at each of the five achievement levels to indicate what students are able to do based on their performance in Test 3. Conceptually, students located at an achievement level should have the capacity to successfully complete those items located in the lower achievement levels.

Table 29: Year 3 Benchmark Descriptions by Proficient and At Risk Levels - continued

At Risk **Level 3** (20 up to <40)%	**Item 3**. O le a le tele o le susu o lo o I le fagususu? **Item 16**. O le siata I lalo o lo o ta'u mai ai ….E fia e tele ai ata a Mane nai lo Kimi? **Item 18**. Sa faapipii e Atamu ana sitika…..O fea o sitika o lo o I le A4? **Item 23**.E fia faamau e moomia I le pusa mulimuli o le pateni? **Item 25**. Sa piki e Sione se siepi mai pusa. O fea o pusa e tele se avanoa e piki ai? **Item 26**. O le ata lenei na pue I le 5.15pm…….O le fea o uati o lo o tau mai ai le taimi na pue ai? **Item 29**. O fea o numera o I lalo e tutusa ma le 300 + 70 + 6? **Item 30**. O le a le numera e sosoo I le pateni o lo o I lalo?	Student are able to read the volume of liquids in a calibrated bottle of standard units; interpreting information presented in simple tables; using coordinates on simple maps to describe positions; recognize and describe the element of chance in everyday events ; reading and recording hour and quarter-hour time on analogue clocks; use mental strategies for addition involving three numbers and find a higher term in an increasing number pattern given the first four terms.
At Risk **Level 4** (0 up to <20)%	**Item 4**. E toe fia lio atoa le 10?	Students are able to count forward to 10 from a given number.

Year 3 Students' Most Common Errors

Students' common errors are those choices (including blank responses) that had the two highest error rates according to the item analysis data for each of the 33 items. The results are presented in Table 30. The results show that errors with at least 40% include those about viewing 3D objects from different perspectives (e.g. top), identifying the number of equal groups given an amount, representing descriptions of time using digital notation, computing the correct number of items to be bought with a given amount of money given a cost that has 2 decimal places, and identifying the fraction (eighths) of a shape that is shaded.

Table 30: Test 3 Items' Two Most Common Errors

Rank	ITEM	Item Description	Correct Answer (%)	Most Common Error	Second Most Common Error
1	33	E lua numera o lo o misi i le seti o numera o lo o i lalo, ma o lo o fa'ailoa mai ele fa'ailoga **?**	7 & 7 (8%)	Open response	
2	32	O le pepa memori o le mea pu'eata o lo o i talaane o le vase. O le a le umī o le pepa memori i milimita?	25mm (8%)	Open response	
3	27	siepi pe vaai mai I luga o le koge tusa'o ile pito maai	Circle (10%)	Oval (55%)	Triangle (26%)
4	14	Na fa'atau e Foti pani e ta'i ono i le paketi … mo'omia pani e 27, fia paketi e tatau ona fa'atau e Foti?	5 (11%)	8 (48%)	5 (11%)
5	12	O le fea o taimi nei o le 'toe 5 minute i le 11' ?	10:55 (11%)	11:05 (47%)	11:11 (20%)
6	10	O lē fea o galuega nei e sa'o?	18÷2<13 (22%)	$10 + 4^2 < 20$ (36%)	$16 - 8 > 15$ (26%)
7	13	E fa siepi valivali o lo o i lalo. O fea le siepi valivali o lona eria (area) e lē 12 $unit^2$?	Lona fa (23%)	Lona lua (32%)	Lona tolu (22%)
8	9	O le tau o le avoka i le maketi e $1.49. E fia ni avoka e maua i le $5.00?	3 (23%)	4 (48%)	6 (28%)
9	8	Afai o le a piki e Malia se pepa mai i pepa a Pita, o le a se avanoa na te pikiina ai se pepa e tutusa ma lana (Malia) pepa?	Tele le avanoa (26%)	Mautinoa (28%)	Laitiiti le avanoa (27%)
10	31	54 - 17 =	37 (28%)	Open response	
11	6	Sa fai e Lake sana pateni o numera. Na amata lana pateni i le numera 5, ona fa'aopoopo tai 4 lea o numera agai i luma. O le fea o pateni o lo o i lalo o le pateni a Lake?	5,9,13,17, … (30%)	5, 4, 3, 2, … (28%)	5, 6, 7, 8, … (20%)
12	28*	tupe moomia pe afai nao le $2 le tupe o iai ae $5 le tau ole ato	$3 (60%)	$2 (14%)	$7 (11%)
13	5	O le laina numera lenei. O lē fea o mata'itusi o lo o fa'asino i le 7/8?	D (31%)	C (28%)	B (23%)
14	**20**	E tolu apu na vaevae tutusa e tamaiti e to'aono. O le a le vaega a le tagata e to'atasi?	Afa (33%)	Tasi vaeono (32%)	Kuata (17%)
15	15	O le a le perimita o le siepi o lo o i luga?	58 (33%)	50 (26%)	48 (20%)
16	21	O le a le vaegamea o le siepi o lo o valivaliina?	⅜ (36%)	⅗ (40%)	¾ (13%)
17	19	valu pepa ua fa'anumeraina … O lē fea o numera o lo o i lalo e lē mafai ona maua ?	25 (39%)	65 (23%)	16 (18%)
18	2	O fea o mea faitino nei e fua ai le umi?	Fua toso (43%)	Fua paleni (19%)	Fua mamafa (19%)
19	22	O le a le numera e 10 e tele ai nai lo le 149?	159 (47%)	150 (19%)	139 (18%)
20	11	E fia le eseesega o le tamaiitiiti umī ma le tamaitiiti pu'upu'u?	24 (52)	18 (18%)	20 (16%)
21	7	O lē fea o siepi nei e i ai pea e lua o laina sasa'o tutusa?	Tafafa (55%)	Li'o (17%)	Triangle (36%)
22	17	Na gagau e Mari le pepa fa'a'afa ona tipi ese lea o le ata o le 'aū. Fea le ata pe a tatala le pepa?	Lona fa (56%)	Muamua (17%)	Lona tolu (13%)
23	30*	o le a le numera e sosoo I le pateni 109, 119, 129, 139,	149 (54%)	Open response	
24	1	O lē fea o fuaiupu numera o i lalo o lo o fa'aali mai ai le aofa'i o vaiaso i le 14 aso?	14 ÷ 7 = 2 (58%)	14 + 3 = 17 (20%)	14 – 3 = 11 (10%)
25	24*	O fea o vili nei e tele se avanoa e tu ai i le lanu paepae?	Afa li'o (68%)	Tasi vaetolu li'o (12%)	Tolu vaevalu (10%)
26	3*	o le a le tele o le susu o loo I totonu ole fagususu (ile ata)	150 (77%)	200 (9%)	100 (7%)
27	29*	fea le numera e tutusa ma le 300 + 70 + 6	376 (55%)	313 (16%)	673 (15%)
28	26*	fea le uati e tau mai ai le kuata e tea ai le lima?	Muamua (44%)	4:45 (20%)	3:25 (19%)
29	23	E fia faamau e mo'omia i le pusa mulimuli o le pateni?	10 (62%)	16 (22%)	12 (8%)
30	16	siata i lalo o lo o ta'u mai ai le aofa'i o ata tifaga sa matamata … fia e tele ai ata a Mane nai lo Kimi?	4 (67%)	3 (15%)	1 (8%)
31	25*	Sa piki e Sione se siepi mai pusa … fea o pusa nei e telē se avanoa e pikiina ai se kuki?	Ata e 4 kuki (50%)	Ata e 3 kuki (27%)	Ata e 2 kuki (14%0
32	18*	Sa faapipii e Atamu ana sitika i le siata lena. O fea o sitika o lo'o i le A4?	Face (58%)	Heart (16%)	Star (15%)
33	4*	Toe fia li'o atoa le 10 ae lima o loo i le ata	5 (80%)	3 (7%)	4 (7%)

Student Test 4 Year 4 Results

The Test 4 Rasch analysis used Test 3 item estimates for the 22 common items (Test 3 Items 1-2, 4-6, 8-12, 14, 19-27, 29, and 32) to anchor them thus enabling test equating between the two cohorts and two Year Levels.

Fit of Data to the Model

Person Fit to the Model –After the initial analysis of responses from 372 cases, all person infit mean square (ms) values fall within the recommended range of 0.50 to 1.50 logits. This is further corroborated by the mean of 1.16 logits (SD 0.16 logits) as being equal to the expected value of 1 logit, see Table 31. One case had zero score.

Table 31: Cohort Student Test 4 Rasch Statistics

Student Test 4 anchored on 22 Test 3 common items	Student Test 4 anchored on 22 Test 3 common items
Item Estimates (Thresholds)all on all (N = 372 L = 33 Prob Level=0.50)	Case Estimates all on all (N = 372 L = 33 Prob Level=0.50)
Summary of item Estimates	Summary of case Estimates
Mean 1.28 SD 1.08 SD (adjusted) 1.07 Reliability of estimate 0.99	Mean 0.31 SD 0.71 SD (adjusted) 0.56 Reliability of estimate 0.63
Fit Statistics Infit Mean Square: Mean 1.22, SD 0.67 Outfit Mean Square: Mean 1.24, SD 0.65 Infit t: Mean 2.11, SD 4.57 Outfit t: Mean 1.47, SD 3.05 1 item with zero scores 0 items with perfect scores	Fit Statistics Infit Mean Square: Mean 1.16, SD 0.16 Outfit Mean Square: Mean 1.24, SD 0.37 Infit t: Mean 0.86, SD 0.88 Outfit t: Mean 0.65, SD 0.76 1 case with zero scores 0 cases with perfect scores
Internal Consistency = 0.60	

Item Fit to the Model – An item mean infit ms value of 1.22 (also around the expected mean value of 1.00) was produced by the Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50. One item had zero score.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Test 4 Reliability Indices and Mean Estimates

From the Rasch analysis of students' Test 4 responses, the person reliability index of the instrument (i.e., 0.63, see Table 31) was average with its traditional Cronbach's alpha value also average (i.e. 0.60, both of

which are closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the items in the test. The test's item reliability index of 0.99 was relatively higher (than the 0.63 person reliability index) and ideal indicating that the items were reliably and sufficiently separated by the cases into a hierarchical order along the logit continuum. The high item reliability index also means that we can reliably rely on this order of item estimates to be replicated when we give the test to other samples for whom it is suitable.

The Test 4 mean item difficulty estimate was 1.28 logits compared to that of Test 3 (1.05 logits), indicating that Test 4 was relatively more difficult, as expected, than Test 3. The Test 4 mean ability estimate was 0.31 (SD 0.56) suggesting that, overall, the Test 4 cohort, on average, found Test 4 harder by approximately 0.97 logit (the difference between the two means). Statistically, this difference (or mismatch between mean ability and mean difficulty) is significant (t = 8.6677, df = 403, p = 0.00) with Cohen's effect size value (d = 1.58) suggesting a very large practical difference. This statistically significant and practically very large difference also suggests that the test items and sample cases were not well-matched and that the achievement standards which form the basis of the Test 4 items were not attained, on average, by the cohort.

Student Test 4 Item-Person Maps

With the Test 4 Rasch statistics provided in Table 31, Figure 10 shows the Test 4 cohort item-person map (Figure 10) with one X representing 2 students. No case had ability estimate that was above the most difficult item (Item 28, 3.59 logits) and 50 students (12%) had ability estimates that were below the easiest (cohort Test 4) item (Item 21, -0.42 logits). The distribution of ability estimates in Figure 10 is spread over approximately 4.75 logits from 2.12 down to -2.63 logits compared to a 4.01 logits spread of difficulty estimates from 3.59 to -0.42 logits. Whilst there were enough items at the top end of the continuum to challenge the top cases, there were no easiest items at the lower end to reliably separate the bottom 46 cases further corroborating the lower person separation index signaled earlier.

Student Test 4 Ranked Item Difficulties and Descriptions

Provided in Table 32 are the ranked Test 4 items, brief item descriptions and supporting K&SLO while Table 33 provides the item analysis statistics for the ranked items, that is, number of students who scored the item correctly, total number of the cohort (n=372), percentage of the cohort who answered the item correctly and the item's difficulty estimate.

One item, Item 34, had zero score. For the most difficult Test 3 item, Item 28, only 12 (3%) of the cohort got it correct and the item's difficulty estimate is 3.59 logits. For the easiest (cohort Test 4) item (#21, a common item with Test 3), 197 out of 372 (53%) got it correct. Six of the 34 Test 4 items (18%) showed majority (>50) percentages correct (Items 20, 13, 22, 1, 3, and 21). See item descriptions of the most difficult and easiest items provided below in Table 34.

The cohort median person ability is 0.40 logits. The middle 50% of the person distribution lie between –0.12 (lower quartile) and 0.88 logit (upper quartile), an interquartile range of approximately 1.00 logit, as graphically displayed by the Cohort Student Test 3 item-person map in Figure 10.

The cohort median item is Item 9 which 42% of the cohort got correct and the difficulty estimate is 1.31 logits. The upper quartile estimate is at 1.90 logits (Item 4) and lower quartile estimate at 0.32 logit (Item 14) providing a 1.58 logit interquartile range of item difficulty estimates for the middle 50% of items.

Student Test 4 Year 4

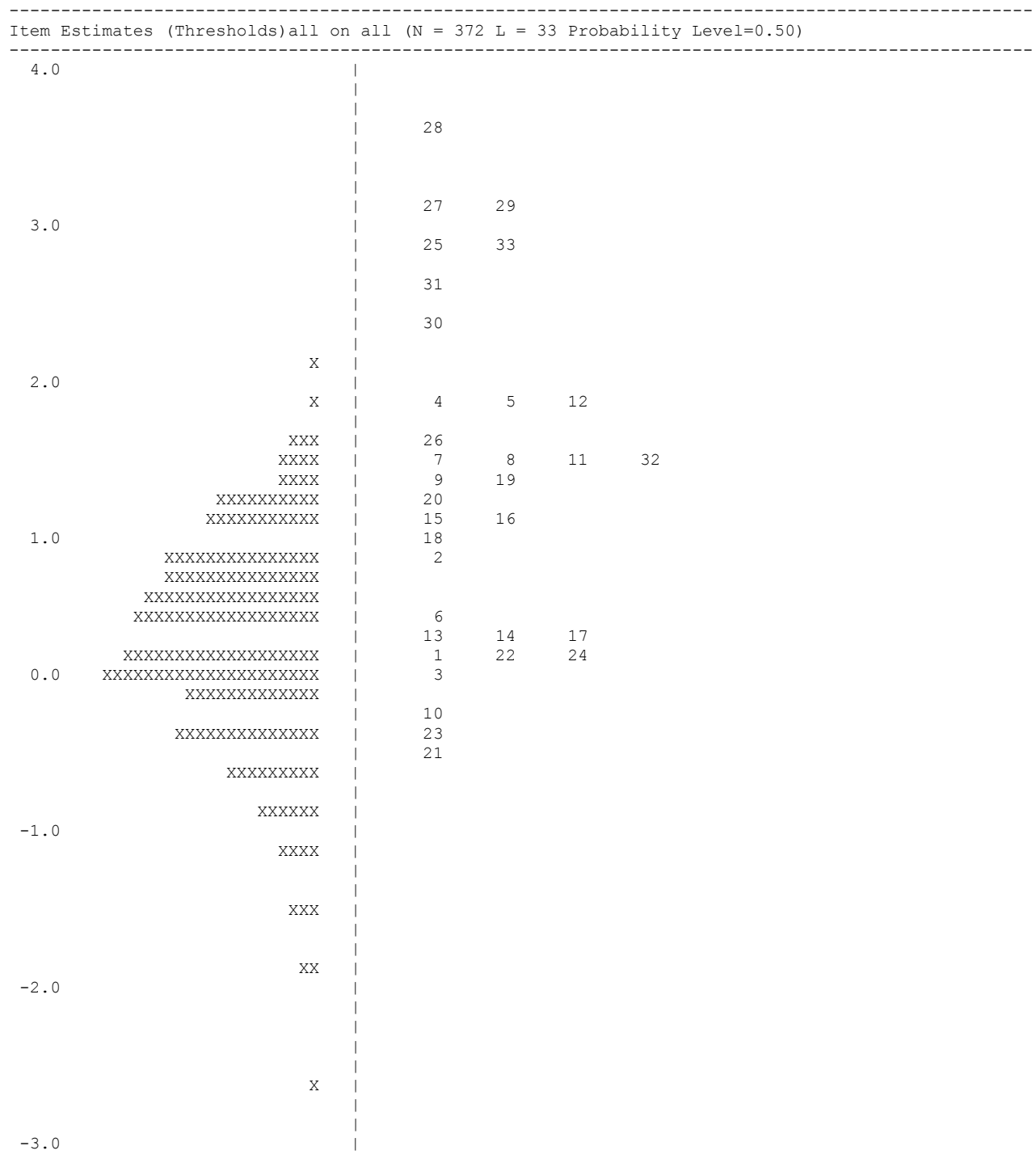


Figure 10: Cohort Year 4 Test 4 Item-Person Map

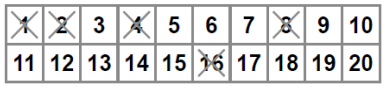
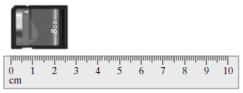
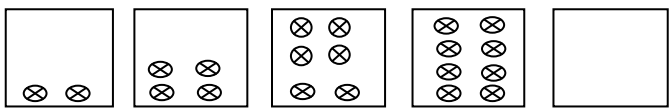
Table 32: Ranked Year 4 Test 4 Items and Knowledge & Skills Learning Outcomes

Rank	ITEM	Item Descriptions	K&S LO
1	34	O le a le aofai o feta ua kolosi ese?	NR4.3 – K&SLO 1-2
2	28	O le pepa memori o le mea pu'eata o lo o i talaane o le vase. O le a le umī o le pepa memori i milimita?	MS3.1 – K&SLO 1 – 3 MS4.1 – K&SLO 4
3	27*	O le kalafi o lo o i lalo o lo o fa'ailoa mai ai ta'aloga e fiafia i ai tamaiti. E to'afia tamaiti e fiafia i le Netipolo po o le Hoki?	DA4.1 – K&SLO 4, 6
4	29*	E lua numera o lo o misi i le seti o numera o lo o i lalo, ma o lo o fa'ailoa mai ele fa'ailoga**?**	PA4.1b – K&SLO 6
5	33	O le a le aofa'i o numera (feta) ua kolosi ese?	NR4.3 – K&SLO 1, 2, 9
6	25*	o le a le numera e sosoo I le pateni 109, 119, 129, 139,	PA2.1 K&SLO 1, 2 PA4.1a – K&SLO 1
7	31	siepi pe vaai mai I luga o le koge tusa'o ile pito maai	SG1.1 – K&SLO 2; SG3.1 – K&SLO 3; SG4.1 – K&SLO 8
8	30	17 × 8 = 136, o le a la le 17 × 80 = ?	NR4.3 - K&SLO 2
9	4*	O lē fea o galuega nei e sa'o?	PA3.1b – K&SLO 1; NR4.1 - K&SLO 8; NR4.3 – K&SLO 3
10	12*	O le a le avanoa e sau ai lea pepa o se numera lē soagia?	DA4.5 – K&SLO 2, 3, 5; NR4.2 - K&SLO 1,2
11	5*	O le tau o le avoka i le maketi e $1.49. E fia ni avoka e maua i le $5.00?	NR3.4 – K&SLO 4 NR4.4 – K&SLO 6
12	26*	54 - 17 =	PA3.1b – K&SLO 6; NR3.2 – K&SLO 5; NR4.2 – K&SLO 1
13	11*	E fa siepi valivali o lo o i lalo. O fea le siepi valivali o lona eria (area) e lē 12 unit^2 ?	MS2.2 – K&SLO 8; MS3.2 – K&SLO 1-2; MS4.2 – K&SLO 3; SG1.2 – K&SLO 1, 2, 6
14	8*	O le a le perimita o le siepi o lo o i luga?	MS3.1 – K&SLO 1-5, MS4.1 – K&SLO 10
15	32*	O lo o tu le ta'avale a Bob i talane o le fa'ailoilo lenei o nu'u o Eta ma Kana. O le a le umi o le va o nu'u nei o Eta ma Kana?	MS3.1 – K&SLO 2-3; MS4.1 – K&SLO 4-5; MSG3.3 – K&SLO 1-3
16	7	O le laina numera lenei. O lē fea o mata'itusi o lo o fa'asino i le 7/8?	NR4.4 – K&SLO 1
17	19*	O le a le vaegamea o le siepi o lo o valivaliina?	NR4.4 – K&SLO 1
18	9*	E fia e tele ai ata a Mane nai lo Kimi?	DA3.1 – K&S LO3, 5; NR3.2 – K&SLO 5; DA4.1 – K&SLO 6
19	20*	Sa faapipii e Atamu ana sitika i le siata lena. O fea o sitika o lo'o i le A4?	SG3.3 – K&SLO 6, 7 DA4.1 – K&SLO 4
20	15	O lē fea o ata o lo o i lalo e lē o se ata sa'o pe a faataamilo le ata o lo'o tuuina atu?	SG4.2 – K&SLO 8
21	16	Na tusi e Taniela le ata lea. E fia laina simeteri o le ata ?	SG3.2 – K&SLO 9, SG4.2 – K&SLO 8
22	18	E tolu apu na vaevae tutusa e tamaiti e to'aono. O le a le vaega a le tagata e to'atasi?	NR1.4 – K&SLO 1, 2; NR1.3 – K&SLO 8; NR4.3 – K&SLO 3 NR4.4 – K&SLO 1
23	2*	O fea o mea faitino nei e fua ai le umi?	MS2.1 – K&SLO 7 MS4.1 – K&SLO 11
24	6	E fia le eseesega o le tamaiitiiti umī ma le tamaitiiti pu'upu'u?	NR4.2 – K&SLO 1, MS4.1 – K&SLO 4
25	17	valu pepa ua fa'anumeraina … O lē fea o numera o lo o i lalo e lē mafai ona maua ?	NR4.5 – K&SLO 4
26	14*	6.87 e tutusa ma le	NR4.1 – K&SLO 6
27	13	Na gagau e Mari le pepa fa'a'afa ona tipi ese lea o le ata o le 'aū. Fea le ata pe a tatala le pepa?	SG4.2a – K&SLO 7
28	22*	fea le vili e tele le avanoa e tu ai ile lanu paepae	NR4.5 – K&SLO 5
29	1*	O lē fea o fuaiupu numera o i lalo o lo o fa'aali mai ai le aofa'i o vaiaso i le 14 aso?	NR4.3 – K&SLO 3, 5
30	24*	O le ata lenei na pu'e i le 5.15pm. O le fea o uati i lalo o lo'o ta'u mai ai le taimi na pu'e ai le ata?	MS2.5 – K&SLO 9; MS3.5 – K&SLO 1, 5; MS4.5 – K&SLO 2
31	3	O lē fea o siepi nei e i ai pea e lua o laina sasa'o tutusa?	SG4.2a – K&SLO 4
32	10*	Sa fai e Lake sana pateni o numera. Na amata lana pateni i le numera 5, ona fa'aopoopo tai 4 lea o numera agai i luma. O le fea o pateni o lo o i lalo o le pateni a Lake?	PA3.1a – K&SLO 1, 3; PA4.1a – K&SLO 1
33	23*	piki le pusa e tele ai le avanoa e maua ai le kuki mai ata e fa	NR4.5 – K&SLO 5
34	21*	E fia faamau e mo'omia i le pusa mulimuli o le pateni?	PA4.1a – K&SLO 1

Table 33: Ranked Year 4 Test 4 Items and Item Analysis Results

Rank	ITEM	SCORE	MAXSCORE	% Correct	ESTIMATE
1	34	0	372	0	
2	28	12	372	3	3.59
3	27*	28	372	8	3.07
4	29*	30	372	8	3.07
5	33	25	372	7	2.88
6	25*	177	372	48	2.85
7	31	33	372	9	2.60
8	30	41	372	11	2.37
9	4*	74	372	20	1.90
10	12*	130	372	35	1.86
11	5*	113	372	30	1.83
12	26*	139	372	37	1.55
13	11*	65	372	18	1.45
14	8*	112	372	30	1.42
15	32*	32	372	9	1.42
16	7	93	372	25	1.41
17	19*	148	372	40	1.33
18	9*	156	372	42	1.31
19	20*	228	372	61	1.16
20	15	116	372	31	1.11
21	16	120	372	32	1.06
22	18	125	372	34	1.00
23	2*	175	372	47	0.87
24	6	152	372	41	0.48
25	17	182	372	49	0.36
26	14*	91	372	25	0.32
27	13	190	372	51	0.28
28	22	264	372	71	0.24
29	1	217	372	58	0.24
30	24	121	372	33	0.18
31	3	213	372	57	0.02
32	10	59	372	16	–0.17
33	23	155	372	42	–0.32
34	21	197	372	53	–0.42

Table 34: Test 4 Cohort Most Difficult and Easiest Items

Item	Item Description - Most Difficult Item	Knowledge & Skills Learning Outcomes
34	 I le ata o numera o i luga, na kolosi e Kaino feta (factor) o le 16. Ona ia kolosi foi lea o feta o le 18 ma feta o le 20. O le a le aofa'i o numera ua kolosi ese?	NR4.3 – K&SLO 1-2 Zero score item
28	O le pepa memori o le mea pu'eata o lo o i talaane o le vase.  O le a le umī o le pepa memori i milimita?	MS3.1 – K&SLO 1 – 3 MS4.1 – K&SLO 4 Difficulty Estimate = 3.59 logits
Item	**Item Description – Easiest Item**	
21*	E fia faamau e mo'omia i le pusa mulimuli o le pateni? 	NR1.1 – K&SLO 1, 8, 10 Difficulty Estimate = –0.42 logit

Student Test 4 School Results

Provided in Table 35 are the relevant Test 4 statistics for each of the eight schools, and their respective mean difficulty and ability estimates. Ranking the Year 4 groups by their Test 4 mean group ability estimates (Figure 11) showed that STP PS (*n*=52) had the highest (0.62, SD 0.34 logits) with SPU PS (*n*=33) at the lowest (–0.33, SD 0.71 logits). In Figure 12 are the individual schools' item-person maps which visually display both the distribution of students and that of items on a common logit scale.

Table 35: School Student Test 4 Rasch Statistics

Primary School	Item Estimates (logits)			Case Estimates (logits)		
	Number	Mean	Std Dev	Number	Mean	Std Dev
LOT	34	1.16	0.95	30	0.02	0.31
STM	34	1.17	1.07	75	0.45	0.38
VAM	34	1.27	0.99	68	0.03	0.73
FLS	34	1.19	0.95	59	0.52	0.45
SLV	34	1.10	0.87	31	0.43	0.74
STP	34	1.32	1.22	52	0.62	0.34
SPU	34	0.86	0.98	33	-0.33	0.71
MAN	34	1.24	1.04	24	0.60	0.34

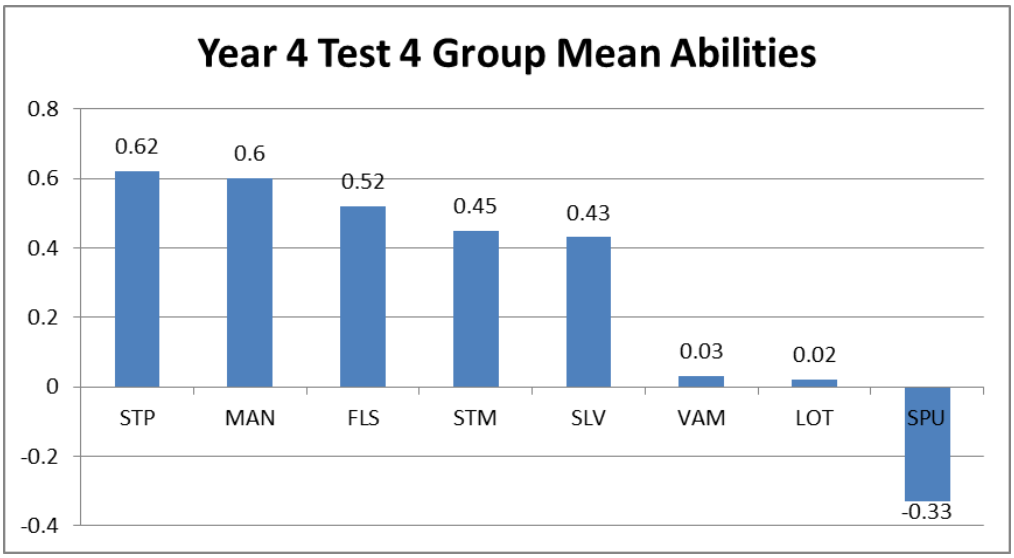


Figure 11: School Year 4 Test 4 Group Mean Ability Estimates

Year 4 Students' Level of Achievement and Performance

Students' Test 4 ranked ability estimates by school, including percentage correct out of a total possible score of 33, z-scores, percentile rankings, and stanine scores are provided in Appendix D Table T4.1. Z-scores are case ability estimates normalised in terms of number of standard deviations (0.56 logits) each ability estimate is from the mean ability (0.31 logit).[6]

[6] Rasch analysis to determine performance levels recoded blank responses as incorrect responses.

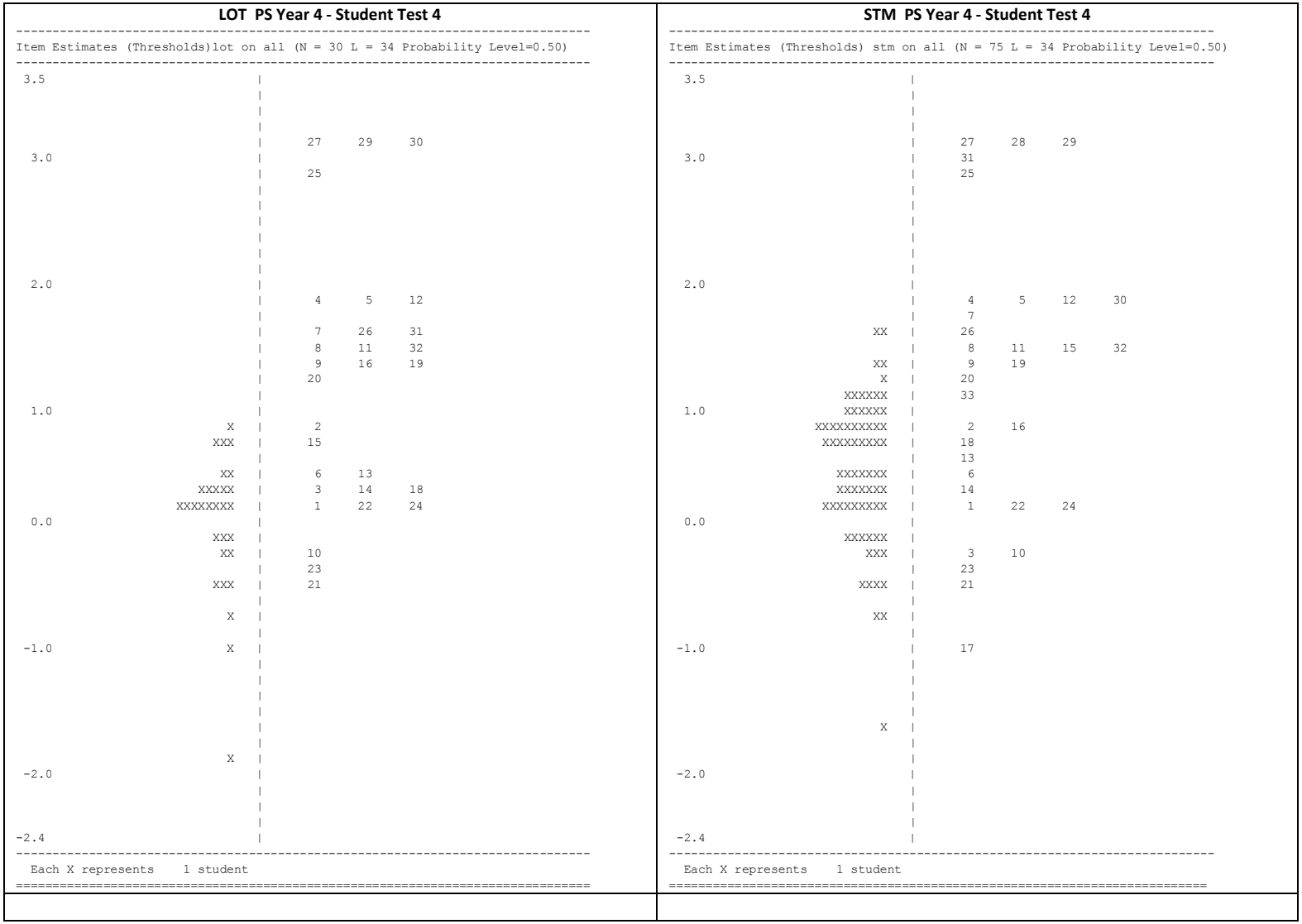


Figure 12: Schools' Year 4 Test 4 Item-Person Maps

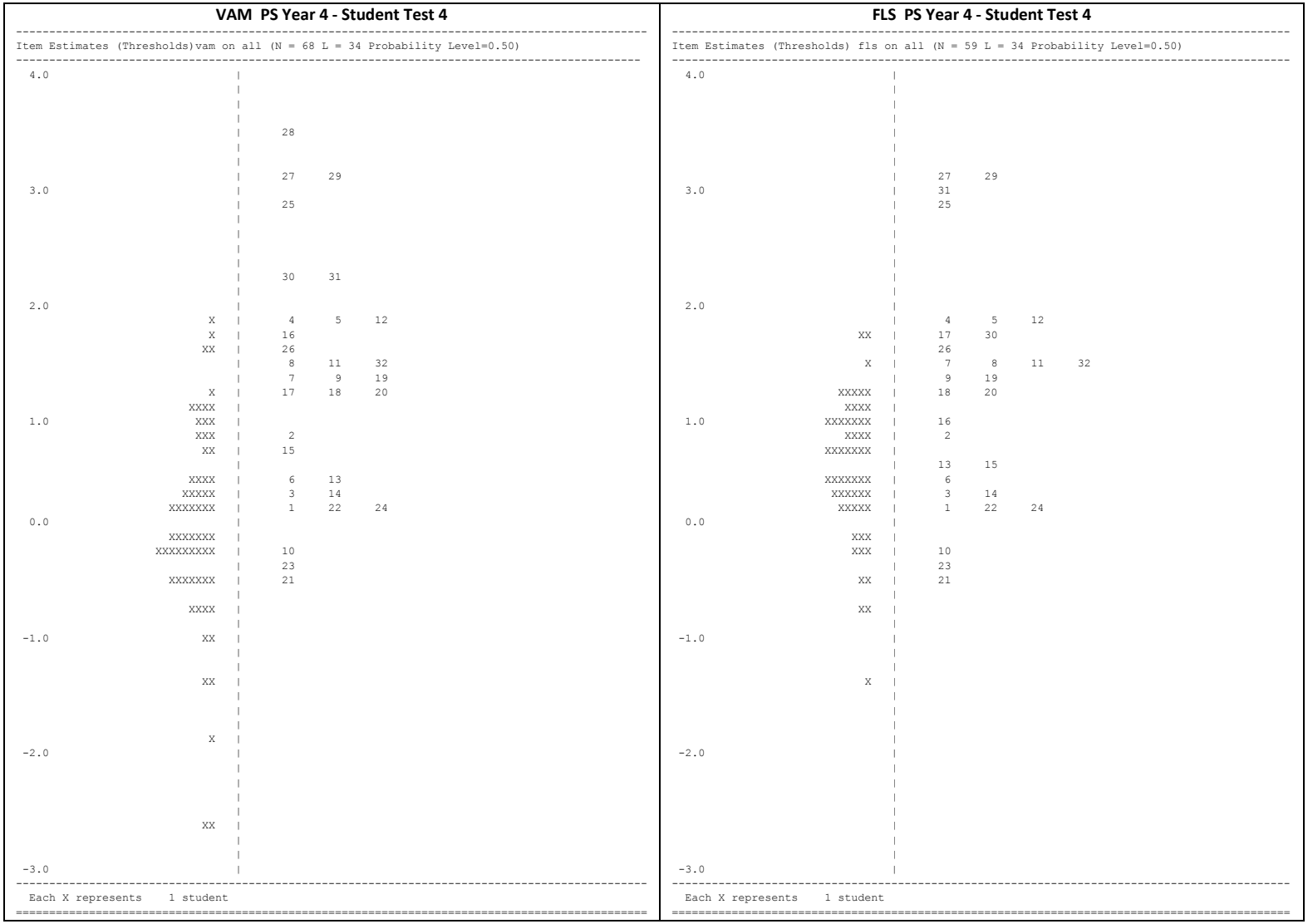


Figure 12: Schools' Year 4 Test 4 Item-Person Maps

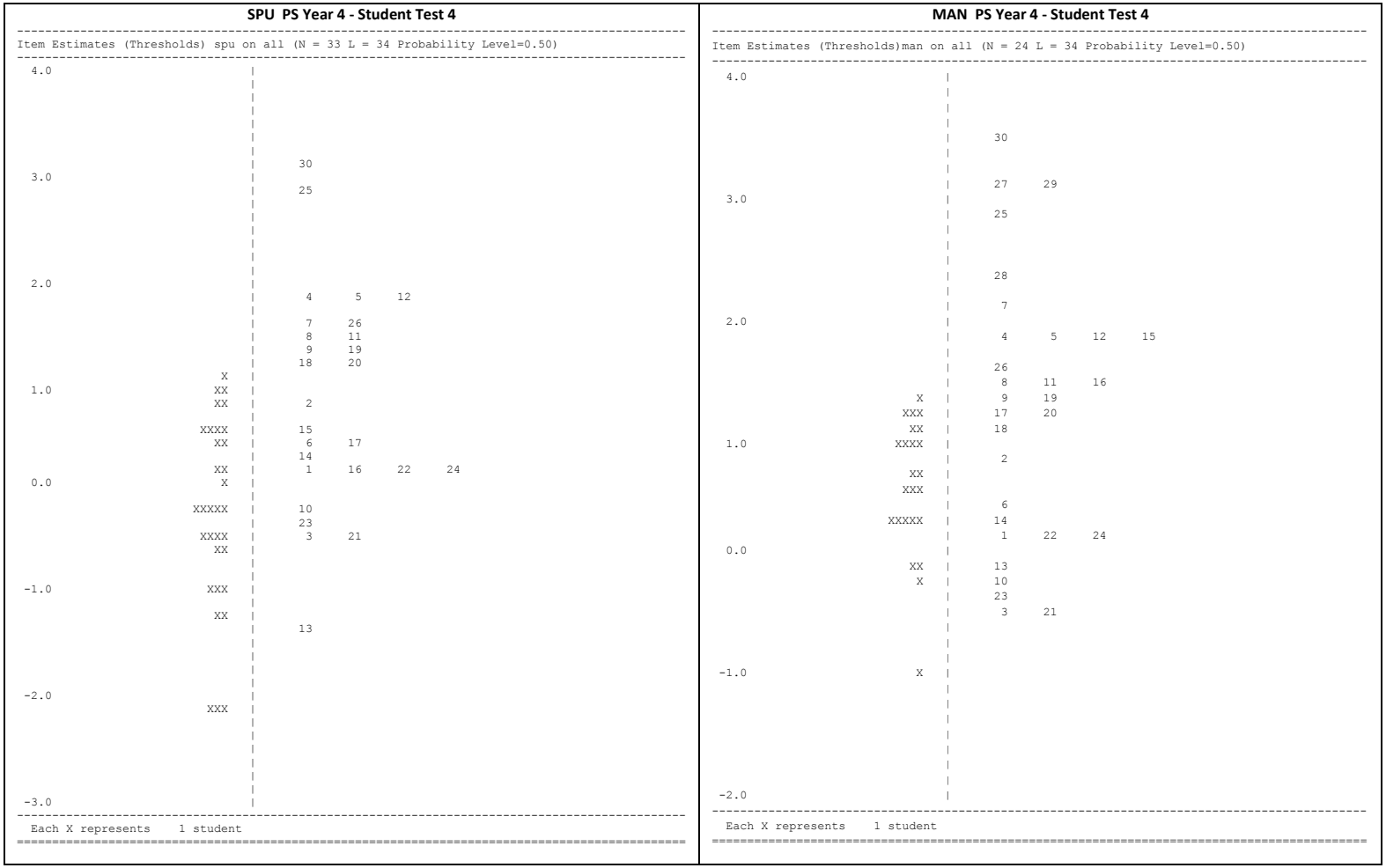


Figure 12: Schools' Year 4 Test 4 Item-Person Maps

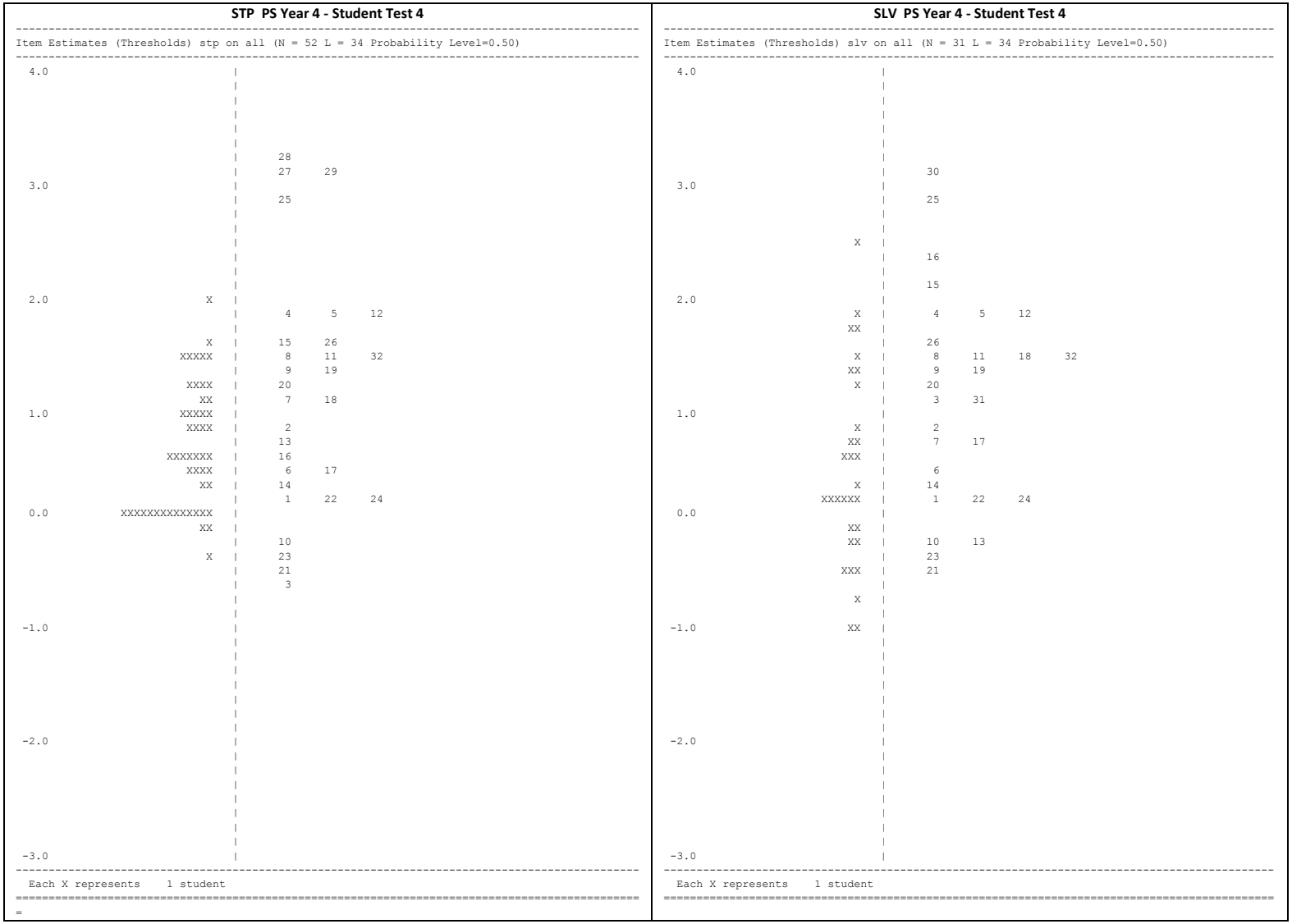


Figure 12: Schools' Year 4 Test 4 Item-Person Maps

Also provided are stanine scores and performance levels. While the performance level is a general descriptor of an individual's performance relative to the cohort, the achievement level indicates proficiency (or mastery) of the Year Level's prescribed achievement standards as measured by the test or whether the student is 'at-risk'. Provided in Table 36 is the distribution of students across the achievement and performance levels for each school.

Table 36: School Distribution of Achievement and Performance Levels

Year 4	Achievement Levels					Performance Levels					Total
School	Proficient	At Risk Level 1	At Risk Level 2	At Risk Level 3	At Risk Level 4	Very High	Above Average	Average	Below Average	Very Low	
LOT	0	0	1	26	3	0	1	22	6	1	30
STM	0	0	27	45	3	3	21	42	8	1	75
VAM	0	1	11	37	19	4	8	24	24	8	68
FLS	0	0	19	35	5	2	16	33	7	1	59
SLV	0	1	7	17	6	4	4	14	9	0	31
STP	0	1	17	34	0	2	13	34	3	0	52
SPU	0	0	3	20	10	0	3	14	12	4	33
MAN	0	0	6	17	1	0	4	18	2		24
Total Number	0	3	91	231	47	**15**	**70**	**201**	**71**	**15**	**372**
Percentage N=372	0	1	24	62	13	**4**	**19**	**54**	**19**	**4**	**100**

The results show that none (0%) of the students of the Year 4 cohort achieved the Proficient Achievement Level with the students all distributed across the four At Risk Achievement Levels. For example, 1% of the students were at At Risk Level 1, 24% at At Risk Level 2, 62% at At Risk Level 3 and 13% at At Risk Level 4. In terms of individual performance relative to the rest of the cohort, 4% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 19% and 4% of the students were classified to be at the Below Average and Very Low Levels.

Whereas the performance levels are norm-referenced, the achievement levels indicate whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 4.

Year 4 Benchmark Descriptions

Provided in Table 37 are the benchmark descriptions for Year 4 based on the achievement results of the Year 4 students in Test 4. Conceptually, students located at an achievement level should have the capacity to successfully complete those items located in the lower achievement levels.

Year 4 Students' Most Common Errors

Students' common errors are those choices (including blank responses) that had the two highest error rates according to the item analysis data for each of the 33 items. The results are presented in Table 38. The results show that errors with at least 40% include those about conducting simple chance experiments to inform discussions about the likelihood of outcomes; using coordinates to describe position on grid maps, using mental strategies to divide multiplication facts (up to 12 × 12) by a one digit number; grouping 2D shapes using multiple attributes; continuing an increasing geometric pattern; making tessellating designs by flipping, translating and rotating a 2D shape; predicting and recording all possible

outcomes of a simple experiment; continuing an increasing number pattern; interpreting information given in simple tables; identifying devices for measuring length; computing with information given in simple tables; and identifying the fraction (eighths) of a shape that is shaded.

Table 37: Year 4 Benchmark Descriptions by Proficient and At Risk Levels

Benchmark and Range	Item Numbers and Descriptions	Benchmark Description
Proficient (at least 80%)	**Item 28**. O le memori card o lo o I talane o le vase. O le a le umi o le memory card i milimita?	Students are able to estimate, measure, compare and record lengths using centimeter or millimetres.
At Risk **Level 1** **(60 up to <80)%**	**Item 25**. O le a le numera e sosoo o le pateni 109, 119, 129, 139, …? **Item 27**. O le kalafi o lo o I lalo …. E to'afia tamaiti e fiafia I le netipolo po'o le hoki? **Item 29**. E lua numera o lo o misi I le seti...O a numera o lo o misi? **Item 33**. I le ata o numera o I luga, na kolosi e Kaino …. O le a le aofai o numera ua kolosi ese?	Students are able to continue, create and describe a number pattern that increases; identify patterns when counting forward by tens; interpret information presented in graphs and pictures; complete number sentences involving two operations by calculating missing values; and determine factors for given numbers.
At-Risk **Level 2** **(40- up to<60%**	**Item 4.** O le fea o galuega nei e sa'o? **Item 5**. O le tau o le avoka e $1.49. E fia avoka e maua I le $5? **Item 7.** O le numera laina lenei. O le fea o mataitusi o lo o faasino i le $\frac{7}{8}$? **Item 8.** Ole a le perimita o le siepi o lo o I luga? **Item 11**. E fa siepi valivali o lo o I lalo. O fea le siepi e …. e le 12 unit ^{2} ? **Item 12**. O pepa numera nei o le a fuli …. O le a se avanoa e sau ai le pepa o se numera le soagia? **Item 26**. Tusi le tali sa'o I le pusa. 54 – 17 = **Item 30**. Tusi le tali sa'o I le pusa. 17*80= **Item 31**. Taga'I I le ata o le kone. O fea o ata nei e tutusa ma foliga o le pito I luga o le kone? **Item 32.** O lo o tu le taavale a Bob I talane … O le a le umi o va o nuu o Eta ma Kana?	Students are able to use the symbols <, or > to show relationships between given numbers; multiply and divide decimals with the same number of decimal places (2dp); model, compare and represent simple fractions with denominators 2,4,8 and locate them on the number line; estimate and measure the perimeter of 2-D shapes; estimate, measure and compare areas in unit square; conduct experiment and estimate the likelihood of outcomes and use language of chance in everyday contexts; compute number sentences involving one operation and two 2-digit numbers; use mental strategies to multiply two 2-digit numbers and use multiplication facts; sketch views of 3D objects from the top, front and side; and estimate, measure, compare and compute distances using metres.

Table 37*:* **Year 4 Benchmark Descriptions by Proficient and At Risk Levels** *continued*

At-Risk **Level 3** **(20 up to <40)%**	**Item 1**. O le vaiaso e 7 ona aso …. E fia le aofai o vaiaso I le 14 aso? **Item 2**. O fea o meafaitino nei e fua ai le umi? **Item 3**. O le fea o siepi nei e I ai pea e lua o laina sasa'o tutusa? **Item 6**. E fia le eseesega o le tamaiti umi ma le tamaiti puupuu? **Item 9**. O le siata I lalo o lo o ta'u mai ai ….E fia e tele ai ata a Mane nai lo Kimi? **Item 13**. Na gagau e Mari le pepa ……O le fea o ata e maua pe a tatala le pepa? **Item 14**. 6.87 e tutusa ma le …. **Item 15**. Na tusi e Tora le ata o le siepi …. O le fea o ata I lalo e le se ata sa'o? **Item 16.** Na tusi e Taniela le ata lea. E fia laina simeteri o le ata? **Item 17.**E valu pepa ua faanumeraina …. ona piki mai lea o pepa e lua …. **Item 18.** E 3 apu na vaevae tutusa e tamaiti e toaono. O le a le vaega a le tagata e toatasi? **Item 19**. O le a le vaegamea o le siepi o lo o valivaliina? (⅜) **Item 20**. Sa faapipii e Atamu ana sitika …. O fea o sitika o lo o I le A4? **Item 22**. O fea o vili nei e tele se avanoa e tu ai I le lanu paepae? **Item 24**. O le ata lenei na pu'e I le 5.15pm. O le fea o uati o lo o ta'u mai ai le taimi na pu'e ai le ata?	Students are able to use mental strategies to divide by one digit number multiplication facts up to 12 × 12 and record answer to division problems to show connection with multiplication; identify the appropriate measuring device for length; identify and describe 2D shapes using multiple attributes; interpret and compute with quantitative information presented in a display; interpret and compute information presented in simple tables; make tessellating designs by reflecting (flipping), translating and rotating a 2D figure; state the place value of digits in numbers with up to 2 decimal places; manipulate, translate and rotate a 2D shape; identify lines of symmetry for a given shape; predict and record all possible combinations of a simple experiment; share objects equally including those resulting in fractional equal shares; model, compare and represent simple fractions including those with denominators 3 and 6; use coordinates on simple maps to describe position; conduct simple experiments to inform discussions about the likelihood of outcomes; and relate analogue notation to digital notation of time.
At Risk **Level 4** **(0 up to <20)%**	**Item 10**. Sa fai e Lake sana pateni o numera, amata i le 5 ona faaopoopo tai 4 agai I luma. O le fea o pateni o le pateni a Lake? **Item 21**. O ata nei o le pateni a Pele.E fia faamau e moomia I le pusa mulimuli o le pateni? **Item 23**. Sa piki e Sione se siepi mai pusa nei. O fea o pusa nei e tele se avanoa e pikiina ai se kuki?	Students are able to identify, describe and continue patterns when counting forward by twos up to fours, sixes and sevens; extend an increasing geometric pattern given the first four terms; and predict and describe the likelihood of outcomes of a simple experiment.

Table 38: Test 4 Items' Two Most Common Errors

Rank	ITEM	Item Description	Correct Answer (%)	Most Common Error	Second Most Common Error
1	28	O le pepa memori o le mea pu'eata o lo o i talaane o le vase. O le a le umī o le pepa memori i milimita?	25 mm (3%)	Open response	
2	27*	O le kalafi o lo o i lalo o lo o fa'ailoa mai ai ta'aloga e fiafia i ai tamaiti. E to'afia tamaiti e fiafia i le Netipolo po o le Hoki?	11 (8%)	Open response	
3	29*	E lua numera o lo o misi i le seti o numera o lo o i lalo, ma o lo o fa'ailoa mai ele fa'ailoga**?**	7 and 7 (8%)	Open response	
4	33	O le a le aofa'i o numera (feta) ua kolosi ese?	12 (7%)	Open response	
5	25*	o le a le numera e sosoo I le pateni 109, 119, 129, 139,	149 (48%)	Open response	
6	31	siepi pe vaai mai I luga o le koge tusa'o ile pito maai	Li'o lapotopoto (9%)	Open response	
7	30	17 × 8 = 136, o le a la le 17 × 80 = ?	1360 (11%)	Open response	
8	4*	O lē fea o galuega nei e sa'o?	18 ÷2<13 (20%)	$10+4^2$ <20 (43%)	16–8>15 (18%)
9	12*	O le a le avanoa e sau ai lea pepa o se numera lē soagia?	Tele le avanoa (35%)	Laitiiti le avanoa (21%)	E le mafai (19%)
10	5*	O le tau o le avoka i le maketi e $1.49. E fia ni avoka e maua i le $5.00?	3 (30%)	4 (42%)	2 (15%)
11	26*	54 - 17 =	37 (37%)	Open reponse	
12	11*	E fa siepi valivali o lo o i lalo. O fea le siepi valivali o lona eria (area) e lē 12 $unit^2$?	Lona fa (18%)	Lona lua (40%)	Muamua (22%)
13	8*	O le a le perimita o le siepi o lo o i luga?	58 (30%)	50 (28%)	48 (22%)
14	32*	O lo o tu le ta'avale a Bob i talane o le fa'ailoilo lenei o nu'u o Eta ma Kana. O le a le umi o le va o nu'u nei o Eta ma Kana?	87 km (9%)	Open reponse	
15	7	O le laina numera lenei. O lē fea o mata'itusi o lo o fa'asino i le 7/8?	D (25%)	B (37%)	C (23%)
16	19*	O le a le vaegamea o le siepi o lo o valivaliina?	⅜ (40%)	⅗ (24%)	¾ (14%)
17	9*	E fia e tele ai ata a Mane nai lo Kimi?	4 (42%)	3 (23%)	1 (19%)
18	20*	Sa faapipii e Atamu ana sitika i le siata lena. O fea o sitika o lo'o i le A4?	Face (61%)	Star (14%)	Sun (11%)
19	15	O lē fea o ata o lo o i lalo e lē o se ata sa'o pe a faataamilo le ata o lo'o tuuina atu?	Lona fa (31%)	Lona lua (24%)	Lona tolu (23%)
20	16	Na tusi e Taniela le ata lea. E fia laina simeteri o le ata ?	2 (32%)	4 (45%)	1 (17%)
21	18	E tolu apu na vaevae tutusa e tamaiti e to'aono. O le a le vaega a le tagata e to'atasi?	½ (34%)	⅙ (31%)	⅓ (25%)
22	2*	O fea o mea faitino nei e fua ai le umi?	Fuatoso (47%)	Uati (18%)	Fua paleni (17%)
23	6	E fia le eseesega o le tamaiitiiti umī ma le tamaitiiti pu'upu'u?	24 (41%)	18 (20%)	20 (19%)
24	17	valu pepa ua fa'anumeraina … O lē fea o numera o lo o i lalo e lē mafai ona maua ?	25 (49%)	65 (25%)	16 (19%)
25	14*	6.87 e tutusa ma le	6 + 0.8 + 0.07 (25%)	6 + 0.8 + 0.7 (29%)	0.6 + 0.8 + 0.7 (23%)
26	13	Na gagau e Mari le pepa fa'a'afa ona tipi ese lea o le ata o le 'aū. Fea le ata pe a tatala le pepa?	Lona fa (51%)	Muamua (16%)	Lona tolu (16%)
27	22	fea le vili e tele le avanoa e tu ai ile lanu paepae	Afa (71%)	Tasi vaetolu (13%)	Tolu vaevalu (7%)
Olu (16%)28	1	O lē fea o fuaiupu numera o i lalo o lo o fa'aali mai ai le aofa'i o vaiaso i le 14 aso?	14÷7= 2 (58%)	14+3=17 (19%)	14-3=11 (8%)
29	24	O le ata lenei na pu'e i le 5.15pm. O le fea o uati i lalo o lo'o ta'u mai ai le taimi na pu'e ai le ata?	Lona tolu (33%)	Muamua (28%)	Lona lua (23%)
30	3	O lē fea o siepi nei e i ai pea e lua o laina sasa'o tutusa?	Tafafa (57%)	Tafatolu (21%)	Li'o (12%)
31	10	Sa fai e Lake sana pateni o numera. Na amata lana pateni i le numera 5, ona fa'aopoopo tai 4 lea o numera agai i luma. O le fea o pateni o lo o i lalo o le pateni a Lake?	5, 9, 13, 17,… (16%)	5, 4, 3, 2, … (41%)	5, 6, 7, 8. … (19%)
32	23	piki le pusa e tele ai le avanoa e maua ai le kuki mai ata e fa	Fa kuki (42%)	Tolu kuki (26%)	Lua kuki (22%)
33	21	E fia faamau e mo'omia i le pusa mulimuli o le pateni?	10 (53%)	16 (18%)	12 (15%)

Test Equating on the Four Linked Tests

Theoretically, at the cohort level, it is expected that the four linked tests would show a monotonic increase of both item and case mean estimates from Years 1 to 4 given that numeracy and mathematics standards (knowledge and skills) become increasingly more complex as students progress vertically through the primary levels. Provided in Figure 13 is a graph showing the trends for both item mean difficulty and case mean ability estimates from Tests 1 to 4. In particular, for mean item difficulties the difficulty means increase (with the exception of Test 2 [T2]), as expected, as level increases. The deviant Test 2 mean is due to the high number of common items (i.e. 30 out of 34) between Tests 2 and 1 in which the Test 2 response analysis used 30 anchored Test 1 estimates consequently making Test 2, on average, relatively easier for Year 2 students than Test 1 was for the Year 1 students. In comparison, the case mean difficulty estimate graph shows a monotonic increase for the first three tests and displaying a decrease in mean ability for Test 4. Also note that for each test (with the exception of Test 2) the mean ability estimate is usually lower than the mean difficulty estimate. These gaps (between each test's difficulty and ability mean estimates) indicate quantitatively the misalignment between students' achievement of their Year Level standards, as measured by their ability to answer correctly the test items, and their Year Level standards as sampled by the test items. For Test 1, the gap is statistically highly significant (t = 3.1525, df = 386, p = 0.001) with a moderate practical difference (effect size Cohen's d = 0.50) whist it was statistically insignificant (t = 0.9824, df = 404, p = 0.33) and a small practical difference for Test 2 (effect size Cohen's d = 0.18). However for Tests 3 and 4, the gaps were highly significant (t = 4.3716, df = 372, p = 0.00 and t = 8.6677, df = 403, p = 0.00, respectively) and large to very large practical differences (effect size Cohen's d = 0.80 and d = 1.58, respectively).

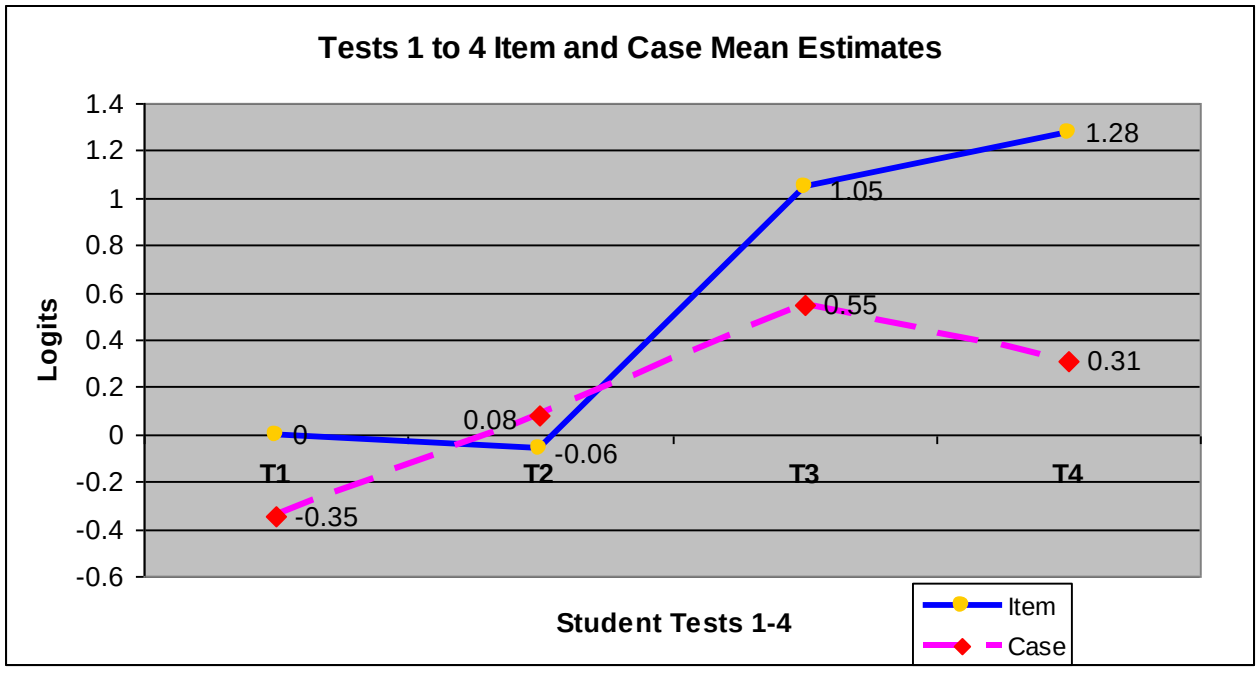


Figure 13: Tests 1 to 4 Item and Case Mean Estimates

Theoretically, it is expected that, within schools, Years 1 to 4 group mean ability estimates should be monotonically increasing and ranked in the order: Years 1, 2, 3 and 4. Presented below in Figure 14 are graphs of each of the eight schools displaying mean abilities for Tests 1 to 4. While two schools (FLS and

SLV) demonstrated this monotonic increase from Years 1 to 4, of interest are the deviations from the expected within-school trend. The first type includes deviations displayed at Year 2 such as those presented by two schools, namely, LOT PS and STP PS. Whereas Year 2 at LOT PS demonstrated the school's best average of all the four years, Year 2 at STP PS demonstrated the lowest school average of all four Year Levels. The second type involves significant deviations occurring at Year 4 such as those of three schools, namely, STM, VAM and SPU PSs. The third type includes MAN PS which showed a significant drop in achievement, on average, at both Years 2 and 4 levels.

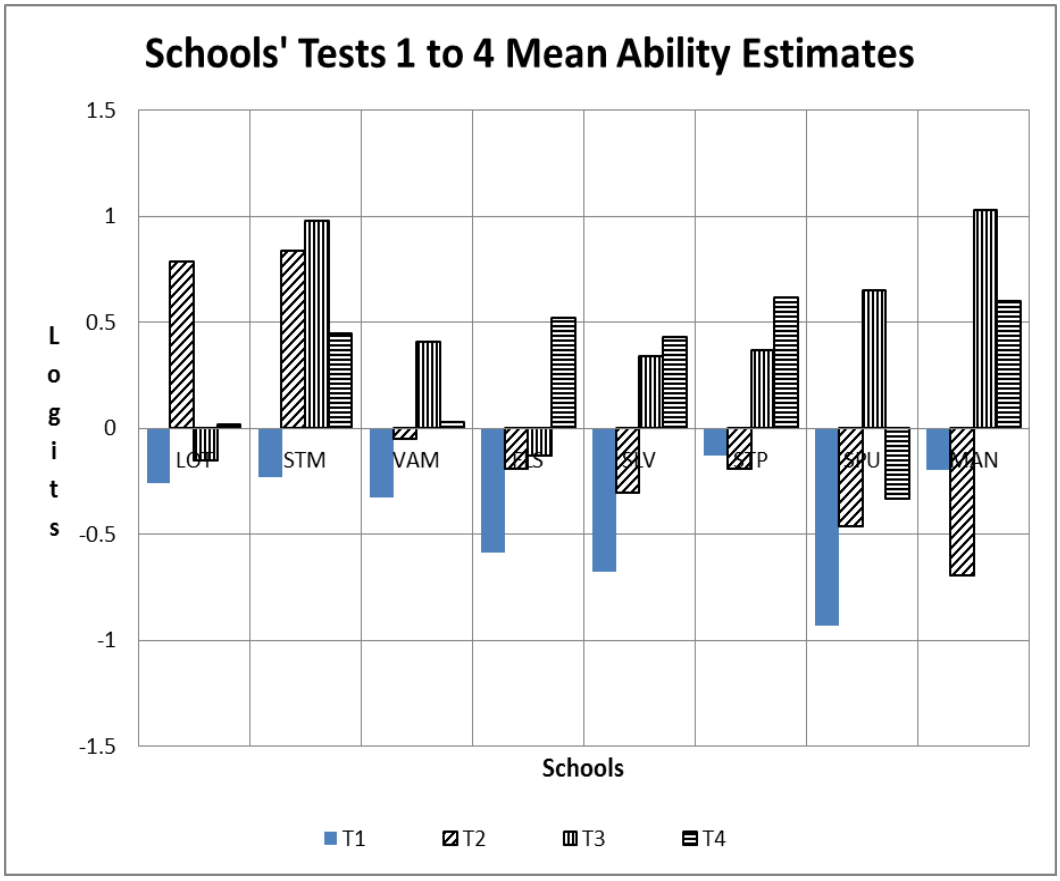


Figure 14: Schools' Mean Ability Estimates from Years 1 to 4

When all Year Levels are ranked by group mean ability estimates the results are as shown in Figure 15. Note that it is theoretically expected that the rankings will be Year 4 groups followed by Year 3 then Year 2 and lastly Year 1 groups. However, as the evidence shows the actual order based on empirical evidence is not as expected.

Also provided in Figure 16 is a summary of the distributions of students across each achievement level with the actual percentages as listed in Table 12, Table 20, Table 28, and Table 36 for each of the four Year Levels respectively.

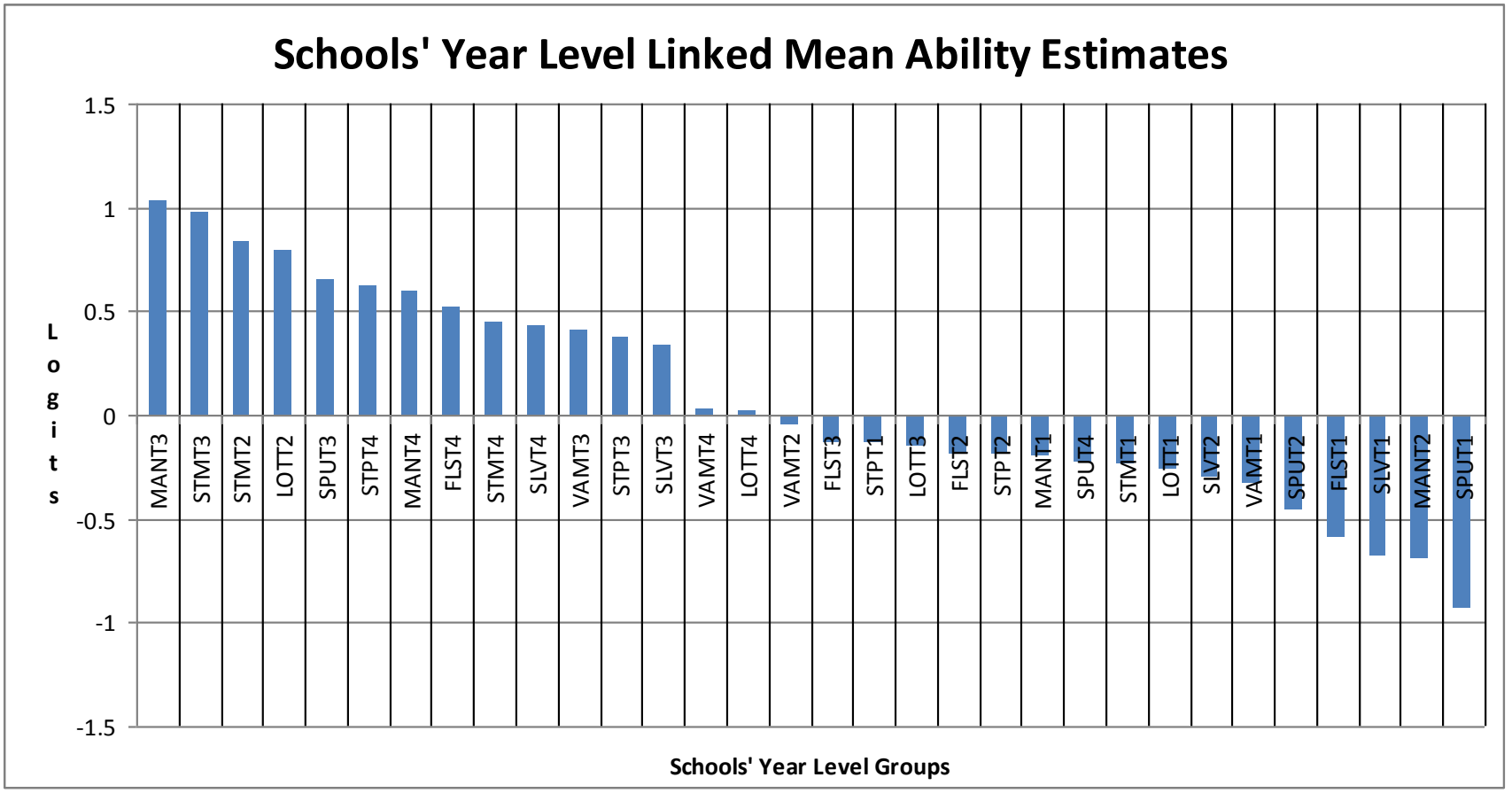


Figure 15: Linked Tests 1 to 4 Ranked by Group Mean Ability Estimates

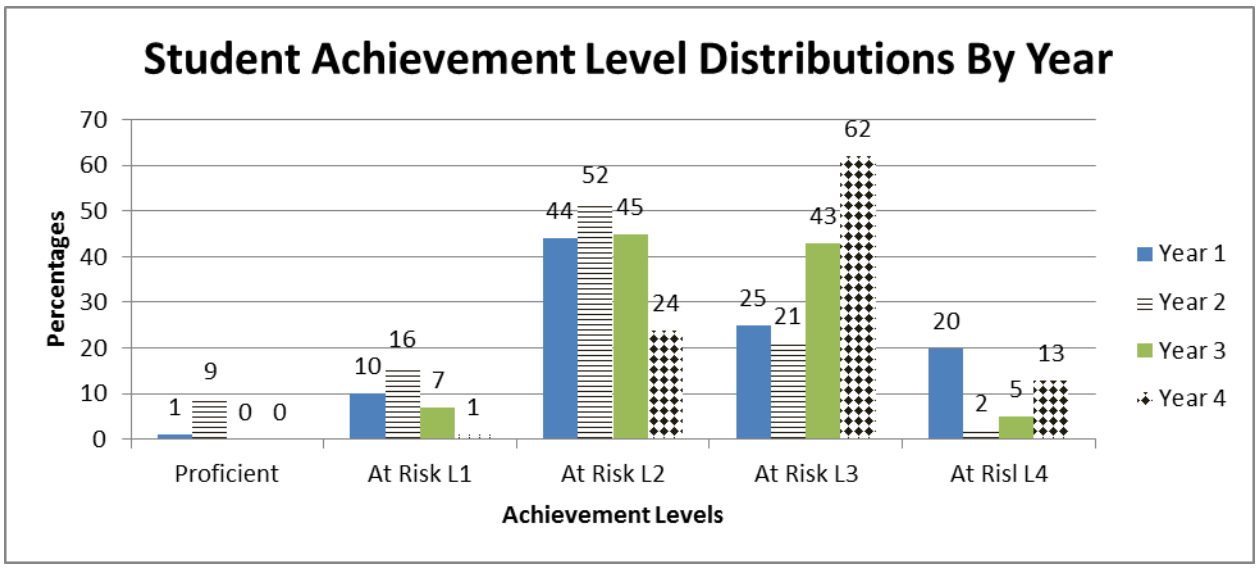


Figure 16: Cohort Achievement Levels

Student Questionnaires

A total of 1251 Years 1 to 4 student answered the student questionnaires. The following sections present the results of students' attitudes towards mathematics, students' classroom practices in mathematics lessons, students' home activities, and students' home environments and practices.

Mathematics Attitudes

The particular item in the questionnaire that specifically assessed students' attitudes towards mathematics was Question 7 with its 14 stems. The attitude stems/items used a 4-point Likert scale with response categories ranging from *Lagolago tele*, *Lagolago laitiiti*, *Tetee laitiiti*, to *Tetee tele*. Student responses were coded 1 to 4 (as on the questionnaire) depending on whether they responded: *Lagolago tele*, *Lagolago laitiiti*, *Tetee laitiiti*, or *Tetee tele*. However, to reflect an increasingly positive attitude towards mathematics from 1 to 4, for positively worded statements (e.g. Items 1. 2, 4, 6, 8-12, and 14), the codes were reversed during the analysis so that *Lagolago tele* was recoded 4, *Lagolago Laitiiti* 3, *Tetee Laitiiti* 2, and *Tetee Tele* 1. The responses were then analysed using the Partial Credit Rasch Model (PCRM) (Adams & Khoo, 1996; Rasch, 1980). Consequently, the Rasch analysis results presented in this section, provided estimates of Years 1 to 4 students' attitudes towards mathematics based on their endorsement of response categories of the questionnaire attitudinal items/stems.

For the rating scale data from *Tetee Tele* (coded 1) to *Lagolago tele* (coded 4) for each item/stem in the questionnaire, not only does the analysis provide an item attitudinal estimate for each Likert stem, but it also provides a set of estimates for the four thresholds to mark the boundaries between the four Likert response categories. The item and its threshold estimates indicated the extent of students' endorsement of the attitudinal item stem. The Rasch model theorises that each item reflects a different level of the latent trait being investigated (Bond & Fox, 2001). The case estimates on the other hand, indicated the extent of students' mathematical attitudes at the time of the study. That is, the person's attitudinal estimate "represents the magnitude of *latent trait* of the individual, which is the human capacity or attribute measured by the (questionnaire)" (Lazarsfeld & Henry, 1968); in this case, students' attitudes towards mathematics. Provided in

Table 39 are the Rasch statistics from the subsequent analysis of student responses using the QUEST software. Part (a) of Table 39 shows the results of the initial Rasch analysis of students' attitudinal responses from those in the cohort that completed the questionnaires.

Fit of Data to the Model

Person Fit to the Model –The initial results showed a person infit ms value of 0.98 logit (SD 0.81 logits), see Table 39a. However, a closer inspection of all cases' infit values showed that 509 cases fall outside of the acceptable range of infit ms values of 0.50 to 1.50. The deleted cases also included the original 66 cases with perfect scores. Hence a second analysis followed which resulted in the statistics shown in Table 39b. It is noted that all 742 cases' infit ms value fall within the acceptable range and that the new mean infit ms value (0.97, SD 0.45) is closer to the expected mean value of 1.00 logit.

Item Fit to the Model – An items' mean infit ms value of 0.96 (SD 0.24 also around the expected mean value of 1.00) was also produced by the second Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50. None of the items had zero or perfect scores.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Mathematics Attitudes Items' Reliability Indices and Mean Estimates

From the second Rasch analysis of students' attitude responses, the person reliability index of the instrument (i.e., 0.61) was average with its traditional Cronbach's alpha value of 0.69 closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the attitudinal items, see Table 39

The item reliability index of the questionnaire attitudinal items (i.e. 0.95) was relatively higher (than the 0.61 person reliability index) indicating that the 14 items were more than reliably and sufficiently separated by the 742 cases into a hierarchical order along the logit continuum than the 742 cases were by the 14 items as noted by the gaps of item response categories around the locations of the case estimates at the top end around 2 logits, see Figure 17.

The mean endorsement estimate of attitudinal item stems was set at 0.00. The subsequent calibrations of person attitudinal estimates resulted in a mean case attitudinal estimate of 0.49 logit (SD 0.41), which was slightly higher than the zero mean item difficulty to endorse estimate. The difference between the attitudinal item and case mean estimates indicate that, on average, the cohort mean estimate is on the positive side by approximately a 0.5 logit. Statistically, this difference (or mismatch between mean case attitudinal and mean endorsement estimates) is statistically significant (t = 4.3455, df = 754, p = 0.00) with Cohen's effect size value (d = 1.17) suggesting a very large practical difference. This statistically significant and practically very large difference also suggests that the cohort's attitude to mathematics was, on average, positive.

Student Mathematics Attitude Item-Person Maps

With the attitudinal Rasch statistics provided in Table 39, Figure 17 shows the attitudinal cohort item-person map. The map displayed item threshold estimates, denoted by item number and response category, i.e. 3.4 in Figure 17, on the right of the vertical logit continuum, towards the top are the hardest-to-endorse item response categories denoting very positive attitudes while those relatively easiest-to-endorse item response categories describing negative attitudes are towards the bottom.

Table 39: Cohort Mathematics Attitudes Rasch Statistics

a. Initial Analysis

```
Mathematics Attitude
-----------------------------------------------
Item Estimates (Thresholds) all on all (N =
1251 L = 14 Prob Level=0.50)
-----------------------------------------------
Summary of item Estimates
=========================
Mean                          -0.01
SD                             0.25
SD (adjusted)                  0.20
Reliability of estimate        0.63

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    0.95             Mean    1.14
    SD      0.28             SD      0.58
      Infit t                  Outfit t
    Mean   -1.31             Mean    1.43
    SD      6.72             SD      8.58

   0 items with zero scores
   0 items with perfect scores
===============================================
```

```
  Mathematics Attitude
-----------------------------------------------
Case Estimates all on all (N = 1251 L = 14
Prob Level=0.50)
-----------------------------------------------
Summary of case Estimates
=========================
Mean                          -0.74
SD                             5.32
SD (adjusted)                  5.30
Reliability of estimate        1.00

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    0.98             Mean    1.13
    SD      0.81             SD      1.36
      Infit t                  Outfit t
    Mean   -0.26             Mean   -0.11
    SD      1.85             SD      1.70

   0 cases with zero scores
  66 cases with perfect scores
===============================================
```

Cronbach Alpha 0.75

b. Second Analysis

```
Mathematics Attitude
-----------------------------------------------
Item Estimates (Thresholds) all on all (N =
742 L = 14 Probability Level=0.50)
-----------------------------------------------
Summary of item Estimates
=========================
Mean                           0.00
SD                             0.76
SD (adjusted)                  0.74
Reliability of estimate        0.95

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    0.96             Mean    1.06
    SD      0.24             SD      0.49
       Infit t                  Outfit t
    Mean   -0.55             Mean    0.51
    SD      4.55             SD      5.46

   0 items with zero scores
   0 items with perfect scores
===============================================
```

```
  Mathematics Attitude
-----------------------------------------------
Case Estimates all on all (N = 742 L = 14
Probability Level=0.50)
-----------------------------------------------
Summary of case Estimates
=========================
Mean                           0.49
SD                             0.53
SD (adjusted)                  0.41
Reliability of estimate        0.61

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    0.97             Mean    1.07
    SD      0.45             SD      0.83
       Infit t                  Outfit t
    Mean   -0.03             Mean    0.10
    SD      1.03             SD      1.09

   0 cases with zero scores
   0 cases with perfect scores
===============================================
```

Cronbach Alpha 0.69

To the left of the same vertical logit scale is the distribution of cases, denoted by X to represent 9 students, indicating the location of persons' attitudinal estimates from those with positive attitudes

towards the top and those with relatively negative attitudinal estimates towards the bottom. Three item response categories (i.e. Item 3.4, 5.4, and 13.4) representing positive attitudes and the hardest-to-endorse item response categories, were located around 2 logits, within ability bands of the top two students whereas ten easiest-to-endorse item response categories (Items 1.2, 6.2, 8.2, 11.2, 14.2, 4.2, 9.2, 12.2, 2.2, and 10.2) were located around -1.0 logits, below the lowest case estimate (approximately –0.80 logit). Furthermore, there were no cases at the lower extreme end of the logit continuum to match the easiest to endorse item response categories as illustrated on the item-person map in Figure 17. However, at the top end, there were only three items across from the top two case estimates.

The distribution of attitudinal estimates in item-person map is centrally located around its case mean (at 0.49 logit) estimate and it further corroborates that the cohort's mathematics attitudes was, on average, slightly positive. The range of case attitudinal estimates is from –2.32 to 2.46 logits, approximately an interval of 4.78 logits with the median person attitudinal estimate at 0.59 logit, see Appendix E Table E1. The ranked person attitudinal estimates showed eighty four students (11%) with ability estimates at or above 1 logit whereas at the lower end 112 students (15%) had attitudinal estimate located below zero logit with the ten easiest-to-endorse item response categories located further down (from Item 1.2 [–0.80] down to Item 10.2 [–1.22] logits). The middle 50% of the person distribution lie between 0.16 (lower quartile) and 0.69 logit (upper quartile), a case interquartile range of approximately 0.53 logit, as graphically displayed by the Cohort Mathematics Attitude item-person map in Figure 17. The median item response category is Item 1.4 (–0.02 logit) with upper and lower quartiles at item response categories Item 3.2 (0.63 logit) and Item 1.2 (–0.80 logit) respectively, an item interquartile range of 1.43 logit. Item threshold attitudinal estimates for each of the 14 Likert stems are provided in Appendix E Table E2.

Item Analysis of Attitudinal Items

Displayed in Table 40A is the list of the 14 attitudinal item stems organized into positively and negatively worded statements and percentage of the cohort (*n*=742) who endorsed each response category. For example, for the first positively worded item, Item 1, 8% endorsed *Tetee* tele, 9% endorsed *Tetee laitiiti*, 13% endorsed *Lagolago laitiiti* and 70% endorsed *Lagolago tele* (also the highest percentage of the item). With the negatively worded stem, Item 3, 5% endorsed *Lagolago tele,* 21% endorsed *Lagolago laitiiti,* 17% endorsed *Tetee laitiiti* and 56% endorsed *Tetee tele* (also highest percentage of the stem).

To facilitate a more meaningful presentation of the data, the four original response categories (1 to 4) are collapsed to form two new broader categories namely 'Tetee' and 'Lagolago' as shown in Table 40b. Doing so revealed more transparently the majority endorsement percentage favouring the 'Lagolago' category with all ten positively worded item stems and the 'Tetee' category for all three negatively worded item stems. This pattern further corroborates that the cohort, on average, has a positive mathematics attitude.

Provided in Table 41 are the Rasch statistics for mathematics attitudes by Year Level and Figure 18 a graph of mean attitudinal estimate from Years 1 to 4. A drop in mathematics attitude is noted at Year 2 with an increase at Year 3 with a slight decrease at Year 4. Shown in Figure 19 are the Year Level attitudinal item-person maps to show the distribution of items and case along the common logit continuum.

Cohort Mathematics Attitudes

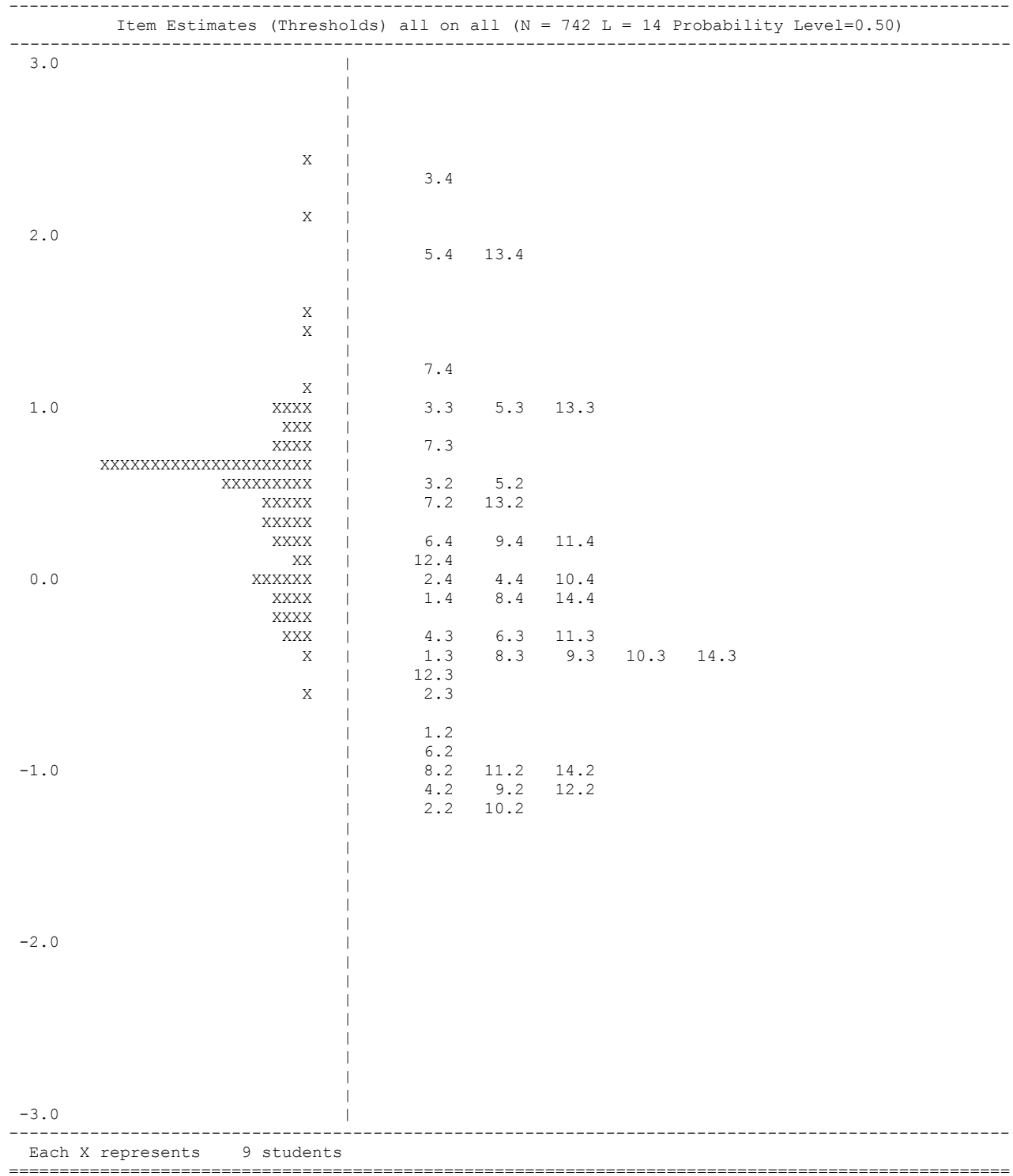


Figure 17: Cohort Mathematics Attitude Item-Person Map

Table 40: Cohort Mathematics Attitudes Item Analysis

A. Four Response Categories

Statements – Faailoa mai le maualuga o lou lagolagoina o fuaiupu taitasi ia e uiga i le a'oina o le matematika?	Tetee tele ① %	Tetee laitiiti ② %	Lagolago laitiiti ③ %	Lagolago tele ④ %
Positively Worded Item Stems				
1. E lelei la'u matematika.	8	9	13	70
2. Ou te manao e tele a'u galuega matematika e fai i le aoga.	4	10	21	64
4. Ou te fiafia e a'o le matematika.	7	12	20	57
6. E vave lo'u malamalama i galuega e fai i le matematika.	7	12	21	56
8. Ou te fiafia i le matematika.	6	11	13	66
9. Ou te fiafia e saili tali o galuega fai upu.	6	13	21	57
10. Ou te fiafia e galue ma fuainumera.	5	13	15	62
11. E faigofie le matematika mo a'u.	7	12	20	57
12. Ou te fiafia e muamua ona o'u taumafai e saili tali o galuega faatoa fesili ai mo se fesoasoani.	5	9	22	59
14. Ou te fiafia e fai uma mea aoga o loo ave i le fale e fai ai (homework).	6	10	10	69
Negatively Worded Stems	Lagolago tele ① %	Lagolago laitiiti ② %	Tetee laitiiti ③ %	Tetee tele ④ %
3. E faigata ia te a'u le matematika i lo o isi tamaiti o la'u vasega.	5	21	17	56
5. E lē lelei la'u matematika.	9	18	15	56
7. E faafiamoe tagata le matematika.	18	14	14	50
13. E faigata le a'oina o le matematika.	8	17	20	50

B - Collapsed Categories

Statements – Faailoa mai le maualuga o lou lagolagoina o fuaiupu taitasi ia e uiga i le a'oina o le matematika?	Tetee %	Lagolago %
Positively Worded Item Stems		
1. E lelei la'u matematika.	17	83
2. Ou te manao e tele a'u galuega matematika e fai i le aoga.	14	85
4. Ou te fiafia e a'o le matematika.	19	77
6. E vave lo'u malamalama i galuega e fai i le matematika.	19	77
8. Ou te fiafia i le matematika.	17	79
9. Ou te fiafia e saili tali o galuega fai upu.	19	78
10. Ou te fiafia e galue ma fuainumera.	19	77
11. E faigofie le matematika mo a'u.	19	77
12. Ou te fiafia e muamua ona o'u taumafai e saili tali o galuega faatoa fesili ai mo se fesoasoani.	14	81
14. Ou te fiafia e fai uma mea aoga o loo ave i le fale e fai ai (homework).	16	79
Negatively Worded Stems	Lagolago %	Tetee %
3. E faigata ia te a'u le matematika i lo o isi tamaiti o la'u vasega.	26	73
5. E lē lelei la'u matematika.	27	71
7. E faafiamoe tagata le matematika.	32	64
13. E faigata le a'oina o le matematika.	25	70

Table 41: Year Level Mathematics Attitude Rasch Statistics

Year level	Item Estimates			Case Estimates		
	Number	Mean	Std Dev	Number	Mean	Std Dev
1	14	0.01	0.84	197	0.46	0.42
2	14	0.00	0.74	198	0.27	0.30
3	14	0.00	0.80	203	0.66	0.26
4	14	0.01	0.51	144	0.62	0.58

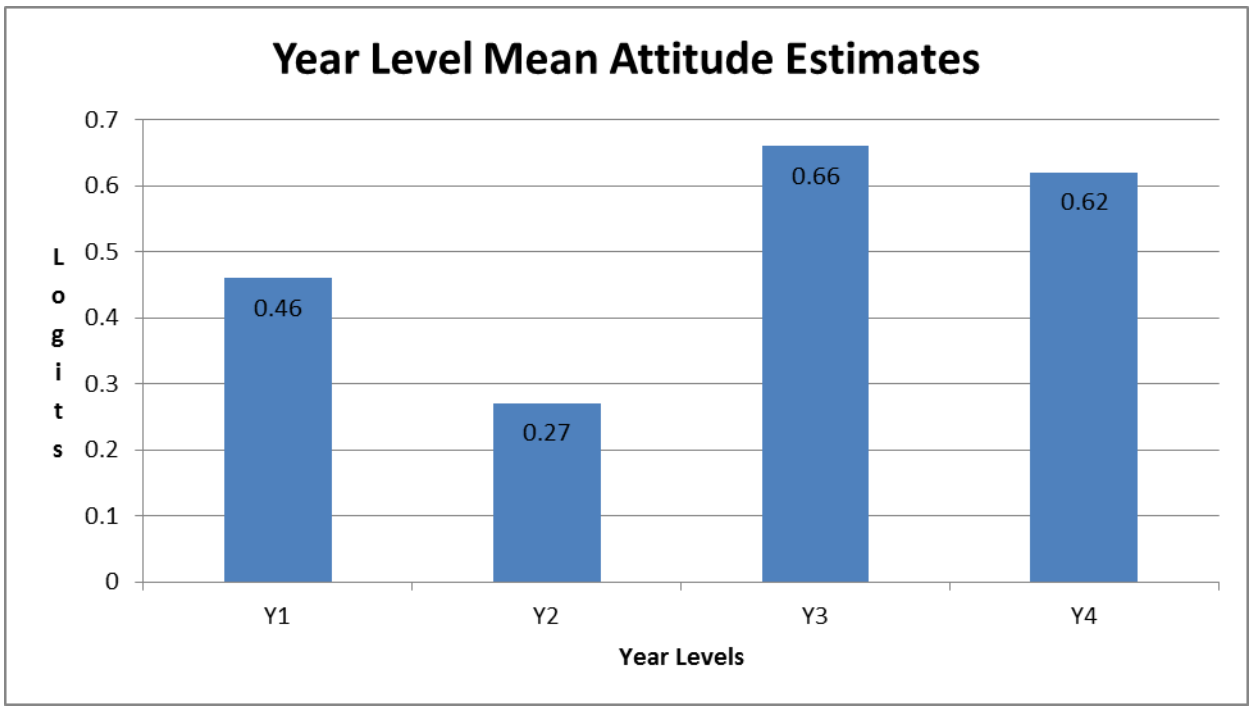


Figure 18: Year Level Mean Attitudinal Estimates

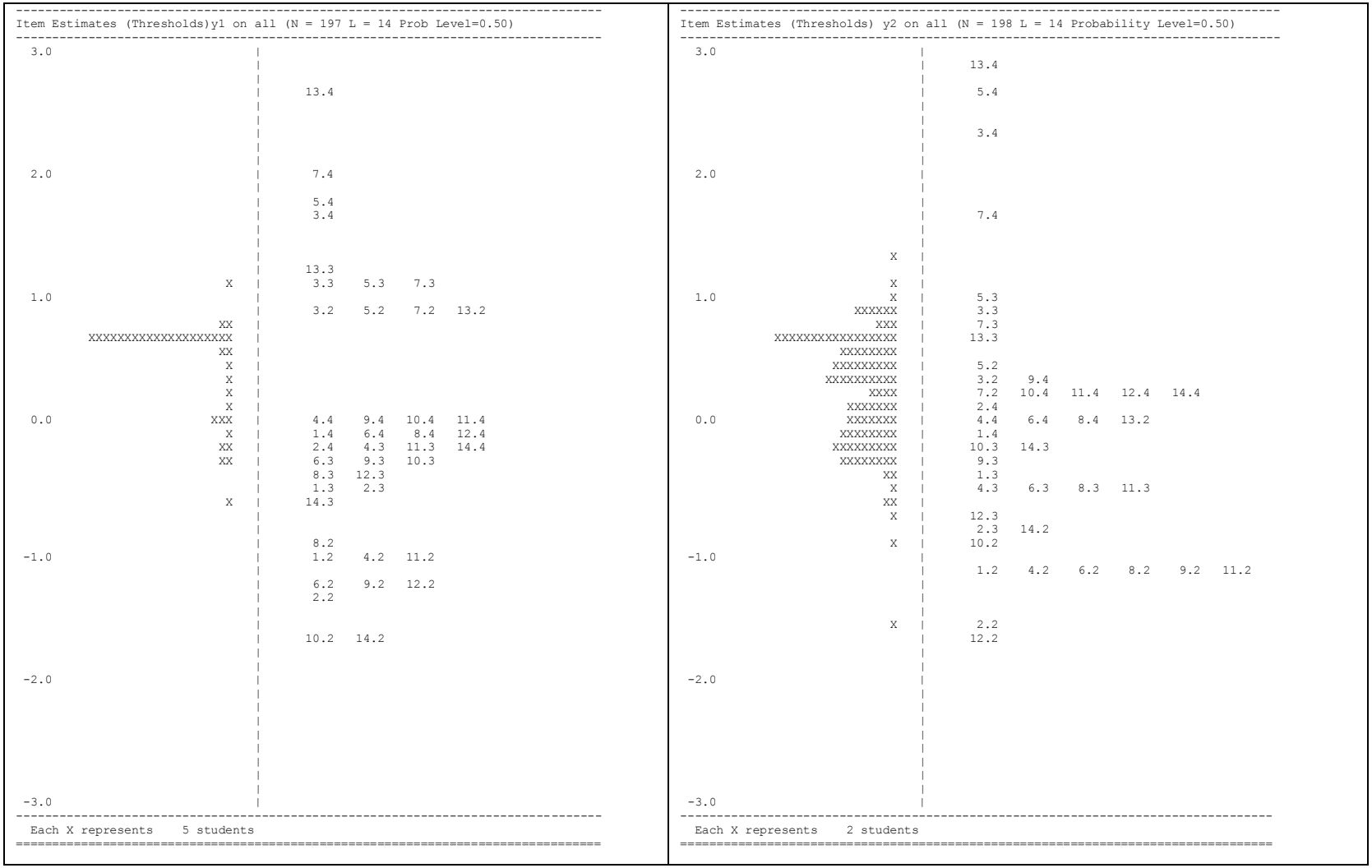


Figure 19: Year Level Attitudinal Item-Person Maps

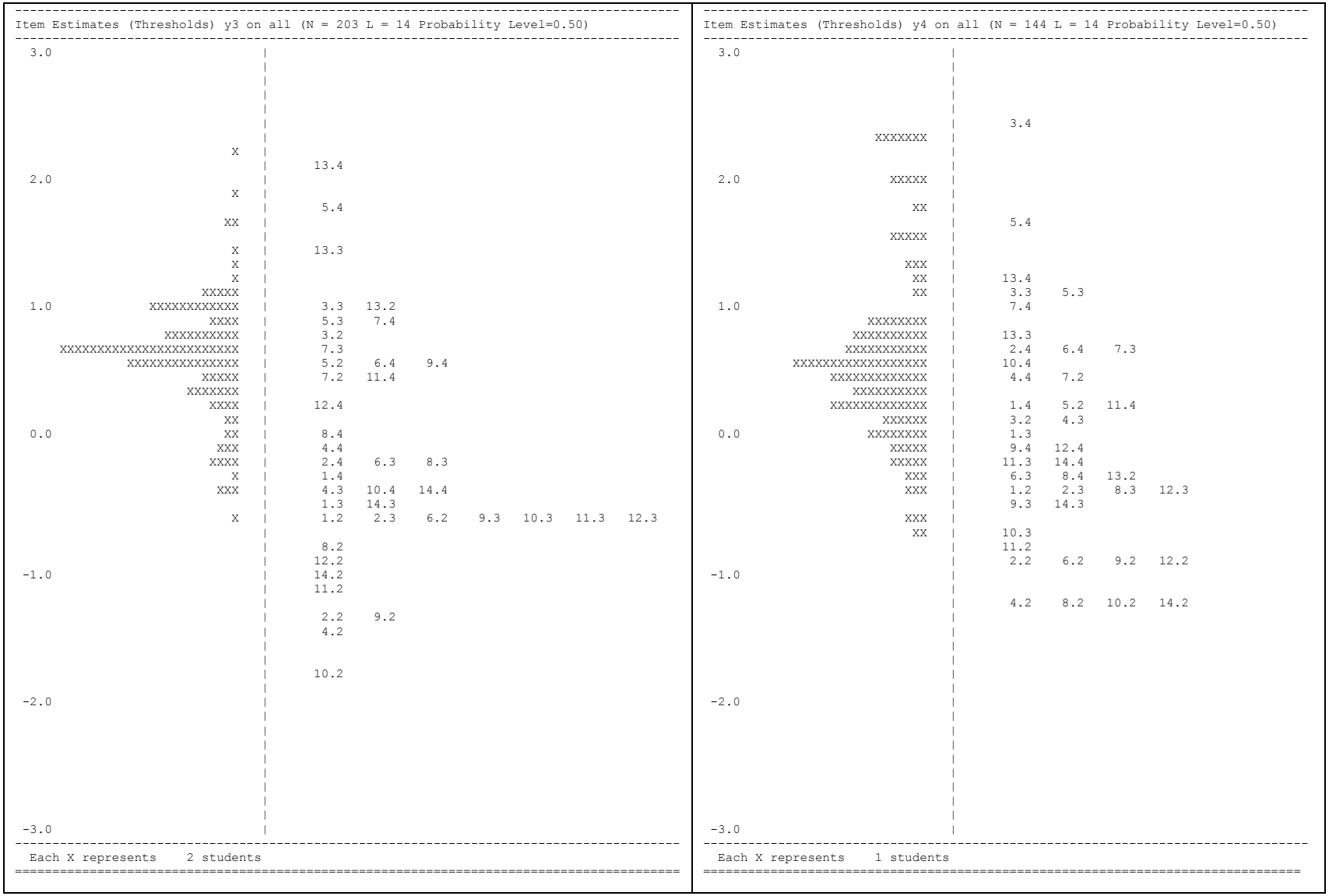


Figure 19: Year Level Attitudinal Item-Person Maps

Classroom Practices in Mathematics Lessons

The particular item in the questionnaire that specifically required students to endorse the frequency of occurrences of some classroom practices in mathematics lessons (i.e. lesson practices) was Question 8 with its 13 stems. The lesson practice stems/items used a 4-point Likert scale with response categories ranging from *Lesona uma poo le tele o lesona*, *Pe afa o lesona*, *O nai lesona*, to *Leai se mea e faia*. Student responses were coded 1 to 4 (as on the questionnaire) depending on whether they responded: *Lesona uma poo le tele o lesona*, *Pe afa o lesona*, *O nai lesona*, or *Leai se mea e faia*. However, to reflect an increasing frequency of lesson practices from 1 to 4, the codes were reversed during the analysis so that *Lesona uma poo le tele o lesona* was recoded 4, *Pe afa o lesona* 3, *O nai lesona* 2, and *O nai lesona* 1. The responses were then analysed using the Partial Credit Rasch Model (PCRM) (Adams & Khoo, 1996; Rasch, 1980). Consequently, the Rasch analysis results presented in this section, provided estimates of Years 1 to 4 students' endorsement of the frequency response categories of the questionnaire lesson practices items/stems. For the rating scale data from *O nai lesona* (coded 1) to *Lesona uma poo le tele o lesona* (coded 4) for each item/stem, not only does the analysis provide an item lesson practice estimate for each Likert stem, but it also provides a set of estimates for the four frequency thresholds to mark the boundaries between the four Likert response categories. The item and its threshold estimates indicated the extent of students' difficulty to endorse the frequency of the lesson practice described by the item stem. The Rasch model theorises that each item reflects a different level of the latent trait being investigated (Bond & Fox, 2001). The case estimates on the other hand, indicated the extent of students' endorsement of the frequency of these particular lesson practices at the time of the study. That is, the person's endorsement estimate "represents the magnitude of *latent trait* of the individual, which is the human capacity or attribute measured by the (questionnaire)" (Lazarsfeld & Henry, 1968); in this case, students' endorsement of the frequency of lesson practices. Provided in Table 42 are the Rasch statistics from the subsequent analysis of student responses using the QUEST software.

Fit of Data to the Rasch Model

Person Fit to the Model –The initial results showed a person infit ms value of 0.97 logit (SD 0.58 logits), see Table 42A. However, a closer inspection of all cases' infit values (n = 1251) showed that 692 cases fall outside of the acceptable range of infit ms values of 0.50 to 1.50. The deleted cases also included the original 264 cases with perfect scores and those with erratic responses. Hence a second analysis followed which resulted in the statistics shown in Table 42B. It is noted that all 559 cases' infit ms value fall within the acceptable range and that the new mean infit ms value (0.99, SD 0.30) is closer to the expected mean value of 1.00 logit.

Item Fit to the Model – An items' mean infit ms value of 0.99 (SD 0.11, also around the expected mean value of 1.00) was also produced by the second Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50. None of the items had zero or perfect scores.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Classroom Practices in Mathematics Lessons - Reliability Indices and Mean Estimates

From the second Rasch analysis of students' lesson practice responses, the person reliability index of the instrument (i.e., 0.75) and its traditional Cronbach's alpha value of 0.85 were closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the lesson practices items, see Table 42B. The item

reliability index of questionnaire items (i.e. 0.91) was relatively higher (than the 0.75 person reliability index) indicating that the items were more reliably and sufficiently separated by the cases into a hierarchical order along the logit continuum than cases were by the items.

Table 42: Cohort Classroom Practices in Mathematics Lessons Rasch Analyses Statistics

A. Initial Analysis

Lesson Practices --- Item Estimates (Thresholds)all on all (N = 1251 L = 13 Prob Level=0.50) --- Summary of item Estimates ========== Mean 0.00 SD 0.45 SD (adjusted) 0.44 Reliability of estimate 0.92 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 1.00 / Mean 1.00 SD 0.14 / SD 0.18 Infit t / Outfit t Mean -0.26 / Mean -0.24 SD 3.21 / SD 2.65 0 items with zero scores 0 items with perfect scores ==========	Lesson Practices --- Case Estimates all on all (N = 1251 L = 13 Prob Level=0.50) --- Summary of case Estimates ========== Mean -2.74 SD 17.94 SD (adjusted) 17.93 Reliability of estimate 1.00 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 0.97 / Mean 0.98 SD 0.58 / SD 0.63 Infit t / Outfit t Mean -0.44 / Mean -0.28 SD 2.20 / SD 1.90 0 cases with zero scores 264 cases with perfect scores ==========
Cronbach Alpha = 0.89	

B. Second Analysis

Lesson Practices --- Item Estimates (Thresholds) all on all (N = 559 L = 13 Prob Level=0.50) --- Summary of item Estimates ========== Mean 0.00 SD 0.57 SD (adjusted) 0.54 Reliability of estimate 0.91 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 0.99 / Mean 1.02 SD 0.11 / SD 0.13 Infit t / Outfit t Mean -0.16 / Mean 0.12 SD 1.90 / SD 1.28 0 items with zero scores 0 items with perfect scores ==========	Lesson **Practices** --- Case Estimates all on all (N = 559 L = 13 Prob Level=0.50) --- Summary of case Estimates ========== Mean 0.44 SD 0.77 SD (adjusted) 0.67 Reliability of estimate 0.75 Fit Statistics ========== Infit Mean Square / Outfit Mean Square Mean 0.99 / Mean 1.02 SD 0.30 / SD 0.43 Infit t / Outfit t Mean 0.05 / Mean 0.13 SD 0.83 / SD 0.70 0 cases with zero scores 0 cases with perfect scores ==========
Cronbach Alpha = 0.85	

The mean endorsement estimate of lesson practice item stems was set at zero logit. The subsequent calibrations of person endorsement of the frequency of classroom practices resulted in a mean case estimate of 0.44 logit (SD 0.67), which was slightly higher than the zero mean item difficulty to endorse estimate (SD 0.54 logit).

The difference between the item and case mean estimates indicate that, on average, the cohort mean estimate is on the positive side by approximately a 0.44 logit. In fact, statistically, this difference (or mismatch between the mean case endorsement and mean item difficulty to endorse estimates) is statistically significant (t =2.3489, df =570, p = 0.029) with Cohen's effect size value (d = 0.66) suggesting a moderate practical difference. This statistically significant and moderate practical difference also suggests that, on average, the cohort's endorsement of the frequency of classroom practices in mathematics lesson was positive towards the more frequent end.

Classroom Practices in Mathematics Lessons Item-Person Map

With the lesson practices Rasch statistics provided in Table 42, Figure 20 shows the lesson practice cohort item-person map. The map displayed item threshold estimates, denoted by item number and response category, i.e. 10.4, on the right of the vertical logit continuum, towards the top are the hardest-to-endorse item response categories denoting very frequent lesson practices while those relatively easiest-to-endorse item response categories describing least frequent lesson practices are towards the bottom. To the left of the same vertical logit scale is the distribution of cases, represented by X, each denoting 3 students, indicating the location of persons' estimates from those with high endorsement of more frequently occurring lesson practices towards the top end and those with relatively low endorsement of less frequently occurring lesson practice estimates towards the bottom end.

Three item response categories (i.e. Item 10.4, 11.4 and 12.4) representing the top three hardest-to-endorse item response categories denoting the most frequently occurring practices were located at 1.57, 1.55 and 1.25 logits respectively, whereas the bottom three easiest-to-endorse item response categories (Item 7.2, 5.2 and 8.2) denoting the least frequently occurring practices were located between −1.22 and −1.38 logits respectively, at or below the lowest case estimates.

At the top end of the logit continuum are 60 top cases (9%) from 2.9 down to 1.59 logits whose estimates are above the highest ranking item estimate (Item 10.4, 1.57 logits), representing students who are endorsing more frequently occurring practices, however, there were no item response categories across from these case estimates to reliably separate them further corroborating the lesser person separation index (compared to the item separation index) signalled earlier. Similarly, at the lower end across from the two lowest item estimates representing students' endorsement of less frequently occurring practices, there were no cases to reliably separate them.

The distribution of case estimates in the item-person map (Figure 20) is centrally located around its case mean estimate (at 0.44 logit) and it further corroborates that the cohort's endorsement of the frequency of lesson practices was, on average, slightly positive towards the more frequent end of the continuum. The range of case lesson practice estimates is from −1.98 to 2.90 logits, approximately an interval of 4.88 logits. The median case estimate is 0.38 logit. The median item response category is Item 3.3 (0.01 logit) with upper and lower quartiles at item response categories Item 8.4 (0.60 logit) and Item 13.2 (-0.66 logit) respectively, an item interquartile range of 1.26 logit.

Classroom Practices in Mathematics Lessons

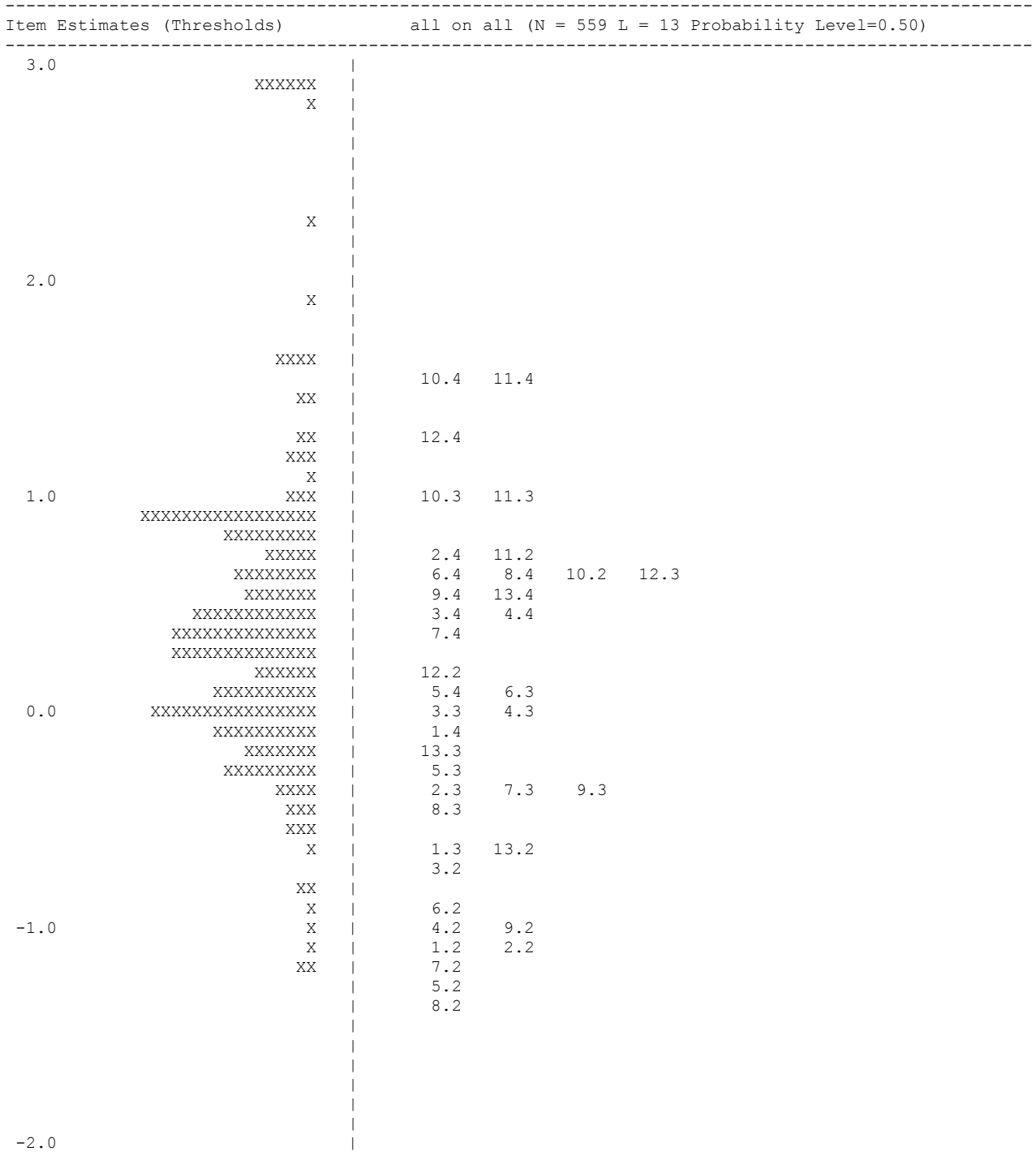


Figure 20: Cohort Lesson Practices Item-Person Map

Classroom Practices in Mathematics Lessons Item Analysis

Displayed in Table 43 is the list of the 12 lesson practice items showing the percentages of the cohort (*n*=559) that endorsed each of the response categories from *Leai se mea e faia* to *Lesona uma pe o le tele o lesona* and including those who did not tick any response (*Leai se tali*). For example, Item 1: *E koleni le a'oina o le faaopoopo, toese, faatele, ma le vaevae e aunoa ma le faaaogāina o se kalikiulaita* item response category 4, has the highest percentage (66%) of the four categories.

To facilitate a more meaningful presentation of the data, firstly, two of the four original response categories (2 and 3) are collapsed to form one much broader category namely '*Nai lesona – Afa o lesona*' with the other two response categories (1 and 4) remaining as before, see Table 43b. Secondly, the lesson practices are organised into activity types (i.e. Learning Practices, Working Mathematically Practices, and Using Learning Resources) to facilitate discussion later on. Doing so revealed more transparently some patterns with students' lesson practices.

For example, of the learning and working mathematically practice types, Table 43b shows that from 7% up to 15% of the cohort endorsed no lesson time is spent on these practices. Also indicated with the learning practice type is that relatively more students endorsed practicing the four operations without calculators (66%) and learning about shapes (62%) occurring in most or all lessons compared to a lesser percentage endorsing that these occurred in some to less than half the lessons (26% and 30% respectively). Moreover, 51% of the cohort endorsed that in some to about half the lessons they worked with fractions and decimals and 39% made tables, charts and graphs. In most or all lessons, relatively more students (46%) endorsed making tables compared to only 39% working with fractions and decimals.

With the working mathematically type, working with other students in small groups as occurring in most to all lessons was endorsed by 48% compared to 41% endorsing that it occurred in some to about half the lessons. Similarly with measuring things around their school environment, relatively more students (45%) endorsed practising this in most lessons compared to 37% who endorsed doing this in some to half the lessons. With the same two practices, 8% and 15% respectively, reported they never did these during mathematics lessons.

Of the rest of the working mathematically practices, relatively more students endorsed that, in some to half of the lessons, they explained their solutions/answers (48%), memorised how to solve problems (44%), and solved problems on their own (45%) compared to lesser percentages (42%, 39% and 42% respectively) of the cohort endorsing that these occurred in most or all of the lessons. With the same three practices, 6% to 13% of the cohort reported they never practised these during mathematics lessons.

Of the 'using learning resources' type, for example, calculators, computers and SRA mathematics they were never part of their lesson practices according to 55%, 57% and 38% respectively, of the cohort. However, some practised with these resources in some to half of the lessons according to about 22% of the cohort with computers and 28% with calculators and about 34% with SRA mathematics. But about 13% to 21% of the cohort endorsed using these learning resources in most to all lessons.

Table 43: Cohort Classroom Practices in Mathematics Lessons Item Analysis

a. Four Categories

	Statements – E faafia ona e faia mea ia i totonu o tou lesona matematika?	Leai se mea e faia	O nai lesona	Pe afa o lesona	Lesona uma pe o le tele o lesona
Item	Item Stem	**1**	**2**	**3**	**4**
1	E koleni le a'oina o le faaopoopo, toese, faatele, ma le vaevae e aunoa ma le faaaogāina o se kalikiulaita	7	8	18	66
2	Ou te faia galuega e faaaogā ai vaegamea ma tesimale	9	15	36	39
3	Ou te faia fuataga o mea i le potu aoga ma le siosiomaga o le aoga.	15	19	18	45
4	E fai a'u teipolo, siaka, poo kalafi	12	23	16	46
5	E a'o a'u siepi e pei o li'o, tafatolu, tafafa-letutusa, kiupi, pirisima, silinita ma sifia.	7	17	13	62
6	E a'o faatauloto le faiga o galuega e saili ai tali o fesili.	13	24	20	39
7	E matou te galulue faatasi ma isi tamaiti i kulupu toalaiti.	8	17	24	48
8	Ou te faamatala a'u galuega faatino ma tali,	6	16	32	42
9	Ou te saili lava e a'u faatinoga o galuega ma tali o fesili.	9	13	32	42
10	Ou te faaaogāina se kalikiuleita.	55	14	14	14
11	Ou te faaaogāina le komipiuta.	57	11	11	13
12	Ou te faaaogāina le SRA Matematika.	38	17	17	21

b. Collapsed Categories

	Statements – E faafia ona e faia mea ia i totonu o tou lesona matematika?	Leai se mea e faia	O nai lesona – afa o lesona	Lesona uma pe o le tele o lesona
Item #	Item Stem			
	Learning Practices			
1	E koleni le a'oina o le faaopoopo, toese, faatele, ma le vaevae e aunoa ma le faaaogāina o se kalikiulaita	7	26	66
5	E a'o a'u siepi e pei o li'o, tafatolu, tafafa-letutusa, kiupi, pirisima, silinita ma sifia.	7	30	62
2	Ou te faia galuega e faaaogā ai vaegamea ma tesimale	9	51	39
4	E fai a'u teipolo, siaka, poo kalafi	12	39	46
	Working Mathematically Practices			
7	E matou te galulue faatasi ma isi tamaiti i kulupu toalaiti.	8	41	48
8	Ou te faamatala a'u galuega faatino ma tali,	6	48	42
6	E a'o faatauloto le faiga o galuega e saili ai tali o fesili.	13	**44**	39
3	Ou te faia fuataga o mea i le potu aoga ma le siosiomaga o le aoga.	15	37	45
9	Ou te saili lava e a'u faatinoga o galuega ma tali o fesili.	9	45	42
	Using Learning Resources			
12	Ou te faaaogāina le SRA Matematika.	38	34	21
11	Ou te faaaogāina le komipiuta.	57	22	13
10	Ou te faaaogāina se kalikiuleita.	55	28	14

Students' Home Activities

The particular items in the questionnaire that specifically required students to endorse the amount of time they spend before or after school to do the listed home activities were Questions 12A to 12I with a total of 33 stems to cover week days (Question 12A), Saturdays (Question 12E) and Sundays (Question 12I). The home activity stems/items used a 5-point Likert scale with response categories ranging from *Leai se taimi*, *Laititi itula e tasi*, *1-2 itula*, *E sili i le 2 ae ei lalo ifo o le 4 itula* to *4 pe sili atu itula*. Student responses were coded 1 to 5 (as on the questionnaire) depending on whether they responded: *Leai se taimi*, *Laititi itula e tasi*, *1-2 itula*, *E sili i le 2 ae ei lalo ifo o le 4 itula* or *4 pe sili atu itula*. The responses were then analysed using the Partial Credit Rasch Model (PCRM) (Adams & Khoo, 1996; Rasch, 1980). Consequently, the Rasch analysis results presented in this section, provided estimates of Years 1 to 4 students' endorsement of the amount of time response categories of the questionnaire home activity items/stems.

For the rating scale data from *Leai se taimi* (coded 1) to *4 pe sili atu itula* (coded 5) for each item/stem in the questionnaire, not only does the analysis provide an home activity item estimate for each Likert stem, but it also provides a set of estimates for the five amounts of time thresholds to mark the boundaries between the five Likert response categories. The item and its threshold estimates indicated the extent of students' difficulty to endorse the response categories of the home activity item stem. The Rasch model theorises that each item reflects a different level of the latent trait being investigated (Bond & Fox, 2001). The case estimates on the other hand, indicated the extent of students' endorsement of the amounts of time they spend with the listed home activities at the time of the study. That is, the person's endorsement estimate "represents the magnitude of *latent trait* of the individual, which is the human capacity or attribute measured by the (questionnaire)" (Lazarsfeld & Henry, 1968); in this case, students' endorsement of the amounts of time they spend with the listed home activities. Provided in Table 44 are the Rasch statistics from the subsequent analysis of student responses using the QUEST software.

Fit of Data to the Rasch Model

Person Fit to the Model –The initial results showed a person infit ms value of 0.93 logit (SD 0.56 logits), see Table 44a. However, a closer inspection of all cases' infit values showed that 558 cases fall outside of the acceptable range of infit ms values of 0.50 to 1.50. The deleted cases also included the original 104 cases with perfect scores and those with erratic responses. Hence a second analysis followed which resulted in the statistics shown in Table 44b. It is noted that all 693 cases' infit ms value fall within the acceptable range and that the new mean infit ms value (0.96, SD 0.29) is closer to the expected mean value of 1.00 logit.

Item Fit to the Model – An items' mean infit ms value of 1.00 (SD 0.18, also around the expected mean value of 1.00) was also produced by the second Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50. None of the items had zero or perfect scores.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Home Activities Reliability Indices and Mean Estimates

From the second Rasch analysis of students' responses, the person reliability index of the instrument (i.e., 0.85) and its traditional Cronbach's alpha value of 0.91 were closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the home activity items, see Table 44B. The item reliability index of questionnaire items (i.e. 0.83) was slightly lower (than the 0.85 person reliability index) indicating that the cases were slightly more reliably

and sufficiently separated by the items into a hierarchical order along the logit continuum than the items were by the cases with 12 item response categories at the top end of the continuum not having corresponding cases to reliably separate them, see Figure 21. The reverse is the case at the lower end of the logit continuum with no easiest to endorse item categories to reliably separate the lowest 27 cases.

Table 44: Cohort Student Home Activities Rasch Statistics

A. Initial Analysis

```
Student Questionnaire- After School Activities
-----------------------------------------------
Item Estimates (Thresholds)all on all (N =
1251 L = 33 Prob Level=0.50)
-----------------------------------------------
Summary of item Estimates
=========================
Mean                          0.01
SD                            0.29
SD (adjusted)                 0.26
Reliability of estimate       0.85

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    1.00              Mean    1.01
    SD      0.14              SD      0.24

      Infit t                   Outfit t
    Mean   -0.49              Mean   -0.73
    SD      3.30              SD      3.20

   0 items with zero scores
   0 items with perfect scores
===============================================
```

```
Student Questionnaire- After School Activities
-----------------------------------------------
Case Estimates  all on all (N = 1251 L = 33
Prob Level=0.50)
-----------------------------------------------
Summary of case Estimates
=========================
Mean                         -5.78
SD                           23.30
SD (adjusted)                23.30
Reliability of estimate       1.00

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    0.93              Mean    1.00
    SD      0.56              SD      0.70

      Infit t                   Outfit t
    Mean   -0.74              Mean   -0.51
    SD      2.90              SD      2.53

   0 cases with zero scores
 104 cases with perfect scores
===============================================
```

Cronbach Alpha = 0.92

B. Second Analysis

```
Student Questionnaire- Home Activities
-----------------------------------------------
Item Estimates (Thresholds)
all on all (N = 693 L = 33 Prob Level=0.50)
-----------------------------------------------
Summary of item Estimates
=========================
Mean                          0.00
SD                            0.34
SD (adjusted)                 0.31
Reliability of estimate       0.83

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    1.00              Mean    1.04
    SD      0.18              SD      0.30

      Infit t                   Outfit t
    Mean   -0.61              Mean   -0.39
    SD      3.22              SD      2.85

   0 items with zero scores
   0 items with perfect scores
===============================================
```

```
Student Questionnaire- Home Activities
-----------------------------------------------
Case Estimates all on all (N = 693 L = 33 Pro
Level=0.50)
-----------------------------------------------
Summary of case Estimates
=========================
Mean                         -0.33
SD                            0.56
SD (adjusted)                 0.52
Reliability of estimate       0.85

 Fit Statistics
===============
 Infit Mean Square         Outfit Mean Square
    Mean    0.96              Mean    1.05
    SD      0.29              SD      0.38

      Infit t                   Outfit t
    Mean   -0.13              Mean    0.11
    SD      1.35              SD      1.00

   0 cases with zero scores
   0 cases with perfect scores
===============================================
```

Cronbach Alpha = 0.91

The mean endorsement estimate of lesson practice item stems was set at zero logit. The subsequent calibrations of person endorsement of the amount of time for the home activities resulted in a mean case estimate of -0.33 logit (SD 0.52), which was slightly lower than the zero mean item difficulty to endorse estimate (SD 0.31 logit). The difference between the item and case mean estimates indicate that, on average, the cohort mean estimate is on the lower side by approximately a 0.33 logit. In fact, statistically, this difference (or mismatch between the mean case endorsement and mean item difficulty to endorse estimates) is statistically significant (t = 3.6147, df = 724, p = 0.00) with Cohen's effect size value (d = 0.64) suggesting a moderate practical difference. This statistically significant and practically moderate difference also suggests that the cohort's endorsement of the amount of time spent with the listed home activities was, on average, low.

Home Activities Item-Person Map

With the home activity Rasch statistics provided in Table 44, Figure 21 shows the home activities cohort item-person map. The map displayed item threshold estimates, denoted by item number and response category, i.e. 13.5 in Figure 21, on the right of the vertical logit continuum, towards the top are the hardest-to-endorse item response categories denoting longer time (>4 hours) spent on activities while those relatively easiest-to-endorse item response categories describing least time spent on activities towards the bottom. To the left of the same vertical logit scale is the distribution of cases, represented by X, each denoting 3 students, indicating the location of persons' estimates from those with endorsement of much time spent on activities towards the top end and those with endorsement of least time spent on activities estimates towards the bottom. The distribution of item response categories compared to that of case estimates, particularly the 'tail' at the high end, corroborate why the item separation index was lower than that for cases.

As earlier signalled, there were 12 item response categories (see Table 45 for the estimates) that were located above the top most case estimate (0.68, SE 0.16 logit) further corroborating that there were no higher case estimates to reliably separate the hardest-to-endorse item response categories. At the bottom end of the logit continuum are the 27 lowest cases at -1.45 down to -3.48 logits without any matching easiest-to-endorse item response categories to reliably separate them.

The topmost hardest-to-endorse item response category is Item 13:5 (4%) on playing computer games on Saturdays for more than four hours and the easiest-to-endorse response category, on the other hand, is Item 24.2 on going to church on Sundays (14%) for less than an hour.

Home Activities- Item Analysis

Displayed in Table 46 is the list of the 33 home activity item stems showing the percentages of the cohort (n=693) that endorsed each of the response categories from *Leai se taimi* to *4 pe sili atu itula* and including those who did not tick any response (*Leai se tali*). For example, Item 1: *E matamata le TV ma videos* 9% of the cohort watched TV and videos for more than four hours on weekdays, 26% on Saturdays (Item 12.5) and only 9% on Sundays (Item 25.5).

To facilitate a more meaningful presentation of the data, four of the five original response categories (2 to 5) are collapsed to form two new broader categories namely 'less than 2 hours' and 'at least 2 hours' with the first response category 1 still remaining as 'no time'. Furthermore, the home activity item stems are reorganized into sub-types namely *Non-Curricular*, *Study Practices*, *Extra Learning Opportunities*, and *Buying/Selling (Faatau) Goods* to facilitate discussion of results later on. See Table 46B for the results of the collapsed categories.

Students' Home Activities

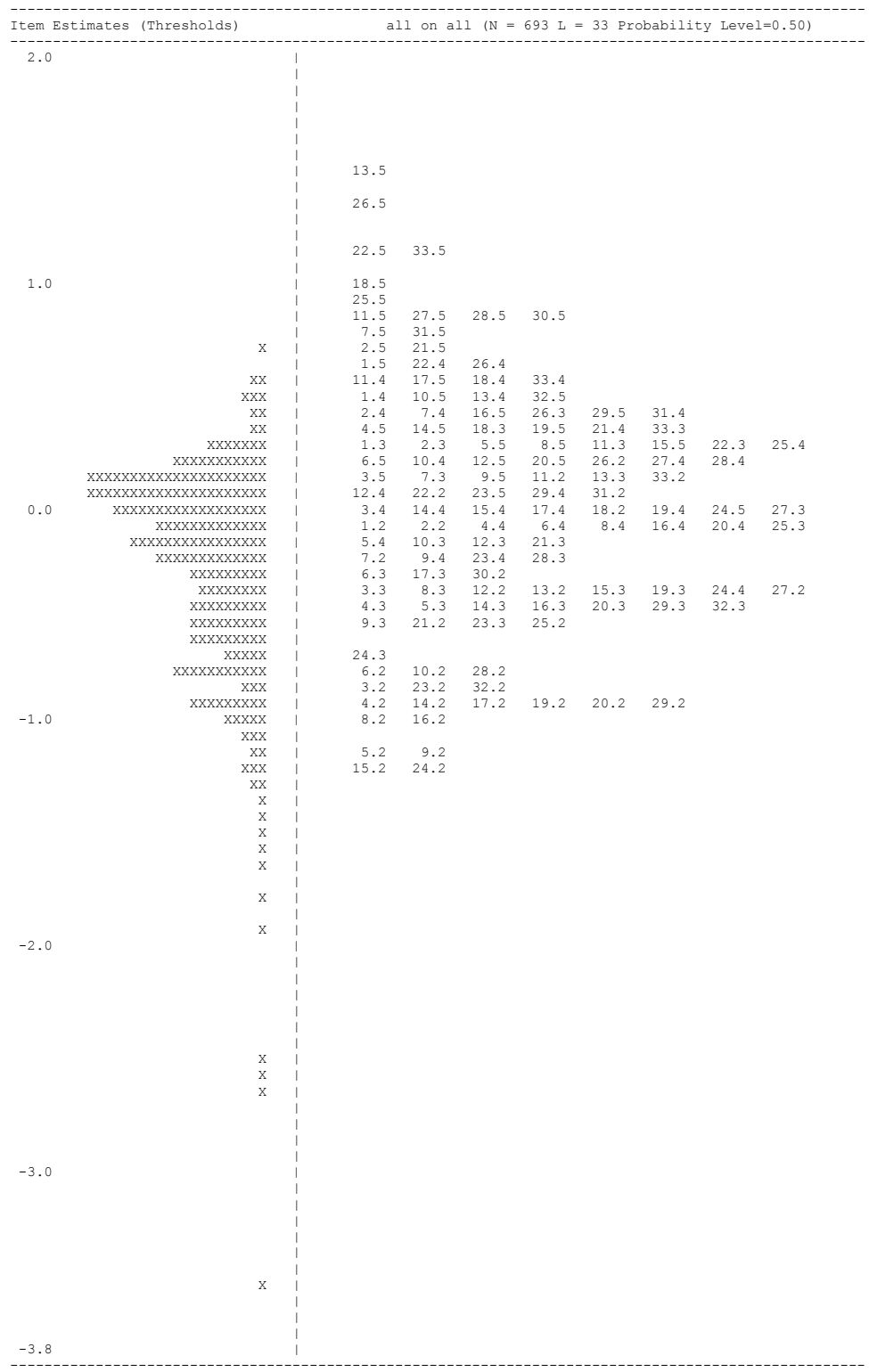


Figure 21: Cohort Home Activities Item-Person Map

Table 45: Cohort Ranked Top 12 Item Response Categories (Home Activities)

Rank	Item Response Category	Item Threshold Estimate (Logits)	Error
1	13.5	1.53	0.22
2	26.5	1.38	0.25
3	22.5	1.10	0.20
4	33.5	1.10	0.18
5	18.5	0.96	0.18
6	25.5	0.94	0.16

Rank	Item Response Category	Item Threshold Estimate (Logits)	Error
7	11.5	0.87	0.18
8	27.5	0.86	0.17
9	30.5	0.84	0.17
10	28.5	0.81	0.13
11	31.5	0.79	0.17
12	7.5	0.75	0.15

Table 46: Cohort Student Home Activities Item Analysis

Item	**Statements –** I se Aso Aoga masani, o le a le umi o lou taimi e faaaluina ae lei amata pe ua tuua le aoga i le faiga o mea taitasi nei?	**Leai se taimi** ①	**< 1 itula** ②	**1-2 itula** ③	**2-4 Itula** ④	**>4 itula** ⑤
1	E matamata le TV ma videos	52	17	9	3	9
2	E taalo taaloga komipiuta	51	15	7	6	9
3	E taalo pe talanoa ma a'u uō	24	14	17	6	28
4	E fai a'u feau mo le aiga	20	15	15	16	22
5	E faitau se tusi ou te fiafia iai	17	17	14	16	24
6	E taalo i taaloga	24	15	12	10	24
7	E faaaogā le inataneti	43	17	10	7	8
8	E fai a'u meaaoga na aumai e fai i le fale	19	17	13	13	24
9	Ou te alu i le aoga faifeau.	16	16	14	13	29
10	Ou te alu i la'u aoga matematika e fai pea tuua le aoga	27	18	16	9	15
11	Ou te fesoasoani e faatau oloa ma mea taulima i luga o auala tele	57	10	8	6	6
Item	**Statements -** I se Aso Toonai masani, ole a le umi o lou taimi e faaaluina i le faiga o mea taitasi nei?	**Leai se taimi** ①	**< 1 itula** ②	**1-2 itula** ③	**2-4 Itula** ④	**>4 itula** ⑤
12	E matamata le TV ma videos	42	13	11	7	26
13	E taalo taaloga komipiuta	41	21	14	13	4
14	E taalo pe talanoa ma a'u uō	24	15	19	15	22
15	E fai a'u feau mo le aiga	18	24	15	13	25
16	E faitau se tusi ou te fiafia iai	21	17	18	17	22
17	E taalo i taaloga	24	20	14	17	16
18	E faaaogā le inataneti	54	15	10	6	5
19	E fai a'u meaaoga na aumai e fai i le fale	23	18	17	14	22
20	Ou te alu i le aoga faifeau.	21	16	17	11	27
21	Ou te alu i la'u aoga matematika	34	16	22	9	11
22	Ou te fesoasoani e faatau oloa ma mea taulima i luga o auala tele	56	12	13	6	4
Item	**Statements -** I se Aso Sa masani, ole a le umi o lou taimi e faaaluina i le faiga o mea taitasi nei?	**Leai se taimi** ①	**< 1 itula** ②	**1-2 itula** ③	**2-4 Itula** ④	**>4 itula** ⑤
23	Ou te alu i le Aoga Aso Sa	25	12	13	15	34
24	Ou te alu i le lotu	15	14	14	16	36
25	E matamata le TV ma videos	38	18	15	16	9
26	E taalo taaloga komipiuta	64	13	7	7	3
27	E taalo pe talanoa ma a'u uō	41	17	11	15	10
28	E fai a'u feau mo le aiga	29	18	19	16	12
29	E faitau se tusi ou te fiafia iai	23	13	25	12	20
30	E taalo i taaloga	44	14	12	13	9
31	E faaaogā le inataneti	60	10	8	8	8
32	E fai a'u meaaoga na aumai e fai i le fale	24	14	16	18	19
33	Ou te fesoasoani e faatau oloa ma mea taulima i luga o auala tele	63	10	7	8	5

Table 46B: Students' Home Activities – Collapsed Categories

Item	**Statements –** I se Aso Aoga masani, o le a le umi o lou taimi e faaaluina ae lei amata pe ua tuua le aoga i le faiga o mea taitasi nei?	**No time**	**≤ 2 hours**	**≥ 2 hours**
	Non-Curricular Activities			
1	E matamata le TV ma videos	52	26	12
2	E taalo taaloga komipiuta	51	22	15
3	E taalo pe talanoa ma a'u uō	24	31	34
6	E taalo i taaloga	24	27	34
4	E fai a'u feau mo le aiga	20	30	38
7	E faaaogā le inataneti	43	27	15
	Study Practices			
8	E fai a'u meaaoga na aumai e fai i le fale	9	30	37
5	E faitau se tusi ou te fiafia iai	17	31	40
	Extra Learning Opportunities			
9	Ou te alu i le aoga faifeau.	16	30	42
10	Ou te alu i la'u aoga matematika e fai pea tuua le aoga	27	34	24
	Buying &/or Selling Goods			
11	Ou te fesoasoani e faatau oloa ma mea taulima i luga o auala tele	57	18	12
Item	**Statements -** I se Aso Toonai masani, ole a le umi o lou taimi e faaaluina i le faiga o mea taitasi nei?	**No time**	**Less than 2 hours**	**Greater than 2 hours**
	Non-Curricular Activities			
12	E matamata le TV ma videos	42	24	33
13	E taalo taaloga komipiuta	41	35	17
14	E taalo pe talanoa ma a'u uō	24	34	37
17	E taalo i taaloga	24	34	33
15	E fai a'u feau mo le aiga	18	39	38
18	E faaaogā le inataneti	54	25	11
		No time	**< 2 hours**	**> 2 hours**
	Study Practices			
19	E fai a'u meaaoga na aumai e fai i le fale	23	35	36
16	E faitau se tusi ou te fiafia iai	21	35	29
	Extra Learning Opportunities			
20	Ou te alu i le aoga faifeau.	21	33	38
21	Ou te alu i la'u aoga matematika	34	28	20
	Buying &/or Selling Goods			
22	Ou te fesoasoani e faatau oloa ma mea taulima i luga o auala tele	56	25	10
Item	**Statements -** I se Aso Sa masani, ole a le umi o lou taimi e faaaluina i le faiga o mea taitasi nei?	**No time**	**Less than 2 hours**	**Greater than 2 hours**
	Non-Curricular Activities			
25	E matamata le TV ma videos	38	33	25
26	E taalo taaloga komipiuta	64	20	10
27	E taalo pe talanoa ma a'u uō	41	28	25
30	E taalo i taaloga	44	26	22
28	E fai a'u feau mo le aiga	29	37	28
31	E faaaogā le inataneti	60	18	16
	Study Practices			
32	E fai a'u meaaoga na aumai e fai i le fale	24	30	37
29	E faitau se tusi ou te fiafia iai	23	38	32
	Extra Learning Opportunities			
23	Ou te alu i le Aoga Aso Sa	25	25	49
24	Ou te alu i le lotu	15	28	42
	Buying &/or Selling Goods			
33	Ou te fesoasoani e faatau oloa ma mea taulima i luga o auala tele	63	17	13

Regarding students' study practices at home (see Figure 22), doing homework on weekdays (Item 8), 9% endorsed no time' with 30% spending 'less than 2 hours' compared to 37% spending 'greater than 2 hours'. Increased percentages are shown for Saturdays (Item 19) at 35% for 'less than 2 hours' and about three times as much increase to 23% for category 'no time' but a slight decrease for 'greater than 2 hours'

to 36%. On Sundays, the result (Item 32) fluctuates down again to 30% for category 'less than 2 hours', a slight increase to 37% for greater than 2 hours and increased percentage (24%) for 'no time'. These results suggest that an increasing percentage of students had 'no time' to do homework on weekdays, through Saturdays and Sundays compared to a relatively stable percentage who do homework on weekdays and Sundays but a decreased percentage on Saturdays for at least 2 hours whereas it was an increased percentage for less than 2 hours as shown in Figure 22.

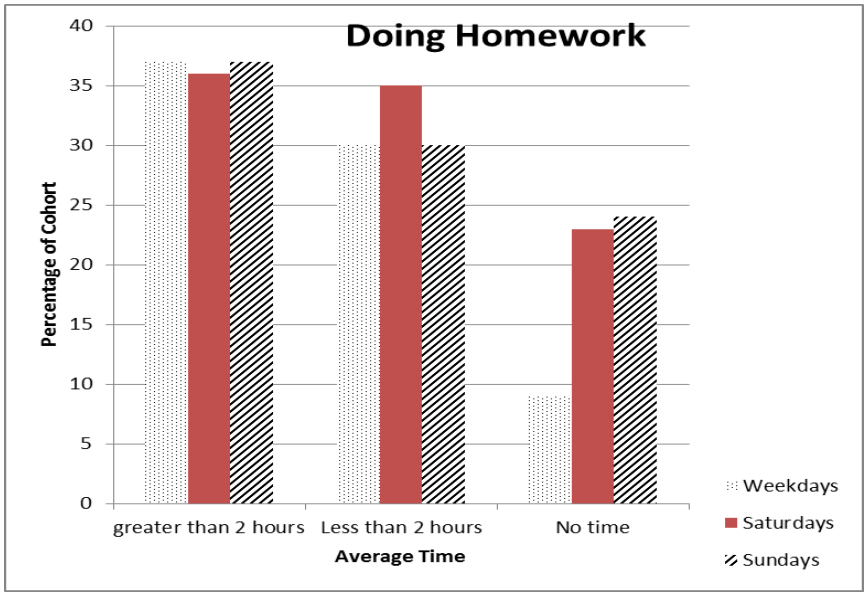


Figure 22: Time Spent on Doing Homework

Attending after-school mathematics classes during weekdays (Item 10) seemed to be the case for 34% of the cohort for less than 2 hours, 24% for greater than 2 hours and 27% had no time for it, see Figure 23. Decreased percentages are observed for Saturday mathematics classes (Item 21), 28% for 'less than 2 hours', 20% for 'greater than 2 hours and increased percentage of 34% of the cohort had 'no time'. Attending Sunday schools (Item 23) showed 25%, 49% and 25% for less than 2 hours, greater than 2 hours and no time respectively. These results (also see Figure 23) suggest that the majority of students (34% plus 24%) attend mathematics classes after school during weekdays (for less than 2 hours or longer) while a minority have no time. In addition, if these results are linked to those for attending Sunday schools, the majority of students indicate continuity in attendance at another informal learning context while at least a quarter up to about a third of the cohort throughout the week has no time for these informal learning opportunities.

Reading a book they like (see Figure 24) seemed to be practised on weekdays (Item 5) by 40% for greater than 2 hours and 31% of the cohort for less than two hours, with 17% having no time for it. On Saturdays, 21% do not have time for reading a book (Item 16), 35% read for less than two hours with 29% reading for more than 2 hours. For Sundays, it was 32%, 38% and 23% for greater than 2 hours, less than 2 hours, and no time respectively. These results suggest that a majority of the students (64% up to 70%) spent some of their time reading a book they liked throughout the week.

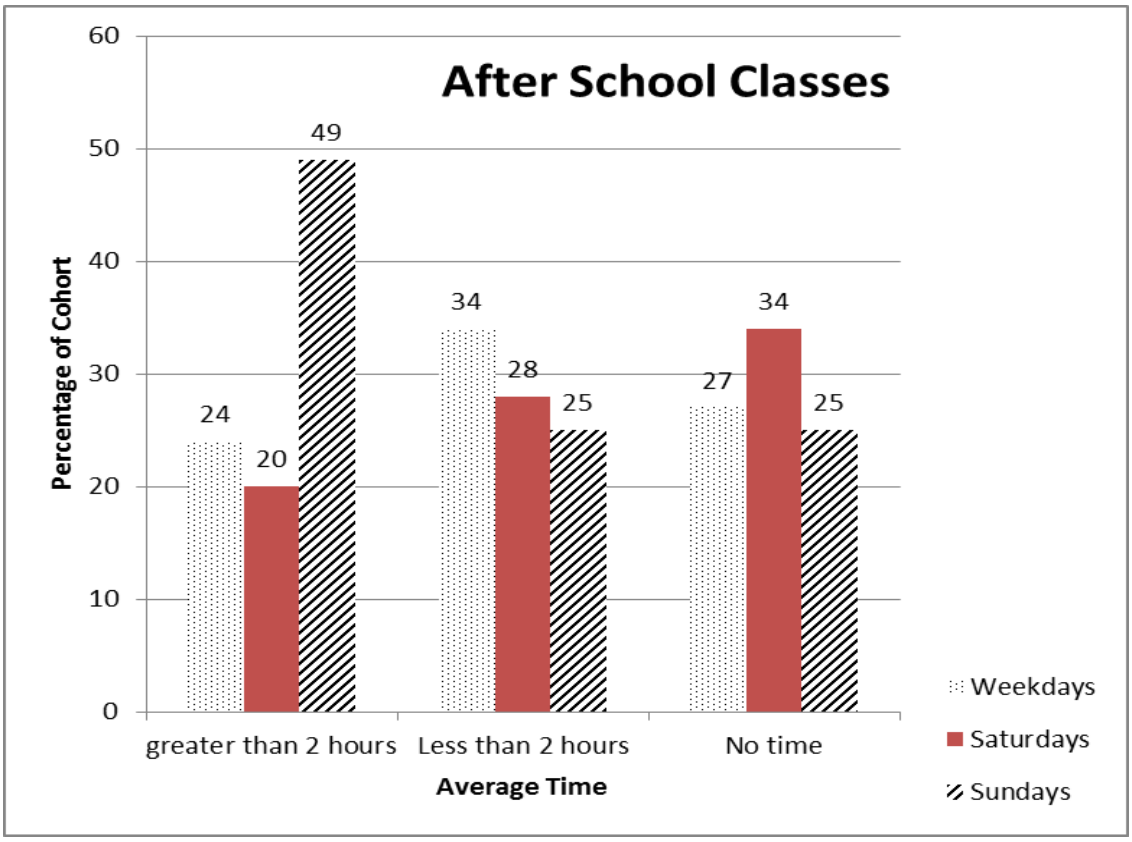


Figure 23: After School Classes

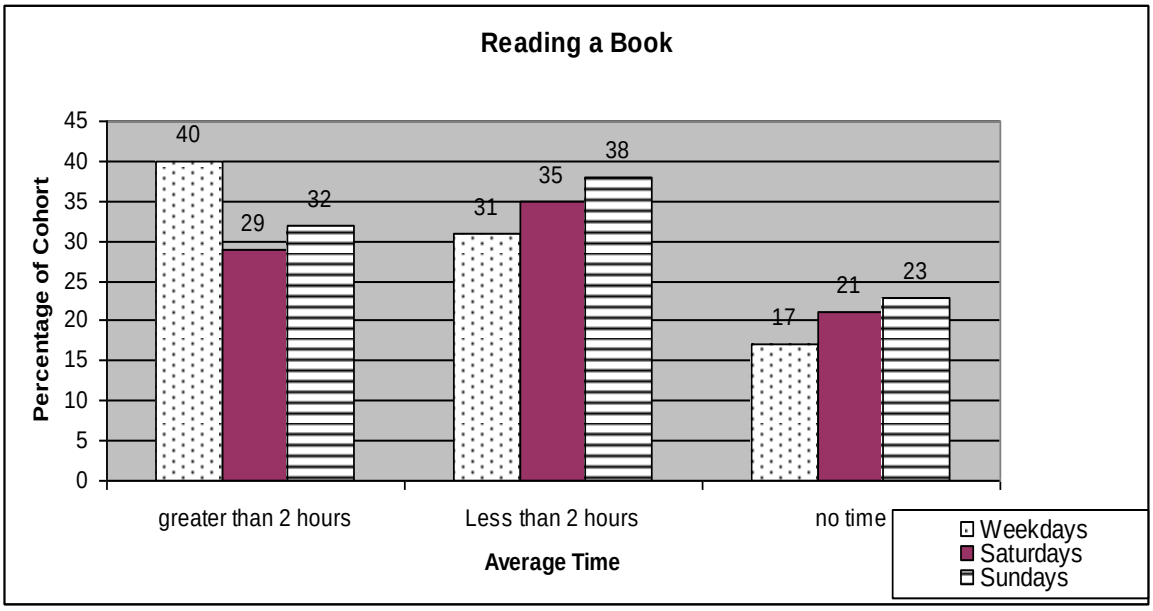


Figure 24: Reading a Book

As for helping out with family chores (Figure 25), students spent 20% and 30% doing chores for greater than 2 hours and less than 2 hours respectively on weekdays while it was 18% and 39% respectively on Saturdays and 29% and 37% respectively on Sundays. The results suggest that students spent up to the majority of their time on chores (50%, 57% and 66%) from weekdays to Sundays respectively.

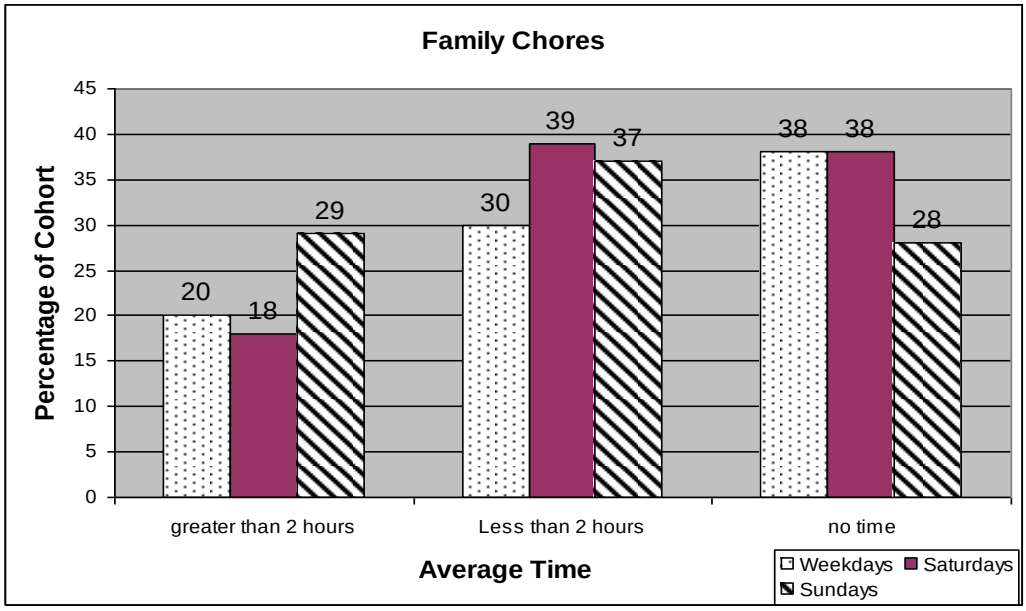


Figure 25: Family Chores

Students' Homework Practices

Question 13 of the questionnaire asked students to indicate how often their teachers give them homework in mathematics. Seventy two (72%) of the cohort (*n* = 1100) endorsed that this happens daily with 15% endorsing 3 to 4 times, 5% at once or twice with 3% at less than once a week and 2% endorsed never with 3% having blank response, see Figure 26.

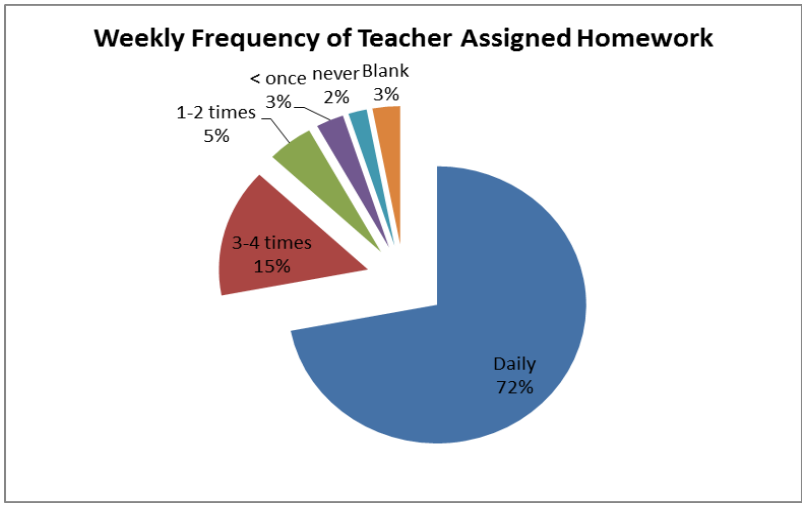


Figure 26: Weekly Frequency of Teacher Assigned Homework

Regarding the usual time students spend on doing homework, 66% endorsed spending less than half-an-hour and 22% endorsed at least a half-hour and up to one hour and a half and 12% left no responses (see Figure 27).

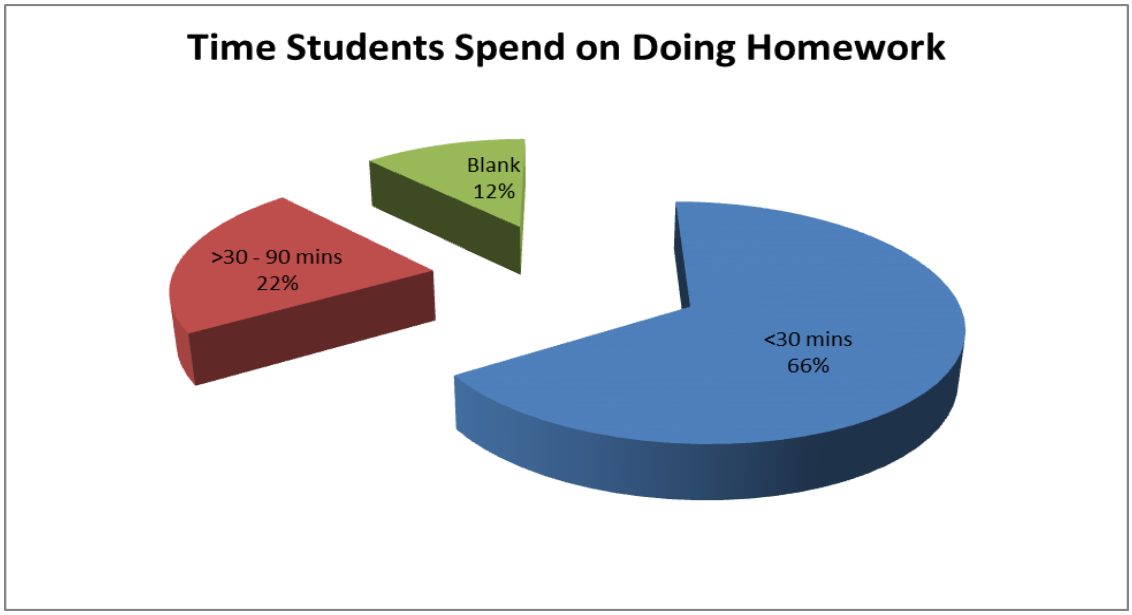


Figure 27: Time Students Spend on Homework

Also 74% of the cohort indicated they stayed with their parents during the school week while 26% indicated they do not (Question 16). Moreover, 66% of the cohort indicated their guardian/parents like mathematics compared to 36% who responded negatively (Question 17); see Figure 28.

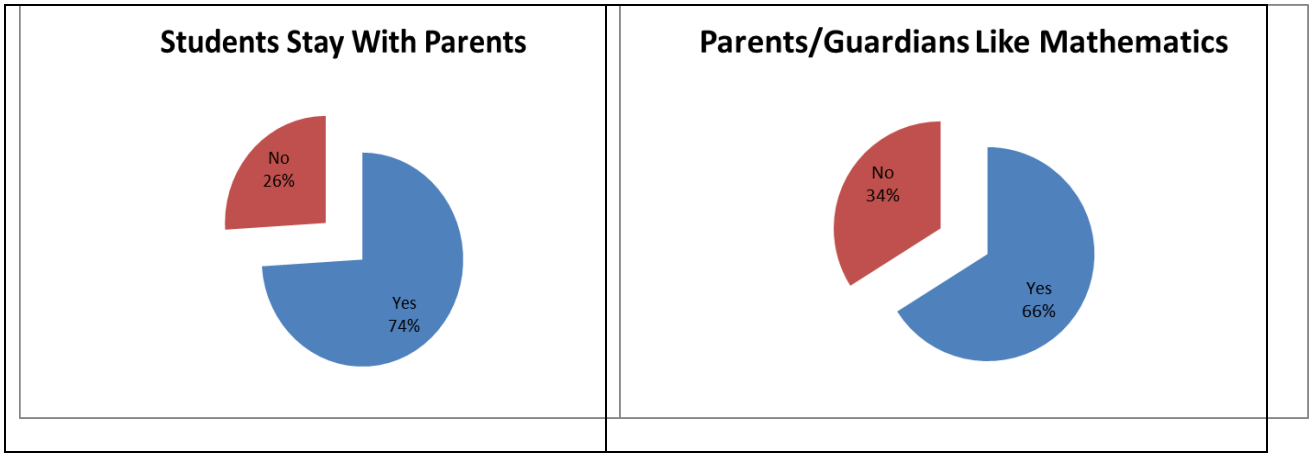


Figure 28: Parents/Guardians – Stay and Mathematics

Part 2: Teacher Tests and Questionnaires

Teacher Tests

A total of 43 school teachers took the mathematics diagnostic test. Provided in Table 47 are the actual number of participating teachers from the eight schools. Teacher responses were coded Correct, Incorrect or Blank and analysed using the Dichotomous Rasch Model (DRM).

Table 47: School Number of Teachers

Primary School (PS)	Number of Teachers
LOT	4
STM	10
VAM	9
FLS	7
SPU	1
STP	7
SLV	5
MAN	0[7]
Total	5
Total Teachers	**43**

Fit of Data to the Model

Person Fit to the Model –The analysis of responses from 43 cases showed that all person infit mean square (ms) values were within the recommended range of 0.50 to 1.50 logits. This is further corroborated by the mean infit ms value of 1.00 logit (SD of 0.20 logit) as being equal to the expected value of 1 logit (see Table 48).

Item Fit to the Model – An items' mean infit ms value of 0.98 (also around the expected mean value of 1.00) with a SD of 0.17 logit, was produced by the Rasch analysis using QUEST. Further inspection of individual items' infit ms values showed that all infit values were within the acceptable range of 0.5 to 1.50. One item had zero score.

Overall, the set of case and item infit ms statistics provided above both corroborate that the overall data fit the Rasch Model.

Teacher Test Reliability Indices and Mean Estimates

From the Rasch analysis of teachers' responses, the person reliability index of the instrument (i.e., 0.87) (and the traditional Cronbach's alpha value of 0.87) were closer to the ideal value of 1.00 suggesting that (the items worked reliably together consistently and as a result) the cases were reliably separated by the items in the test. The item reliability index of the test (i.e. 0.92, see Table 48) was relatively higher (than the 0.87 person reliability index) and much closer to one indicating that the items were reliably and sufficiently separated by the cases into a hierarchical order along the logit continuum. The high item reliability index also means that we can reliably rely on this order of item estimates to be replicated when we give the test to other samples for whom it is suitable.

[7] MAN PS teachers attended a MESC meeting in Apia on the day of the test.

Table 48: Cohort Teacher Test Rasch Statistics

Item Estimates (Thresholds) all on all (N = 43 L = 38 Probability Level=0.50)	Case Estimates all on all (N = 43 L = 38 Probability Level=0.50)
Summary of item Estimates	Summary of case Estimates
Mean 0.00	Mean -0.40
SD 1.58	SD 1.17
SD (adjusted) 1.52	SD (adjusted) 1.08
Reliability of estimate 0.92	Reliability of estimate 0.87
Fit Statistics	Fit Statistics
Infit Mean Square: Mean 0.98, SD 0.17 — Outfit Mean Square: Mean 1.12, SD 0.85	Infit Mean Square: Mean 1.00, SD 0.20 — Outfit Mean Square: Mean 1.13, SD 1.12
Infit t: Mean -0.03, SD 0.97 — Outfit t: Mean 0.15, SD 1.04	Infit t: Mean -0.03, SD 0.92 — Outfit t: Mean 0.15, SD 0.93
1 item with zero scores	0 cases with zero scores
0 items with perfect scores	0 cases with perfect scores
Internal Consistency 0.87	

Teachers' Diagnostic Test Item- Person Map

Teacher test Rasch statistics are provided in Table 48 with the test cohort item-person map in Figure 29. The mean of the item difficulties is adopted by default as zero logit with a standard deviation of about 1.52 logits, indicating a spread of items around the mean that is approximately 1.52 logit on both sides. The location of difficulty estimate for Item 21 was calculated to be at -0.01 logit hence its location on the item-person map.

Three items (8%) had difficulty estimates that were above the top teacher (500102, a SLV PS teacher, ability estimate 2.96 logits). For the teachers' diagnostic test, the mean ability estimate is –0.40 (SD 1.08) logits which is approximately 0.40 logit below that of mean item difficulty (0.00 logit), indicating that the test was difficult by logit, for the cohort of school teachers. The distribution of ability estimates in Figure 29 around its mean (at –0.40 logit) is slightly narrower (SD 1.08 logits) compared to the more spread out distribution of items (SD 1.52) around its zero logit mean difficulty. Statistically, the difference between the case mean estimate and item mean estimate is not significant (t = 1.3774, df = 79, p = 0.18) and the practical difference as suggested by Cohen's effect size (d = 0.31) is small. This insignificant difference and small practical difference suggested that, on average, the test was more or less well-matched to the teachers.

Teachers' Levels of Competence and Performance

Teachers' ability estimates shown in Table 49 (5th column) was based on their performance in the test in terms of the items they got correct (3rd column) out of 38 items. Shown in the first column is each case's rank in the cohort with their ability estimate and percentage correct in the fifth and sixth columns respectively.

Teachers' Diagnostic Test

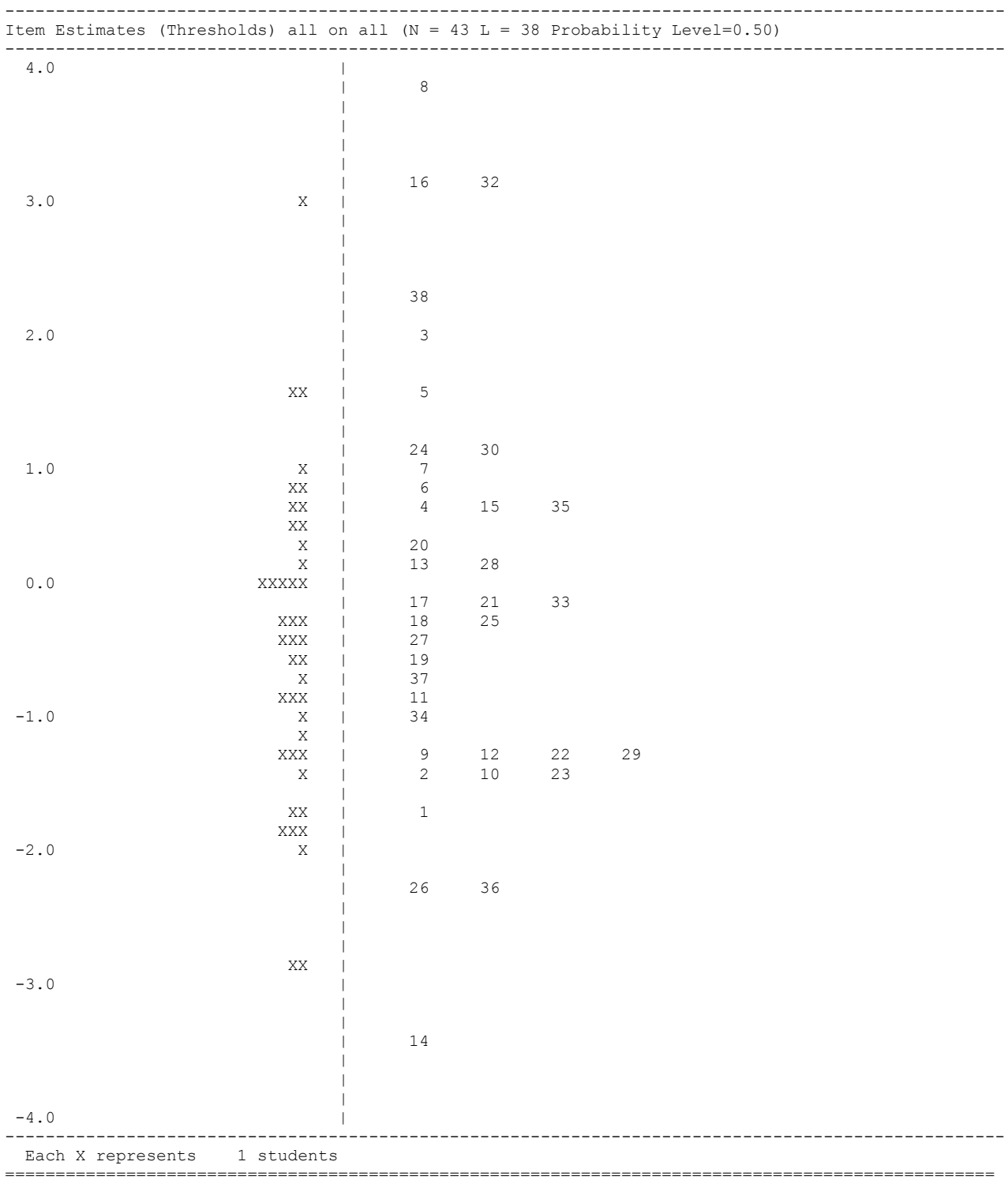


Figure 29: Cohort Teacher Test Item-Person Map

Table 49: Teachers' Ranked Estimates and Competence and Performance Levels

1	2	3	4	5	6	7	8	9	10	11
Rank	NAME	SCORE	MAX-SCORE	ESTIMATE	%CORRECT	COMPETENCE LEVEL	Z-SCORE	PERCENTILE	STANINE	PERFORMANCE LEVEL
LOT	PS									
7	100100	23	38	0.63	60.5	At Risk Level 1	1.0	83.7	7	Above Average
13	100104	17	38	-0.30	44.7	At Risk Level 2	0.1	69.8	5	Average
33	100102	11	38	-1.26	28.9	At Risk Level 3	-0.7	23.3	4	Average
38	100103	8	38	-1.82	21.1	At Risk Level 3	-1.2	11.6	3	Below Average
STM	PS									
4	200104	25	38	0.98	65.8	At Risk Level 1	1.3	90.7	8	Above Average
6	200105	24	38	0.8	63.2	At Risk Level 1	1.1	86.0	7	Above Average
21	200108	17	38	-0.31	44.7	At Risk Level 2	0.1	51.2	5	Average
27	200109	14	38	-0.77	36.8	At Risk Level 3	-0.3	37.2	4	Average
30	200101	12	38	-1.09	31.6	At Risk Level 3	-0.6	30.2	4	Average
31	200102	11	38	-1.26	28.9	At Risk Level 3	-0.7	27.9	4	Average
35	200106	9	38	-1.62	23.7	At Risk Level 3	-1.0	18.6	3	Below Average
37	200100	8	38	-1.82	21.1	At Risk Level 3	-1.2	14.0	3	Below Average
39	200107	8	38	-1.82	21.1	At Risk Level 3	-1.2	9.3	2	Below Average
42	200103	4	38	-2.83	10.5	At Risk Level 4	-2.1	2.3	1	Very Low
VAM	PS									
11	300102	21	38	0.31	55.3	At Risk Level 2	0.7	74.4	6	Average
18	300101	18	38	-0.15	47.4	At Risk Level 2	0.3	58.1	5	Average
22	300106	17	38	-0.31	44.7	At Risk Level 2	0.1	48.8	5	Average
23	300108	16	38	-0.46	42.1	At Risk Level 2	0.0	46.5	5	Average
25	300100	15	38	-0.61	39.5	At Risk Level 3	-0.1	41.9	5	Average
28	300103	14	38	-0.77	36.8	At Risk Level 3	-0.3	34.9	4	Average
29	300104	13	38	-0.93	34.2	At Risk Level 3	-0.4	32.6	4	Average
34	300107	10	38	-1.44	26.3	At Risk Level 3	-0.9	20.9	3	Below Average
36	300105	9	38	-1.62	23.7	At Risk Level 3	-1.0	16.3	3	Below Average
FLS	PS									
5	400104	24	38	0.8	63.2	At Risk Level 1	1.1	88.4	7	Above Average
17	400102	19	38	0	50.0	At Risk Level 2	0.4	60.5	6	Average
16	400103	19	38	0	50.0	At Risk Level 2	0.4	62.8	6	Average
14	400105	19	38	0	50.0	At Risk Level 2	0.4	67.4	6	Average
26	400106	14	38	-0.77	36.8	At Risk Level 3	-0.3	39.5	4	Average
32	400101	11	38	-1.26	28.9	At Risk Level 3	-0.7	25.6	4	Average
40	400100	7	38	-2.03	18.4	At Risk Level 4	-1.4	7.0	2	Below Average

Table 49: Teachers' Ranked Estimates and Performance Levels - *continued*

Rank	NAME	SCORE	MAX-SCORE	ESTIMATE	%CORRECT	COMPETENCE LEVEL	Z-SCORE	PERCENTILE	STANINE	PERFORMANCE LEVEL
SLV	**PS**									
1	500102	33	38	2.96	86.8	Proficient	3.0	97.7	9	Very High
2	500100	28	38	1.56	73.7	At Risk Level 1	1.8	95.3	8	Above Average
3	500101	28	38	1.56	73.7	At Risk Level 1	1.8	93.0	8	Above Average
10	500103	22	38	0.47	57.9	At Risk Level 2	0.8	76.7	6	Average
19	500104	18	38	-0.15	47.4	At Risk Level 2	0.3	55.8	5	Average
STP	**PS**									
8	600102	23	38	0.63	60.5	At Risk Level 1	1.0	81.4	7	Above Average
9	600101	22	38	0.47	57.9	At Risk Level 2	0.8	79.1	7	Above Average
12	600103	20	38	0.16	52.6	At Risk Level 2	0.5	72.1	6	Average
13	600104	19	38	0	50.0	At Risk Level 2	0.4	69.8	6	Average
20	600105	18	38	-0.15	47.4	At Risk Level 2	0.3	53.5	5	Average
24	600100	16	38	-0.46	42.1	At Risk Level 2	0.0	44.2	5	Average
43	600106	4	38	-2.83	10.5	At Risk Level 4	-2.1	0.0	1	Very Low
SPU	**PS**									
15	700100	19	38	0	50.0	At Risk Level 2	0.4	65.1	6	Average

The percentage correct of each case is the percentage of 38 items (including the zero score Item 31 which no one got correct). Included in this analysis/percentage are items that they left unanswered (i.e. coded blank). Two competence levels used are 'Competent Level' for those who have successfully answered at least 80% of the test items or 'At-risk Level' for those who did not (7^{th} column). The At Risk competence level is further subdivided into four sublevels (similar to the students), namely, At Risk Levels 1 to 4. Also provided are z-scores (8^{th} column) based on case ability estimates which have been normalised in terms of number of standard deviations (1.08 logits) each ability estimate is from the mean ability (-0.40 logit). The percentiles (9^{th} column) are based on rankings of ability estimates (1^{st} column) and they indicate the percentages of cases scoring at or below that ability estimate. Both standard scores and percentile ranks relate the individual's result to those of all cases in the group.

Also provided are stanine scores and performance levels (10^{th} and 11^{th} columns). While the performance level is a general descriptive category to compare individual performance to the rest of the teachers in the cohort, competence levels indicate whether or not a teacher is mathematically competent as assessed by items in the test. Highlighted in Table 50 are the level distributions by school of the 43 school teachers that completed the diagnostic test. The summary shows that only one teacher (2%) achieved competence level with the rest classified as 'At-Risk'. The further breakdown of the At Risk competence level shows an overall distribution of 16%, 40%, 35% and 7% to At Risk Levels 1 to 4 respectively, see Figure 30.

To provide a more in-depth view of the top case's test performance, a kidmap generated by QUEST, is provided in Figure 31. Case 500102 got 33 out of 38 items correct (86.8%) with an ability estimate of 2.96 logits. Her kidmap illustrates the items she got correct (on the left side of the middle vertical lines) and those that she got incorrect (on the right side of the vertical lines). Also located on her kidmap on the logit continuum is her ability estimate, marked with XXX, within the two middle vertical lines. The horizontal dotted lines (half on the top left and half on the bottom right of the ability location, XXX)

indicate the boundaries of her ability band (2.96 ± 0.62 logits where the standard error is 0.62 logit) which also divides the kidmap into four sections.

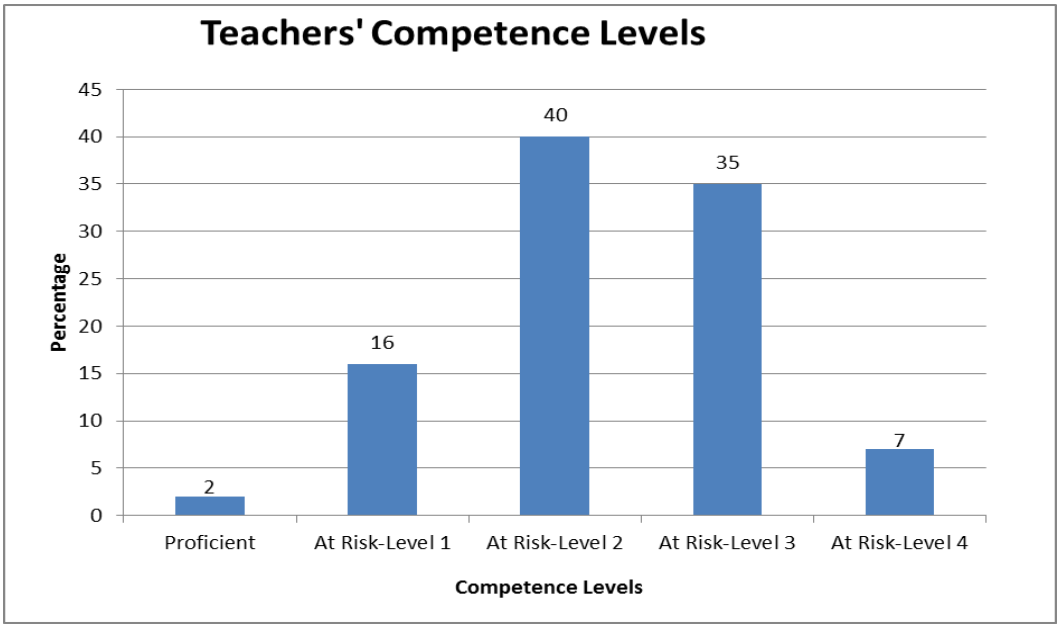


Figure 30: Teacher Percentage Distribution to Mathematics Competence Levels

Table 50: Summary of Teachers by Competence and Performance Levels

Teachers	Competence Levels					Performance Levels					
School	**Profi-cient**	**At Risk Level 1**	**At Risk Level 2**	**At Risk Level 3**	**At Risk Level 4**	**Very High**	**Above Average**	**Average**	**Below Average**	**Very Low**	**Total**
LOT	0	1	1	2	0	0	1	2	1	0	4
STM	0	2	1	6	1	0	2	4	3	1	10
VAM	0	0	4	5	0	0	0	7	2	0	9
FLS	0	1	3	2	1	0	1	5	1	0	7
SLV	1	2	2	0	0	1	2	2	0	0	5
STP	0	1	5	0	1	0	2	4	1	0	7
SPU	0	0	1	0	0	0	0	1	0	0	1
MAN											0
Total Number	**1**	**7**	**17**	**15**	**3**	**1**	**8**	**25**	**8**	**1**	**43**
Percentage	**2**	**16**	**40**	**35**	**7**	**2**	**19**	**58**	**19**	**2**	**100**

The top right section (*Harder Not Achieved*) indicate one item (Item 8, 3.89 logits) located just above her ability band (2.96 ± 0.62 logits) she got incorrect and, theoretically, she had just under average probability of being successful as the item has an item difficulty estimate located just above her ability band. Below her ability band are Items 20, 17 and 9 which have been calibrated to be relative easier for her, and, theoretically, she would have more than average (>50%) probability of getting correct; these items represent mathematics content areas (i.e. knowledge and skills) that she needs to improve on. These items (see the ranked list of items and descriptions in Table 51) assess knowledge and skills in reasoning with an angle, pair of parallel lines and a triangle to determine sum of two interior angles of the

triangle (Item 20) and reasoning proportionally with congruent triangles to determine unknown sides, (Item 17) and with a given speed and time to determine distance travelled (Item 9).

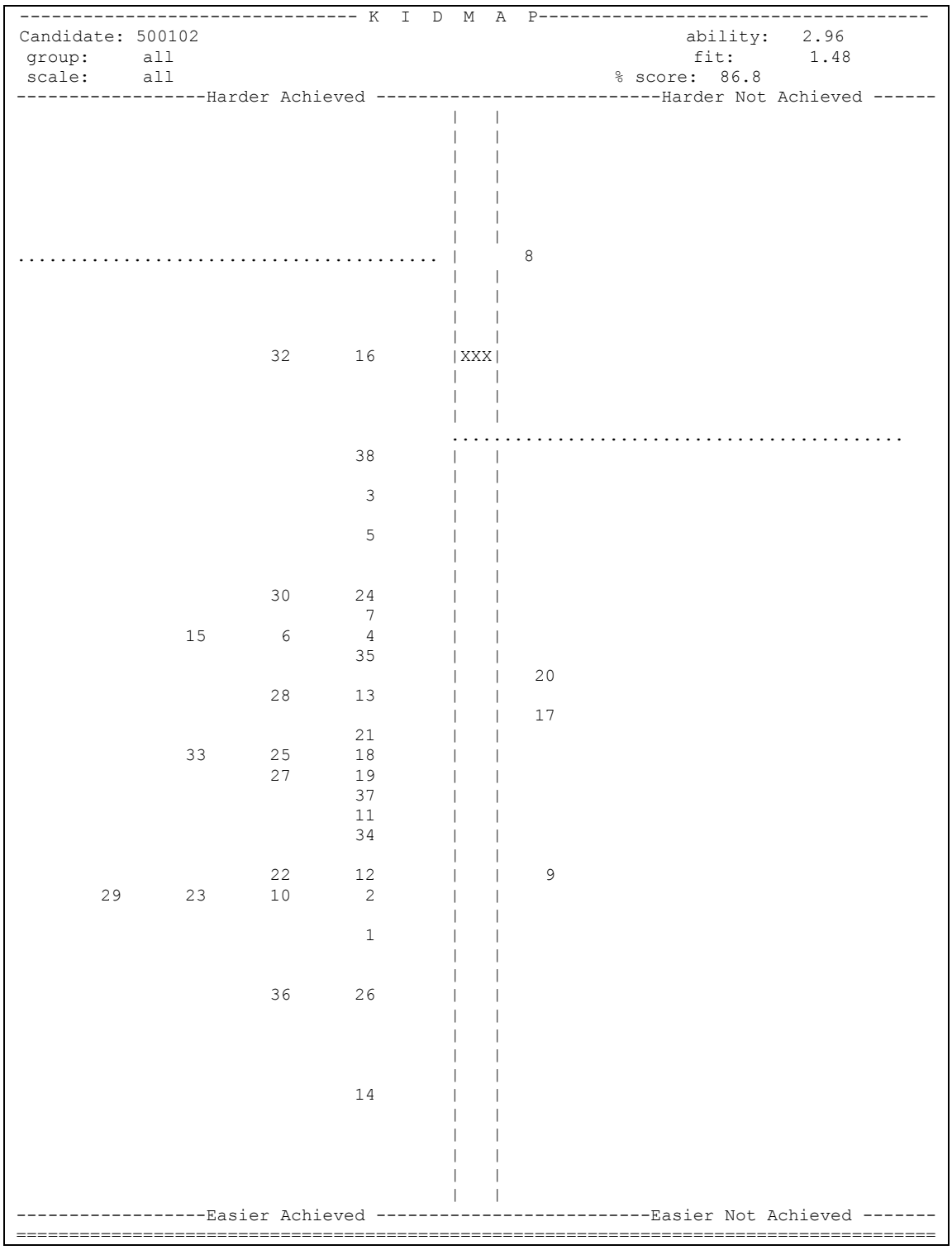


Figure 31: Kidmap of the Top Teacher

The other two sections: *Harder Achieved* and *Easier Achieved* on the kidmap in Figure 31, to the left of the middle vertical lines, together show all the items Case 500102 got correct. All the harder items she tried were incorrect (Item 8, including the zero score Item 31 [not mapped]) and she was successful with two, relatively average items (Items 32 and 16); theoretically, she would have about average probability of being successful. All the other items Candidate 500102 got correct were located below her ability location which according to the Rasch Model, she had above average probability of being successful.

In the cohort item-person map (Figure 29) at the bottom end of the continuum are two cases located at just above the level of the easiest Item 14 (-3.13 logits). They both got only 4 out of 38 items correct (ability estimate -2.83) and are from two different schools, Case 200103 (STM PS) and Case 600106 (STP PS). Provided in Figure 32 are the kidmaps of these two cases showing items they each got correct (left of vertical lines) and those they got incorrect on the right. The incorrect items (majority of the test items) indicate areas of their mathematics content knowledge and skills that require addressing if they are to be competent with the content knowledge of the primary mathematics curriculum.

Provided in Table 51 are the ranked test items, percentage correct, difficulty estimates, and item descriptions. Of the 38 items, only 14 items had majority (>50%) percentage correct. These are Items 37, 11, 34, 12, 22, 9, 29, 10, 2, 23, 1, 26, 36, and 14 in decreasing order of difficulty. There was one item with zero score, that is, zero percent correct with the next two most difficult items being Items 8 and 16 with 2.3% and 4.7% respectively, correct.

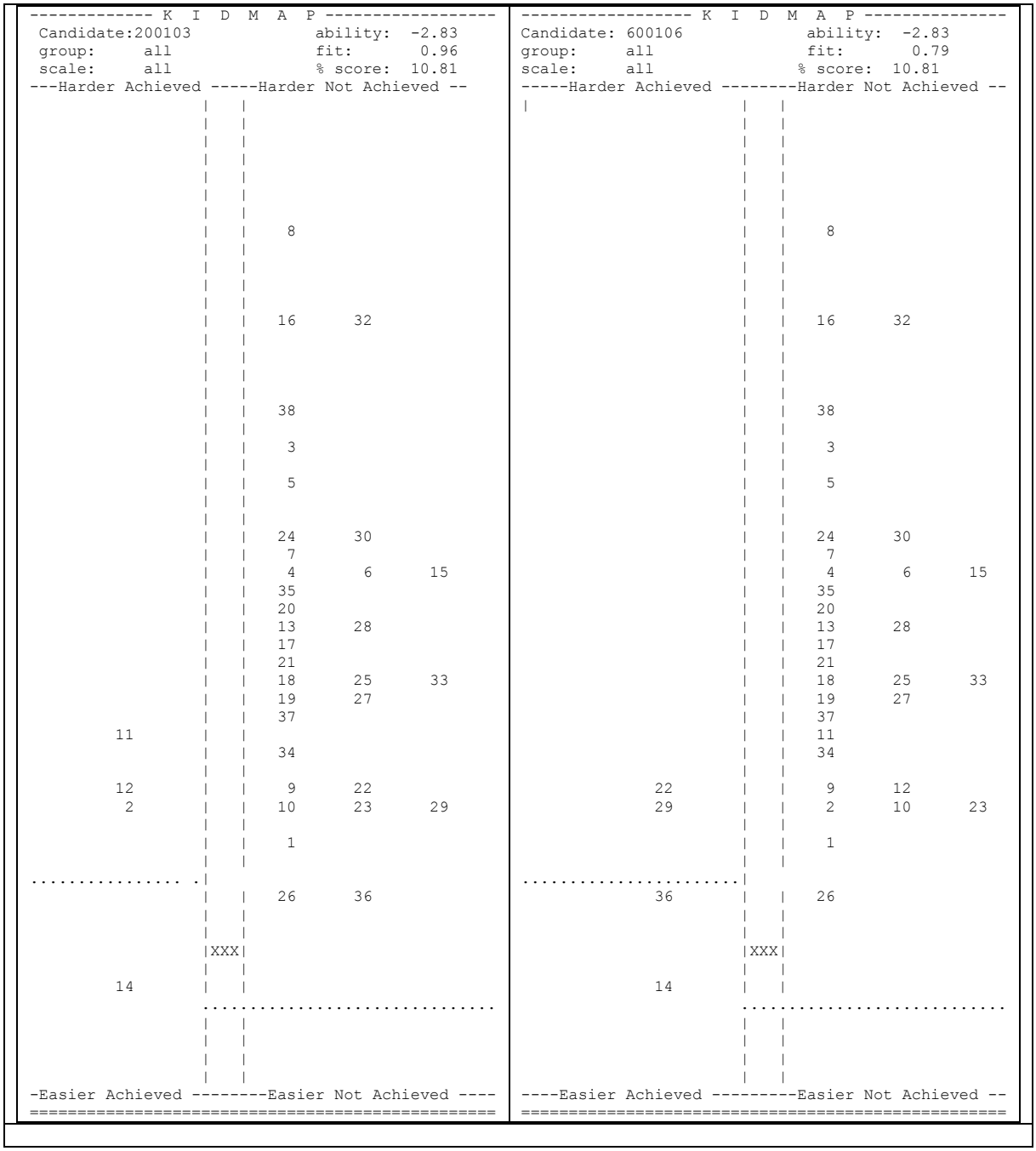


Figure 32: Kidmap of the Two Lowest Placed Teachers

Table 51: Teachers' Test Ranked Items and Item Descriptions

Rank	ITEM #	% Correct	ESTIMATE	Item Descriptions
1	31	0	Zero score	A pile of salt contains 500 individual crystals and has a weight of 6.5g. What is the average weight of a salt crystal?
2	8	2.3	3.89	Arrange these fractions in descending order: $\frac{2}{3}, \frac{5}{6}, \frac{3}{8}, \frac{7}{10}, \frac{3}{5}$
3	16	4.7	3.12	A new rectangle has length which is three-fourths the length of the rectangle below, and whose width is two and one-half times the width of the rectangle below. What is the ratio of the area of the original rectangle to the area of the new one?
4	32	4.7	3.12	An exercise book costs 60 sene at Emile's Store. Sina bought the book when the price was reduced by 30%. How much did Sina save?
5	38	9.3	2.28	If we produced Figure 60 we would require 1891 blocks. Explain how you would calculate the number of blocks required to construct Figure 61.
6	3	11.6	2.00	What is $\frac{x}{3} > 8$ equivalent to?
7	5	16.3	1.54	Place either + or $-$ into each box so that this expression has the greatest possible total.
8	24	23.3	1.01	Tickets for a concert cost either 10 sene, 15 sene or 30 sene. Of the 900 tickets sold, $\frac{1}{5}$ cost 30 sene each and $\frac{2}{3}$ cost 15 sene each. What fraction of the tickets was sold for 10 sene each?
9	30	23.3	1.01	Sound travels at approximately 330 m/sec. A lighting strike was followed 4.5 seconds later by a clap of thunder. How far away did the lightning strike?
10	7	25.6	0.86	An unknown number *n* is doubled and then 9 is subtracted from the result. The final answer is 87. Write this as a mathematical equation (do not solve for *n*).
11	15	27.9	0.71	A rectangular garden bed adjoins a building as shown in the diagram below. The garden bed has a path on 3 sides. What is the area of the path?
12	4	27.9	0.71	What is $\frac{2}{5} + \frac{5}{4} + \frac{9}{8} = ?$
13	6	27.9	0.71	Arrange these decimals in ascending order: 0.625, 0.25, 0.03, 0.5, 0.125
14	35	30.2	0.57	A fertilizer mix contains 200g of nitrate, 300g of phosphate and 600g of potash. What is the ratio of the weight of the nitrate to the total weight of the fertilizer?
15	20	32.6	0.44	In the diagram below, line *l* is parallel to line *m*. The measure of angle *DAC* is 55°, find the value of $x + y$ (in degrees).
16	13	34.9	0.32	A sample of 100 light bulbs is chosen at random from a complete batch containing 3000 light bulbs. When the sample is tested, it is found to contain 5 faulty light bulbs. How many faulty globes would you expect to find in the complete batch?
17	28	37.2	0.19	Provide a statement that is equivalent to: $4n - n + 7m - 2m$.
18	17	39.5	0.07	The triangles shown are congruent. The measures of some of the sides and angles are given. What is the value of $x°$?
19	21	41.9	-0.05	Find the value of x if $12x - 10 = 6x + 32$.
20	18	44.2	-0.17	Last year there were 92 boys and 83 girls in Falemole School. This year there are 210 students, and 97 are boys. How many more girls are there this year than last year?
21	33	44.2	-0.17	There are 30 students in a class. The ratio of boys to girls in the class is 2:3. How many boys are there in the class?
22	25	46.5	-0.28	A bowl contains 36 coloured marbles all of the same size: some blue, some green, some red, and the rest yellow. A marble is drawn from the bowl without looking. The probability that it is blue is $\frac{4}{9}$. How many blue marbles are in the bowl?
23	27	48.8	-0.40	What is the perimeter of a square whose area is 100 square metres?
24	19	48.8	-0.40	Sani used the same rule to get the number in the (square) from the number in (triangle). What was the rule?
25	37	53.5	-0.63	How many blocks would be needed to construct Figure 8 if the same pattern is maintained?
26	11	55.8	-0.75	If 4 times a number is 48, what is one third of the number?
27	34	60.5	-0.99	What is the area of the shaded triangle?
28	12	65.1	-1.23	Mele, Luka, Roni, and Pita sold tickets for the school concert. The graph shows the number of tickets each sold. Two people together sold the same number of tickets as Mele. Who were they?
29	22	65.1	-1. 23	Write three fractions that are equivalent to $\frac{2}{3}$.
30	9	65.1	-1.23	A bus travels at a constant speed so that the distance travelled is directly proportional to the time spent traveling. If the bus travels 120 km in 5 hours, how many kilometres does it travel in 8 hours?
31	29	67.4	-1. 36	In the triangle ABC, what is the length of the side *AB*?
32	10	67.4	-1. 36	The smaller box contains 20 tickets numbered from 1 to 20. The larger box contains 100 tickets numbered from 1 to 100.
33	2	67.4	-1.36	What is 0.402 x .53 = ?
34	23	69.8	-1.49	What is the measure of the angle C in the triangle below?
35	1	74.4	-1.77	What is the value of 3.4×10^2?
36	26	81.4	-2.26	What fraction of this rectangle is shaded?
37	36	81.4	-2.26	Complete the table of values (for Figure 5)
38	14	90.7	-3.16	On a school trip there was 1 teacher for every 12 students. If 108 students went on the trip, how many teachers were on the trip?

Teacher Questionnaires

From the eight schools, 36 teacher questionnaires were received; eight Year 4, seven Year 3, nine Year 2 and twelve Year 1 teachers. There were four different questionnaires, one for each Year Level. The results are organised by Year Levels from across the eight schools.

Year 4 Teachers

Eight Year 4 teachers completed the questionnaires from the eight schools of the sample. Six Year 4 teachers are females and two are males. The results provided in Table 52 show that 2 out of the 8 teachers (25%) are at least 40+ years of age and 50% are 30+ years of age with a quarter under 25 years old.

Table 52: Year 4 Teachers' Age

Age Group	Number	Percentage
Under 25	2	25
25-29	0	0
30-39	4	50
40-49	2	25
50-59	0	0

Teaching Experience

The results in Table 53 show that half the Year 4 teachers have less than 5 years of teaching experience with another quarter of them having between 5 and 9 years teaching and another quarter with at least 20 years of teaching experience. Of the 8 Year 4 teachers, three-quarters of them have taught Year 4 classes for less than 5 years while the rest of the teachers have between 10 and 19 years teaching experience as shown in Table 53.

Table 53: Year 4 Teachers' Teaching Experience and Years Teaching Year 4

	N = 8 Percentage of teachers	**1 <5yrs**	**2 5-9 yrs**	**3 10-19 yrs**	**4 20-29 yrs**
1	Total years of teaching	50	25	0	25
2	Number of years teaching Year 4	75	0	25	0

Teaching Certificate

Seven of the eight Year 4 teachers (87.5%) reported they have a teaching certificate with the minimum formal education being either Form 5 (or School Certificate) and/or a Diploma of Education (Primary).

Year 4 Teacher Interactions

The frequency of various types of interactions the teacher has with colleagues are summarised in Table 54. The results indicate that collegial interactions to discuss teaching methods are frequent activities occurring one to three times a week for half the teachers, 2 to 3 times a month for another quarter of the teachers while it is never the case for another 25% of the teachers. Relatively more interactions are reported by 75% of the teachers to prepare instructional materials once to three times a week while it was more of a monthly activity for one teacher and never for another. Visits to other classrooms to observe colleagues teaching never happens for half the teachers but occurs once to three times a week for 12.5% of the teachers and 2 to 3 times monthly for another 37.5% of the teachers. Half the teachers never have informal observations of their classroom by another teacher and 2 to 3 times monthly and 1 to 3 times a week for 37.5% and 12.5% respectively, of the teachers.

Table 54: Year 4 Teacher Interactions

	N = 8	1 Never or almost never	2 2 or 3 times a month	3 1-3 times per week	4 Daily or Almost daily
1	Discussions about how to teach a particular concept	25	25	50	0
2	Working on preparing instructional materials	12.5	12.5	75	0
3	Visits to another teacher's classroom to observe his/her teaching	50	37.5	12.5	0
4	Informal observations of my classroom by another teacher	50	37.5	12.5	0

School Safety

Mathematics teachers' perception of safety in school summarises teachers' reports of how safe and secure they feel in their schools. Teachers responded to each item using a 4-point scale: *agree a lot* = 1, *agree* = 2, *disagree* = 3, and *disagree a lot* = 4 resulting in the percentage distribution of endorsement provided in Table 55. The evidence indicates that the majority of teachers agree their school is in a safe neighbourhood, they feel safe in school and that the school's security policies and practices are sufficient. Only 25% of the teachers disagreed that the school was in a safe neighbourhood.

Table 55: Year 4 Teachers' Report on Safety in School

	N = 9	1 Agree a lot	2 Agree	3 Disagree	4 Disagree a lot
1	This school is located in a safe neighbourhood	37.5	37.5	25	0
2	I feel safe at this school	75	25	0	0
3	This school's security policies and practices are sufficient	43	57	0	0

Adequacy of School Facilities

Teachers' report of adequate working conditions summarizes teachers' perspectives on the availability of school resources and how these affect their capacity to provide effective mathematics instruction. Teachers rated problems in their school by severity on a 3-point scale: *not a problem* = 1; *minor problem* = 2; and *serious problems* = 3. The three questionnaire statements are as listed in Table 56. The percentage distribution of teachers' ratings indicated that 43% of teachers rated the need for significant repairs to school buildings to be not a problem with another 43% rating it as a minor problem while 14% viewed it as a serious problem. Classrooms as being overcrowded was considered by 50% of the teachers as a serious problem with a quarter regarding it as a minor problem in their schools compared to another quarter who considered it to be not a problem in their school. Having inadequate workspace outside of their classrooms was considered not a problem by 37.5% of the teachers with half the teachers rating it as a minor problem and 12.5% considered it to be a serious problem. As for having computers available for staff use, 50% of the teachers viewed it as not a problem with 37.5% rating it as a serious problem and 12.5% considered it was a minor problem.

Table 56: Year 4 Teachers' Reports on Severity of School Facility Problems

	N = 7	1 Not a problem	2 Minor problem	3 Serious problem
a	The school building needs significant repair	43	43	14
b	Classrooms are overcrowded	25	25	50
c	Teachers do not have adequate workspace outside of their classroom	37.5	50	12.5
d	Computers are not available for staff use	50	12.5	37.5

School Climate for Learning Mathematics

The report of teachers' perception of school climate summarize teachers' reports about their school and how supportive the climate is for learning in terms of their rating of job satisfaction, parental support and involvement, expectations for student achievement, students' desire to do well in school and their regard for school property. The summary percentage distribution of teachers' responses on a 5-point scale: *very high* = 1, *high* = 2, *medium* = 3, *low* = 4, and *very low* = 5 per attribute is provided in Table 57. The results indicate that the majority of the teachers rated all the attributes from high to very high in their schools.

Table 57: Year 4 Teachers' Report on School Climate

	N = 12	1 % Very high	2 % High	3 % Medium	4 % Low	5 % Very low
1	Teachers' job satisfaction	50	37.5	12.5	0	0
2	Teachers' understanding of the school's curricular goals	25	62.5	12.5	0	0
3	Teachers' degree of success in implementing the school's curriculum	12.5	75	12.5	0	0
4	Teachers' expectations for student achievement	37.5	37.5	12.5	12.5	0
5	Parental support for student achievement	12.5	50	0	37.5	0
6	Parental involvement in school activities	12.5	50	25	12.5	0
7	Students' regard for school property	25	37.5	12.5	25	0
8	Students' desire to do well in school	25	37.5	25	12.5	0

Teachers' Preparedness to Teach Year 4 Mathematics

Teachers' perception of their preparedness to teach the prescribed numeracy and mathematics topics of the Year 4 curriculum (in Table 58) are rated on a 4-point scale: *very well-prepared* = 3, *somewhat prepared* = 2, *not well-prepared* = 1, and *not applicable* = 0. The summary percentage distribution of the teachers' responses by topic and by response category is provided in Table 59, in descending order of the 'very well-prepared' percentage. The results indicate that at least half up to three-quarters of the teachers considered themselves to be 'very well-prepared' to teach only 37% ($\frac{22}{60}$) of the 60 prescribed topics. For the same 22 topics, one-eighth to half of the remaining teachers perceived themselves to be 'somewhat prepared' with the remaining teachers (up to one-quarter) considering themselves to be 'not well-prepared' at all or considered the topic to be 'not applicable'.

Mathematics Class Size and Weekly Time Allocation

Total students in the sampled mathematics classes was 40+ for half of the teachers, 30+ for 25% of the teachers and the other 2 teachers each had 20+ classes. The weekly total number of minutes a teacher teaches mathematics to her/his class ranged from 50 minutes (12.5%) to 200 minutes (50%), 250 minutes (12.5%) and up to 300 minutes (25%).

Mathematics Textbook and Resources

Eighty seven and a half percentage (87.5%) of the teachers used a mathematics textbook as a primary source (75%) or a supplementary resource (25%) while 75% of the teachers used the new teachers' manual as the primary basis (57%) or a supplementary resource (29%) for their lessons. Eighty seven and a half percentage (87.5%) of the teachers also used PEMP student resources books as a basis of their lessons (37.5%) or a supplementary resource (50%). Using other resources such as SRA Mathematics and raw materials is done by three-quarters of the teachers.

Table 58: Year 4 Prescribed Mathematics Topics

Number and Operations (NR)

a. Counting forwards to, and backwards from, 9999, by hundreds and thousands from any starting point
b. Recognising, reading, partitioning, regrouping, representing, and ordering numbers up to 9999 using place value
c. Modelling addition and subtraction involving up to four-digit numbers by applying a range of mental strategies
d. Describing, justifying and recording formal algorithms for adding and subtracting
e. Developing mental fluency with number facts up to 12×12
f. Finding multiples and cubes of numbers
g. Interpreting remainders in division problems and as fraction and decimals
h. Using efficient mental and informal written strategies for multiplying or dividing a two-digit number by a one-digit operator using multiplication facts up to 12×12
i. Modelling, comparing and representing fractions with denominators 2, 3, 4, 5, 6, 8 10, and 100 and extending to denominator 12
j. Finding equivalence between halves, tenths, and hundredths; fifths, tenths and hundreds; and thirds and sixths
k. Adding and subtracting decimals with the same number of decimal places (to 2 decimal places)
l. Recognising percentages in everyday situations and relating a common percentage (benchmark) to a fraction or decimal
m. Solving problems involving calculations with money
n. Predicting the outcomes of chance experiments involving equally likely events
o. Collecting and organizing data to compare likelihood of events under various conditions
p. Determining the probability of outcomes of experiments with small numbers of trials

Number Patterns (PA)

a. Creating, describing and extending number patterns and completing simple number sentences using various strategies
b. Analysing and describing change in growing patterns and using tables and graphs to base conclusions
c. Modelling and extending quantitative relationships involving multiplication and division facts to at least 12×12
d. Determining the value of a missing number in simple number sentences involving two operation

Data Representation (DA)

a. Planning and undertaking investigations to answer questions about familiar situations, classifying and organizing data using tables
b. Reading and interpreting data presented in tables, column graphs and picture graphs
c. Drawing conclusions from data displays
d. Displaying data using tables, pictographs, bar graphs, or pie charts

Measurement (MS)

a. Using formal units: metres, millimetres and centimetres & yards, feet and inches to estimate, measure, compare, order, and record lengths and distances
b. Carrying out simple unit conversion within each measurement system (e.g. between metres, centimetres and millilitres & between yards, feet and inches)
c. Developing 'real-life' benchmarks for a length of one millimetre and one inch
d. Estimating using benchmarks and measuring using formal units the perimeter of two-dimensional shapes

Measurement (MS) *cont'd*

e. Using decimal notation to two places to record lengths and distances
f. Understanding the need for, and use, larger formal units: square measures and square feet to measure area
g. Converting between area units within each measurement system
h. Using square metres and square feet to estimate, measure, compare and record areas
i. Exploring what happens to perimeters and areas of rectangles when the shape is changed in some ways
j. Understanding the need for, and use, smaller formal units: millilitres and pints to measure capacity and volume
k. Using formal units to estimate, measure and compare capacity and volume
l. Comparing, estimating and measuring volume of objects using rise in water level or overflows
m. Converting measurements from one unit to another within each measurement system
n. Converting between pints, millilitres and cubic inches
o. Using formal units to record measurements using decimal notation to one decimal
p. Understanding the need for, and use, smaller formal units (grams and ounces) to measure mass
q. Using formal units to estimate, measure, compare and record masses
r. Understanding, recognizing, reading and recording time in one-minute intervals
s. Making comparisons between time units and using digital and analogue notation to read and record time
t. Converting between units of time
u. Telling time to the minute on digital and analogue clocks
v. Reading and interpreting simple timetables, timelines and calendars of real-life situations

Space and Geometry (SG)

a. Naming, explaining, classifying, modelling and drawing prisms, cylinders, cones and spheres showing depth
b. Examining and constructing nets from everyday packages
c. Exploring, identifying and describing cross-sections of three-dimensional objects
d. Rearranging, labelling, comparing, describing, building models of, and drawing two-dimensional shapes including octagons presented in different orientations
e. Grouping two-dimensional shapes using multiple attributes
f. Using translations and rotations to create tessellating designs
g. Using symmetry and identifying symmetry in the environment and tapa designs to create symmetrical patterns
h. Recognising and describing two-dimensional shapes using the terms 'parallel sides' and 'right angles'
i. Describing and sorting angles into groups of 'equal to', 'greater than' or 'less than' a right angle
j. Understanding and recognizing the angle in a turn where one arm is visible
k. Comparing and ordering angles of adjacent sides of shapes in relation to a right angle
l. Representing position and follow routes using simple maps and grids
m. Determining the directions NE, NW, SE and SW, given one of the directions
n. Using coordinates or compass directions to describe the location of an object on a simple map

Table 59: Year 4 Teachers' Ranked Preparedness to Teach Year 4 Mathematics Topics

	Strand	Year 4 Topics	3 % Very well-prepared	2 Somewhat Prepared %	1 % Not well-prepared	0 % Not applicable
1	NRb	Recognising, reading, partitioning, regrouping, representing, and ordering numbers up to 9999 using place value	75	12.5	12.5	0
2	PAa	Creating, describing and extending number patterns and completing simple number sentences using various strategies	75	25	0	0
3	MSa	Using formal units: metres, millimetres and centimetres & yards, feet and inches to estimate, measure, compare, order, and record lengths and distances	75	25	0	0
4	MSd	Estimating using benchmarks and measuring using formal units the perimeter of two-dimensional shapes	75	12.5	12.5	0
5	MSt	Converting between units of time	75	25	0	0
6	MSu	Telling time to the minute on digital and analogue clocks	75	25	0	0
7	SGh	Recognising and describing two-dimensional shapes using the terms 'parallel sides' and 'right angles'	71	14	14	0
8	NRc	Modelling addition and subtraction involving up to four-digit numbers by applying a range of mental strategies	62.5	37.5	0	0
9	NRk	Adding and subtracting decimals with the same number of decimal places (to 2 decimal places)	62.5	25	12.5	0
10	PAd	Determining the value of a missing number in simple number sentences involving two operation	62.5	37.5	0	0
11	MSs	Making comparisons between time units and using digital and analogue notation to read and record time	62.5	25	0	12.5
12	MSv	Reading and interpreting simple timetables, timelines and calendars of real-life situations	62.5	25	0	12.5
13	SGa	Naming, explaining, classifying, modelling and drawing prisms, cylinders, cones and spheres showing depth	62.5	37.5	0	0
14	SGc	Exploring, identifying and describing cross-sections of three-dimensional objects	62.5	25	12.5	0
15	SGd	Rearranging, labelling, comparing, describing, building models of, and drawing two-dimensional shapes including octagons presented in different orientations	62.5	25	12.5	0
16	MSr	Understanding, recognizing, reading and recording time in one-minute intervals	57	29	0	14
17	NRe	Developing mental fluency with number facts up to 12 × 12	50	25	25	0
18	PAc	Modelling and extending quantitative relationships involving multiplication and division facts to at least 12 × 12	50	50	0	0
19	DAa	Planning and undertaking investigations to answer questions about familiar situations, classifying and organizing data using tables	50	37.5	12.5	0
20	MSb	Carrying out simple unit conversion within each measurement system (e.g. between metres, centimetres and millilitres & between yards, feet and inches)	50	37.5	12.5	0
21	MSf	Understanding the need for, and use, larger formal units: square measures and square feet to measure area	50	25	12.5	12.5
22	SGm	Determining the directions NE, NW, SE and SW, given one of the directions	50	25	25	0
23	SGe	Grouping two-dimensional shapes using multiple attributes	42.9	57.1	0	0
24	NRa	Counting forwards to, and backwards from, 9999, by hundreds and thousands from any starting point	37.5	62.5	0	0
25	NRf	Finding multiples and cubes of numbers	37.5	37.5	25	0
26	NRh	Using efficient mental and informal written strategies for multiplying or dividing a two-digit number by a one-digit operator using multiplication facts up to 12 × 12	37.5	50	12.5	0
27	DAc	Drawing conclusions from data displays	37.5	25	25	12.5
28	MSe	Using decimal notation to two places to record lengths and distances	37.5	25	25	12.5
29	MSg	Converting between area units within each measurement system	37.5	37.5	25	0
30	MSh	Using square metres and square feet to estimate, measure, compare and record areas	37.5	25	12.5	25
31	MSj	Understanding the need for, and use, smaller formal units: millilitres and pints to measure capacity and volume	37.5	37.5	12.5	12.5
32	MSl	Comparing, estimating and measuring volume of objects using rise in water level or overflows	37.5	37.5	12.5	12.5
33	MSm	Converting measurements from one unit to another within each measurement system	37.5	50	12.5	0
34	SGj	Understanding and recognizing the angle in a turn where one arm is visible	37.5	37.5	25	0
35	SGi	Describing and sorting angles into groups of 'equal to', 'greater than' or 'less than' a right angle	29	43	29	0
36	MSq	Using formal units to estimate, measure, compare and record masses	28.6	28.6	0	43
37	MSp	Understanding the need for, and use, smaller formal units (grams and ounces) to measure mass	28.6	28.6	14.3	28.6
38	NRd	Describing, justifying and recording formal algorithms for adding and subtracting	25	75	0	0
39	NRg	Interpreting remainders in division problems and as fraction and decimals	25	75	0	0

Table 59: Year 4 Teachers' Ranked Preparedness to Teach Year 4 Mathematics Topics - *continued*

40	NRi	Modelling, comparing and representing fractions with denominators 2, 3, 4, 5, 6, 8 10, and 100 and extending to denominator 12	25	75	0	0
41	NRl	Recognising percentages in everyday situations and relating a common percentage (benchmark) to a fraction or decimal	25	62.5	12.5	0
42	NRm	Solving problems involving calculations with money	25	37.5	37.5	0
43	NRn	Predicting the outcomes of chance experiments involving equally likely events	25	50	12.5	12.5
44	PAb	Analysing and describing change in growing patterns and using tables and graphs to base conclusions	25	75	0	0
45	DAb	Reading and interpreting data presented in tables, column graphs and picture graphs	25	50	12.5	12.5
46	DAd	Displaying data using tables, pictographs, bar graphs, or pie charts	25	50	12.5	12.5
47	MSc	Developing 'real-life' benchmarks for a length of one millimetre and one inch	25	37.5	37.5	0
48	MSi	Exploring what happens to perimeters and areas of rectangles when the shape is changed in some ways	25	62.5	0	12.5
49	MSo	Using formal units to record measurements using decimal notation to one decimal	25	25	25	25
50	SGb	Examining and constructing nets from everyday packages	25	50	12.5	12.5
51	SGn	Using coordinates or compass directions to describe the location of an object on a simple map	25	50	25	0
52	NRo	Collecting and organizing data to compare likelihood of events under various conditions	14	57	14	14
53	NRj	Finding equivalence between halves, tenths, and hundredths; fifths, tenths and hundreds; and thirds and sixths	12.5	62.5	12.5	0
54	NRp	Determining the probability of outcomes of experiments with small numbers of trials	12.5	50	25	12.5
55	MSk	Using formal units to estimate, measure and compare capacity and volume	12.5	37.5	25	25
56	MSn	Converting between pints, millilitres and cubic inches	12.5	37.5	25	25
57	SGf	Using translations and rotations to create tessellating designs	12.5	50	12.5	25
58	SGg	Using symmetry and identifying symmetry in the environment and tapa designs to create symmetrical patterns	0	57	14	29
59	SGk	Comparing and ordering angles of adjacent sides of shapes in relation to a right angle	0	62.5	25	12.5
60	SGl	Representing position and follow routes using simple maps and grids	0	62.5	25	12.5

Student Learning Activities in Mathematics

Teachers reported the percentage of time students spend doing various learning activities in a typical week of mathematics lessons. The results, shown in Table 60, indicate that majority of teachers (62.5%) tend to allocate at least 10% to 20% of their mathematics lesson time during the week to individual or small group activities, reviewing homework, taking quizzes/tests, and solving problems without teacher guidance. Also three-quarters (75%) of the teachers have their students listen to lecture-style presentations and solve problems with teacher guidance for 10% up to 20% of the time. Furthermore, it appears that the majority of the teachers (62.5%) have students spend less than 10% of the weekly mathematics lesson time doing management tasks and listening to teachers' re-teaching and clarification of knowledge, skills and processes with three-quarters of the teachers having students engage with other activities for less than 10% of the time in a typical week.

Table 60: Percentage of Time Year 4 Students Spend on Learning Activities

	≤10%	10 – 20%
a. Doing individual or small group activities	37.5	62.5
b. Listening to you re-teach and clarify relevant Knowledge & Skills and Working Mathematically Processes	62.5	37.5
c. Reviewing homework	37.5	62.5
d. Taking tests or quizzes	37.5	62.5
e. Listening to lecture-style presentations	25	75
f. Solving problems with your guidance	25	75
g. Solving problems on their own without your guidance	37.5	62.5
h. Participating in classroom management tasks not related to the lesson' content / purpose (eg interruptions and keeping order)	62.5	37.5
i. Other student activities	75	25

Calculator Use and Computer Access

The majority of the teachers (88%) reported that calculators are not permitted during mathematics lessons. Furthermore, they reported that calculators are never used at all to check answers, do routine computations, solve complex problems or explore concepts. Also students have no computers for their use during their mathematics classes and no access to internet. Because there are no computers available for student use, students never use computers to discover mathematics principles and concepts, practice skills and procedures and/or look up ideas and information in mathematics.

Mathematics Content Related Activities

Frequency with which the Year 4 teacher asks students to do various content-related activities in mathematics are summarised in Table 61. For example, half to seven-eighths of the teachers, in about half up to every (or almost every) lesson have their students model the four operations without using calculators; explain their answers; relate what they are learning in mathematics to daily life; and memorise formulas. A majority of the teachers, in some lessons, have students work on fractions, decimals and percentages (62.5%); measure things around their school environment (75%); make tables, charts, column graphs and pictographs (75%); learn about shapes (75%); and write equations for word problems (62.5%) with half of the teachers having students relate mathematics to their daily lives. There are also teachers (12.5%) who never do the majority of these activities as shown in Table 61.

Table 61: Percentage of Time Year 4 Students Spend on Content Related Activities

N=7	1 Every / almost every lesson	2 About half the lessons	3 Some lessons	4 never
a. Model addition, subtraction, multiplication, and division without using a calculator	50	12.5	25	12.5
b. Work on fractions, decimals and percentages	12.5	25	62.5	0
c. Measure things in the classroom and around the school	12.5	0	75	12.5
d. Make tables, charts, column graphs and pictographs	0	12.5	75	12.5
e. Learn about shapes such as circles, triangles, rectangles, cubes, prisms, cylinders, cones and spheres	12.5	12.5	75	0
f. Write equations for word problems	12.5	25	62.5	0
g. Explain their answers	75	12.5	12.5	0
h. Relate what they are learning in mathematics to their daily life	50	0	50	0
i. Memorising formulas and procedures	50	12.5	37.5	0

Emphasis on Mathematics Content Areas

Teachers reported on the emphasis they put on mathematics content areas in terms of the percentage of time spent on each content area during the school year. The results, provided in Table 62, demonstrate that the majority of the teachers teach 'number and operations' (75%) and 'number patterns' (62.5%) topics for about 20 up to 30% of the school year. In about less than 15% of the time, three quarters of the teachers teach 'data representation' topics. As for the rest of the strands: 'measurement' and 'space & geometry', half the teachers teach them for less than 15% of the time and the other half for 20 to 30% of the school year.

Table 62: Year 4 Percentage of Time Spent on Content Areas in a School Year

Percentage of the time	**<15%**	**20% - 30%**
Strand		
Number & Operations	25	75
Number Patterns	37.5	62.5
Data Representation	75	25
Measurement	50	50
Space & Geometry	50	50

Mathematics Homework

Hundred percent (100%) of the teachers reported that homework is assigned to students. Three-eighths (37.5%) reported homework is assigned in every, or almost every lesson and another three-eighths about half the lessons (37.5%) or some lessons (25%). The amount of homework assigned is expected to take an average student 15 to 30 minutes according to half the teachers and 31 to 60 minutes as estimated by three-eighths of the teachers. One teacher (12.5%) indicated that his/her assigned homework would take an average student more than 90 minutes.

Student Factors Limiting the Teaching of Mathematics Classes

Table 63 showed the percentage distribution of teachers' ratings of the five statements about student factors limiting mathematics instruction on a 4-point scale: *not at all/ not applicable* = 1; *a little* = 2; *some* = 3; and *a lot* = 4. Half the teachers reported that students with different academic abilities limit their teaching to a lot of extent, a little extent (37.5%) compared to 12.5% of the teachers who considered this factor as not a problem at all. Also, the teachers are split between the impact of students of different language and economic backgrounds on their mathematics teaching; some claim it is not or some problem (25% each) and the others (37.5%) say it limits their teaching to a lot of extent with 12.5% indicating it is a little problem. While students with special needs is not a limiting factor to half the teachers, a quarter viewed it as affecting their teaching to a little extent with another quarter perceiving it as limiting her/his teaching a lot. Furthermore, uninterested students is a not a problem to a quarter of the teachers but 37.5%, 12.5% and 25% find it limits their teaching to a little, some and a lot of extent respectively. For disruptive students, one-eighth of the teachers consider it not a problem and another one-eighth view it as a lot of problems while 37.5% indicated it was a little limiting to some extent for the same percentage of teachers as shown in Table 63.

Table 63: Year 4 Teachers' Reports on Student Factors Impacting the Teaching of Mathematics

In your view, to what extent do the following limit how you teach mathematics to your class?

	N = 7	1 Not at all	2 A little	3 some	4 A lot
a	Students with different academic abilities	12.5	37.5	0	50
b	Students who come from a wide range of backgrounds (eg, economic, language)	25	12.5	25	37.5
c	Students with special needs (eg, hearing, vision, speech impairment, physical disabilities, mental or emotional / psychological impairment)	50	25	0	25
d	Uninterested students	25	37.5	12.5	25
e	Disruptive students	12.5	37.5	37.5	12.5

Year 4 Mathematics Topic Coverage

Teachers' report on when the mathematics topics covered in Test 4 were taught, by content area, using a 3-point scale: *mostly taught before this year* = 1, *mostly taught this year* = 2, and *not yet taught or just introduced* = 3. The percentage distribution of teachers' endorsement of response categories are summarised in Table 64 and ranked by the 'mostly taught this year' category percentage to highlight the prescribed Year 4 topics that have been taught already in the 2013 school year. The results show that half up to seven-eighth of the teachers indicated they 'mostly taught this year' 73% ($\frac{27}{37}$) of the 37 topics assessed by Test 4. For the same topics, up to three-eighth of the teachers responded these were 'mostly taught before this year' with up to one-eighth of the teachers indicating they were 'not yet taught or just introduced' this year.

Table 64: Year 4 Teachers' Ranked Mathematics Topic Coverage

#	Topic	TOPIC	1 Mostly taught before this year	2 Mostly taught this year	3 Not yet taught or just introduced
1	NRg	Recording division problems using numerals and symbols	12.5	87.5	0
2	NRo	Equal sharing of objects resulting in shares that are simple fractions	12.5	87.5	0
3	MSe	Finding and comparing areas of given shapes by counting squares	12.5	87.5	0
4	NRa	Partitioning and regrouping three-digit numbers	25	75	0
5	NRF	Using multiplication facts to compute given products	12.5	75	12.5
6	NRJ	Calculating number of items to buy in a transaction involving computation with decimals	25	75	0
7	NRM	Determining and modelling the equivalent of a quarter of an object	12.5	75	12.5
8	NRN	Solving division problems with remainders	25	75	0
9	MSD	Finding perimeter of composite figures	12.5	75	12.5
10	NRK	Decimal place value including writing decimals using numbers	12.5	62.5	25
11	NRL	Solving problems involving computation with two-digit whole numbers	25	62.5	12.5
12	PAD	Continuing a number pattern that increases	37.5	62.5	0
13	PAE	Determining missing digits in the addition of a three- and a two-digit number	37.5	62.5	0
14	PAF	Finding missing digits in the subtraction of two-digit numbers	37.5	62.5	0
15	DAB	Using information from data displays and performing computations to answer questions	37.5	62.5	0
16	MSA	Knowing the appropriate device for measuring length	25	62.5	12.5
17	MSB	Measuring and reading length from a ruler	25	62.5	12.5
18	MSC	Using measurements of length to describe features of 2D shapes	25	62.5	12.5
19	NRd	Solving problems involving addition of two-digit numbers	37.5	50	12.5
20	NRE	Finding factors of two digit numbers less than 20	25	50	25
21	NRI	Determining fractions as represented by models (shaded part of an object)	37.5	50	12.5
22	NRP	Comparing and predicting chance of an event in simple chance events	12.5	50	37.5
23	PAA	Determining the correctness of number sentences involving two operations	37.5	50	12.5
24	DAA	Reading data from tables, picture graphs, bar graphs, or pie charts	37.5	50	12.5
25	MSI	Telling time to the minute in digital notation	37.5	50	12.5
26	SGA	Identifying a design after folding and cutting paper	37.5	50	12.5
27	SGC	Identifying the top view of a cone	25	50	25
28	NRb	Addition and subtraction of two-digit numbers	62.5	37.5	0
29	PAB	Identifying the correct number pattern given a word description	72.5	37.5	0
30	PAC	Continuing a geometric pattern that increases	50	37.5	12.5
31	MSG	Finding lines of symmetry for a givens shape	25	37.5	37.5
32	SGB	Using coordinates on a simple map to describe position	12.5	37.5	50
33	NRc	Forming two-digit numbers from a given set of 8 digits	62.5	25	12.5
34	NRH	Locating a fraction (seven-eighth) on the number line	12.5	25	62.5
35	NRQ	Performing simple calculations with money	50	25	25
36	MSF	Identifying designs after rotation	12.5	25	62.5
37	MSH	Reading and estimating capacity from a calibrated measuring device	0	12.5	87.5

Year 4 Teacher Professional Development Participation

The Year 4 teachers reported whether they participated in various types of professional development activities for mathematics teaching in the last two years. Teachers' responses showed all of them attended professional development activities on 'mathematics content' and 'mathematics curriculum' while 87.5% attended professional development activities on 'improving students' critical thinking or problem solving skills' and 'mathematics assessment'. With the 'integrating information technology into mathematics' professional development activities, three-quarters of the teachers attended while only 62.5% attended those on 'mathematics pedagogy and instruction' in the last two years.

Year 3 Teachers

Seven Year 3 teachers, all females, completed the questionnaires from the eight schools of the sample. All Year 3 teachers that completed the questionnaires are female teachers. The results provided in Table 65 show that 5 out of the 7 teachers (72%) are at least 40+ years of age with the other 2 teachers between the ages of 25 and 39 years of age and none is under 25 years of age.

Table 65: Year 3 Teachers' Age

Age Group	Number	Percentage
Under 25	0	0
25-29	1	14
30-39	1	14
40-49	2	29
50-59	3	43

Teaching Experience

Forty three percent (43%) of the Year 3 teachers (see Table 66) in the study have at least twenty years of teaching experience with another 29% of them having between 10 and 19 years and another 29% with less than 5 years of teaching experience. Of the 7 Year 3 teachers, 71% of them have taught Year 3 classes for less than 5 years with one teacher who had taught Year 3 less than 10 years and one other with less than 20 years teaching Year 3 experience as shown in Table 66.

Table 66: Year 3 Teachers' Teaching Experience and Years Teaching Year 3

	N = 7	**1 <5yrs**	**2 5-9 yrs**	**3 10-19 yrs**	**4 20-29 yrs**
1	Total years of teaching	29%	0%	29%	43%
2	Number of years teaching Year 3	71%	14%	14%	0%

Teaching Certificate

All of the 7 Year 3 teachers reported they have a teaching certificate with the minimum formal education being either Form 5 (or School Certificate) and/or a Diploma of Education (Primary).

Year 3 Teacher Interactions

The frequency of various types of interactions the teacher has with colleagues are summarised in Table 67. The results indicate that collegial interactions to discuss teaching methods are frequent activities occurring either daily (or almost daily) for the majority (57%) or 1 to 3 times a week for another 29% of the teachers. Relatively less interaction is reported by 14% of teachers happening monthly two or three times to discuss how to teach a particular concept. Working on preparing instructional materials seems to be a daily (or almost daily) activity for the vast majority of Year 3 teachers (71%). Visits to other classrooms to observe colleagues teaching never happens for 29% of the teachers but occurs once to

three times a week for 57% of the teachers and 2 to 3 times monthly for another 14% of the teachers. Forty three percent of the teachers have informal observations of their classroom by another teacher 2 to 3 times monthly or 1 to 3 times a week for 29% of the teachers while it was never (or almost never) for another 29% of the teachers.

Table 67: Year 3 Teacher Interactions

	N = 9	1 Never or almost never	2 2 or 3 times a month	3 1-3 times per week	4 Daily or Almost daily
1	Discussions about how to teach a particular concept	0%	14%	29%	57%
2	Working on preparing instructional materials	0%	14%	14%	71%
3	Visits to another teacher's classroom to observe his/her teaching	29%	14%	57%	0%
4	Informal observations of my classroom by another teacher	29%	43%	29%	0%

School Safety

Mathematics teachers' perception of safety in school summarises teachers' reports of how safe and secure they feel in their schools. Teachers responded to each item using a 4-point scale: *agree a lot* = 1, *agree* = 2, *disagree* = 3, and *disagree a lot* = 4 resulting in the percentage distribution of endorsement provided in Table 68. The evidence indicates that the majority of teachers agree their school is in a safe neighbourhood, they feel safe in school and that the school's security policies and practices are sufficient. Only 29% of the teachers disagreed that the school was in a safe neighbourhood and 14% disagreed about feeling safe at his/her school.

Table 68: Year 3 Teachers' Report on Safety in School

	N = 9	1 Agree a lot	2 Agree	3 Disagree	4 Disagree a lot
1	This school is located in a safe neighbourhood	57%	0%	29%	0%
2	I feel safe at this school	57%	14%	14%	0%
3	This school's security policies and practices are sufficient	43%	29%	0%	0%

Adequacy of School Facilities

Teachers' report of adequate working conditions summarizes teachers' perspectives on the availability of school resources and how these affect their capacity to provide effective mathematics instruction. Teachers rated problems in their school by severity on a 3-point scale: *not a problem* = 1; *minor problem* = 2; and *serious problems* = 3. The three questionnaire statements are as listed in Table 69.

Table 69: Year 3 Teachers' Reports on Severity of School Facility Problems

	N = 7	1 Not a problem	2 Minor problem	3 Serious problem
a	The school building needs significant repair	57	14	14
b	Classrooms are overcrowded	29	29	43
c	Teachers do not have adequate workspace outside of their classroom	57	14	0
d	Computers are not available for staff use	71	0	29

The percentage distribution of teachers' ratings indicated that 57% of teachers rated the need for significant repairs to school buildings to be not a problem with 14% rating it as a serious problem while another 14% viewed it as a serious problem. Classrooms as being overcrowded was considered by 43% of the teachers as a serious problem with 29% regarding it as a minor problem in their schools compared to another 29% who considered it to be not a problem in their school. Having inadequate workspace

outside of their classrooms was considered not a problem by 57% of the teachers with 14% rating it as a minor problem. As for having computers available for staff use, 71% of the teachers viewed it as not a problem with 29% rating it as a serious problem.

School Climate for Learning Mathematics

The report of teachers' perception of school climate summarize teachers' reports about their school and how supportive the climate is for learning in terms of their rating of job satisfaction, parental support and involvement, expectations for student achievement, students' desire to do well in school and their regard for school property. The summary percentage distribution of teachers' responses on a 5-point scale: *very high* = 1, *high* = 2, *medium* = 3, *low* = 4, and *very low* = 5 per attribute is provided in Table 70. The majority of teachers (from 57% up to 71%) rated the listed attributes from high to very high in their schools except for an equal split of 43% between very high and low for parental support for student achievement. A 43%:43% split is also noted with students' regard for school property between high to very high and low to medium priority.

Table 70: Year 3 Teachers' Report on School Climate

	N = 12	1 % Very high	2 % High	3 % Medium	4 % Low	5 % Very low
1	Teachers' job satisfaction	0	71	29	0	0
2	Teachers' understanding of the school's curricular goals	14	57	28	0	0
3	Teachers' degree of success in implementing the school's curriculum	29	29	14	14	0
4	Teachers' expectations for student achievement	57	14	14	0	0
5	Parental support for student achievement	43	0	0	43	0
6	Parental involvement in school activities	29	29	29	14	0
7	Students' regard for school property	29	14	29	14	0
8	Students' desire to do well in school	43	14	29	14	0

Teachers' Preparedness to Teach Year 3 Mathematics

Teachers' perception of their preparedness to teach the prescribed numeracy and mathematics topics of the Year 3 curriculum (in Table 71) are rated on a 4-point scale: *very well-prepared* = 3, *somewhat prepared* = 2, *not well-prepared* = 1, and *not applicable* = 0. The summary percentage distribution of the teachers' responses by topic and by response category is provided in Table 72, in descending order of the 'very well-prepared' percentage. The results show that at least half up to all of the teachers indicated that they were 'very well-prepared' to teach 46% ($\frac{25}{55}$) of the 55 topics. For the same topics, up to 43% of the teachers responded they were 'somewhat prepared' and up to 43% indicated they were 'not well-prepared' with up to 14% considering the topics were 'not applicable'.

Mathematics Class Size and Weekly Time Allocation

Total students in the sampled mathematics classes was 50+ for 28% of the teachers, 30+ for another 28% of the teachers and the other 3 teachers each had a either a 10+, 20+ or a 40+ class. The total number of minutes a teacher teaches mathematics to her/his class ranged from 50 minutes (56%) to 150 minutes (29%) and 200 minutes (14%) per week.

Mathematics Textbook and Resources

Seventy one percent (71%) of the teachers used a mathematics textbook as a primary source while 100% of the teachers used the new teachers' manual as the primary basis (71%) or a supplementary resource (29%) for their lessons. Forty three percent of the teachers (43%) also used PEMP student resources books and 83% used other resources such as SRA Mathematics and raw materials.

Table 71: Year 3 Prescribed Mathematics Topics

Number and Operations (NR)

a. Counting forwards to, and backwards from, 999, by tens and hundreds from any starting point
b. Recognising, reading, partitioning, regrouping, representing, and ordering numbers up to 999 using place value
c. Modelling addition and subtraction involving two- and three-digit numbers by applying a range of mental strategies
d. Describing, justifying and recording informal strategies and formal written algorithm for adding and subtracting
e. Developing mental fluency with number facts up to 10 × 10
f. Extending skip counting to by fours, sevens, eights and nines
g. Finding multiples and squares of numbers
h. Interpreting division problems without remainders and linking these to relationships between operations ×, + and ÷
i. Constructing factor trees for a number
j. Using efficient mental and informal written strategies for multiplying or dividing a two-digit number by a one-digit operator using multiplication facts up to 10 × 10
k. Modelling, comparing and representing fractions with denominators 2, 4, and 8 and extending to fractions with denominator 3
l. Finding equivalence between halves, quarters and eighths
m. Adding and subtracting decimals with the same number of decimal places (to 2 decimal places)
n. Representing money values in multiple ways and calculating change in simple transactions
o. Ordering events from least likely to most likely
p. Exploring, identifying, interpreting, and recording all outcomes of a simple chance situation
q. Discussing the degree of likelihood using words such as certain, equally likely, or more or less likely, and never

Number Patterns (PA)

a. Creating, describing and extending number patterns using a range of strategies
b. Analysing and describing change in growing patterns and using tables to make predictions
c. Modelling and extending quantitative relationships involving multiplication and division facts to at least 10 × 10
d. Determining the value of a missing number in simple number sentences involving one operation

Data Representation (DA)

a. Designing investigations to answer familiar questions, deciding data to collect, carrying out the investigation, classifying and organizing data using tables
b. Reading and making connections between lists and tables of data about themselves and explaining interpretations

Measurement (MS)

a. Using formal units: metres, millimetres and centimetres & yards, feet and inches to estimate, measure, compare, order, and record lengths and distances
b. Carrying out simple unit conversion within each measurement system (e.g. between metres and centimetres & between yards and feet)
c. Developing 'real-life' benchmarks for a length of one foot and one centimetre and using these benchmarks to estimate the perimeter of table tops, desktops, windows and classroom floor
d. Using decimal notation to one place to record lengths and distances
e. Understanding the need for, and use, formal units: square centimetres and square inches to measure area

Measurement (MS) *cont'd*

f. Using square centimetres and square inches to estimate, measure, compare and record areas
g. Constructing and using a square grid overlay to measure area of different shapes
h. Understanding the need for, and use, formal units: litres and quarts to measure capacity and cubic centimetre and cubic inches to measure volume
i. Using formal units (litres and cubic centimetres & quarts and cubic inches) to estimate, measure and compare capacity and volume
j. Constructing 3-dimensional objects using cubic centimetre and cubi inch blocks and counting to determine volume
k. Using formal units to record measurements of capacity and volume
l. Understanding the need for, and use, formal units (kilograms and pounds) to measure mass
m. Using formal units to estimate, measure, compare and record masses using integral values
n. Understanding and recognizing the coordinated movements of the hands on a clock to indicate quarter-to and quarter-past
o. Reading and recording time in 15-minute intervals
p. Comparing and sequencing events according to their duration
q. Telling time to the quarter-hour on digital and analogue clocks
r. Reading and interpreting simple timetables, timelines and calendars

Space and Geometry (SG)

a. Modelling, comparing, describing and sketching 3D objects including pyramids and prisms
b. Comparing and contrasting pyramids and prisms
c. Rearranging, labelling, comparing, describing, building models of, and drawing pentagons and parallelograms presented in different orientations
d. Comparing and describing features of special groups of quadrilaterals
e. Using reflections to create tessellating designs
f. Finding all lines of symmetry for a given 2D shape
g. Creating symmetrical shapes using a line symmetry
h. Recognising, identifying and naming perpendicular lines
i. Describing angles using everyday language and classify them into 'right' and 'not right' angles
j. Understanding and recognizing the two arms and vertex of the angle in an opening and a slope where one arm is visible
k. Comparing angles of adjacent sides of shapes to a right angle
l. Drawing simple maps and plans to represent the relative position of objects
m. Determining the directions N, S, E and W given one of the directions
n. Describing the location of an object on a simple map using grid coordinates or directions
a. Modelling addition, subtraction, multiplication, and division using concrete materials and mental strategies
b. Identifying and modelling halves, quarters and eighths using sets, collections and objects
c. Measuring things in the classroom and around the school using informal units
d. Organising actual objects, pictures of objects or students themselves into a data display
e. Identifying, modelling and learning about shapes such as circles, triangles, and rectangles in pictures and the environment
f. Explaining their answers
g. Relating what they are learning in mathematics to their daily life
Memorising number facts and procedures

Table 72: Year 3 Teachers' Ranked Preparedness to Teach Year 3 Mathematics Topics

	Year 3 Topics	3 % Very well-prepared	2 Somewhat Prepared %	1 % Not well-prepared	0 % Not applicable
1	NRa: Counting forwards to, and backwards from, 999, by tens and hundreds from any starting point	100	0	0	0
2	NRb: Recognising, reading, partitioning, regrouping, representing, and ordering numbers up to 999 using place value	100	0	0	0
3	MSq: Telling time to the quarter-hour on digital and analogue clocks	100	0	0	0
4	NRd: Describing, justifying and recording informal strategies and formal written algorithm for adding and subtracting	86	14	0	0
5	NRg: Finding multiples and squares of numbers	86	0	14	0
6	MSe: Understanding the need for, and use, formal units: square centimetres and square inches to measure area	86	0	14	0
7	MSn: Understanding and recognizing the coordinated movements of the hands on a clock to indicate quarter-to and quarter-past	86	14	0	0
8	MSo: Reading and recording time in 15-minute intervals	86	0	14	0
9	NRk: Modelling, comparing and representing fractions with denominators 2, 4, and 8 and extending to fractions with denominator 3	71	14	14	0
10	PAa: Creating, describing and extending number patterns using a range of strategies	71	29	0	0
11	PAd: Determining the value of a missing number in simple number sentences involving one operation	71	29	0	0
12	MSa: Using formal units: metres, millimetres and centimetres & yards, feet and inches to estimate, measure, compare, order, and record lengths and distances	71	29	0	0
13	MSb: Carrying out simple unit conversion within each measurement system (e.g. between metres and centimetres & between yards and feet)	71	14	14	0
14	MSj: Constructing 3-dimensional objects using cubic centimetre and cubic inch blocks and counting to determine volume	71	14	14	0
15	NRc: Modelling addition and subtraction involving two- and three-digit numbers by applying a range of mental strategies	57	14	29	0
16	NRf: Extending skip counting to by fours, sevens, eights and nines	57	14	29	0
17	NRh: Interpreting division problems without remainders and linking these to relationships between operations ´, + and ¸	57	29	14	0
18	NRl: Finding equivalence between halves, quarters and eighths	57	29	14	0
19	NRm: Adding and subtracting decimals with the same number of decimal places (to 2 decimal places)	57	29	14	0
20	NRo: Ordering events from least likely to most likely	57	14	14	14
21	PAc: Modelling and extending quantitative relationships involving multiplication and division facts to at least 10 ´ 10	57	43	0	0
22	MSf: Using square centimetres and square inches to estimate, measure, compare and record areas	57	14	29	0
23	MSg: Constructing and using a square grid overlay to measure area of different shapes	57	0	43	0
24	MSi: Using formal units (litres and cubic centimetres & quarts and cubic inches) to estimate, measure and compare capacity and volume	57	14	29	0
25	MSr: Reading and interpreting simple timetables, timelines and calendars	57	29	14	0
26	NRe: Developing mental fluency with number facts up to 10 ´ 10	43	43	14	0
27	NRi: Constructing factor trees for a number	43	29	14	14
28	NRn: Representing money values in multiple ways and calculating change in simple transactions	43	43	14	0
29	PAb: Analysing and describing change in growing patterns and using tables to make predictions	43	43	14	0
30	DAa: Designing investigations to answer familiar questions, deciding data to collect, carrying out the investigation, classifying and organizing data using tables	43	29	14	14
31	Dab: Reading and making connections between lists and tables of data about themselves and explaining interpretations	43	57	0	0

Table 72**:** Year 3 Teachers' Ranked Preparedness to Teach Prescribed Mathematics Topics - *continued*

32	MSc: Developing 'real-life' benchmarks for a length of one foot and one centimetre and using these benchmarks to estimate the perimeter of table tops, desktops, windows and classroom floor	43	43	14	0
33	MSk: Using formal units to record measurements of capacity and volume	43	43	14	0
34	SGa: Modelling, comparing, describing and sketching 3D objects including pyramids and prisms	43	14	43	0
35	SGc: Rearranging, labelling, comparing, describing, building models of, and drawing pentagons and parallelograms presented in different orientations	43	29	14	14
36	SGe: Using reflections to create tessellating designs	43	14	32	14
37	SGf: Finding all lines of symmetry for a given 2D shape	43	43	14	0
38	SGi: Describing angles using everyday language and classify them into 'right' and 'not right' angles	43	29	28	0
39	SGl: Drawing simple maps and plans to represent the relative position of objects	43	14	42	14
40	NRj: Using efficient mental and informal written strategies for multiplying or dividing a two-digit number by a one-digit operator using multiplication facts up to 10 ´ 10	29	43	14	14
41	NRp: Exploring, identifying, interpreting, and recording all outcomes of a simple chance situation	29	29	29	14
42	MSh: Understanding the need for, and use, formal units: litres and quarts to measure capacity and cubic centimetre and cubic inches to measure volume	29	43	29	0
43	MSp: Comparing and sequencing events according to their duration	29	57	14	0
44	SGb: Comparing and contrasting pyramids and prisms	29	57	14	0
45	SGd: Comparing and describing features of special groups of quadrilaterals	29	29	29	14
46	SGg: Creating symmetrical shapes using a line symmetry	29	29	33	0
47	SGj: Understanding and recognizing the two arms and vertex of the angle in an opening and a slope where one arm is visible	29	14	42	14
48	SGm: Determining the directions N, S, E and W given one of the directions	29	29	57	14
49	NRq: Discussing the degree of likelihood using words such as certain, equally likely, or more or less likely, and never	14	43	29	14
50	MSd: Using decimal notation to one place to record lengths and distances	14	57	29	0
51	MSl: Understanding the need for, and use, formal units (kilograms and pounds) to measure mass	14	57	14	14
52	MSm: Using formal units to estimate, measure, compare and record masses using integral values	14	43	28	14
53	SGh: Recognising, identifying and naming perpendicular lines	14	43	29	14
54	SGk: Comparing angles of adjacent sides of shapes to a right angle	14	29	42	14
55	SGn: Describing the location of an object on a simple map using grid coordinates or directions	0	43	42	14

Student Learning Activities in Mathematics

Teachers reported the percentage of time students spend doing various learning activities in a typical week of mathematics lessons. The results, shown in Table 73, indicate that majority of teachers (71%) tend to allocate less than 10% of their mathematics lesson time during the week to individual or small group activities. Also fifty seven percentage (57%) of the teachers have their students listen to lecture-style presentations and clarification of knowledge, skills and processes, review homework, take quizzes, and solve problems with or without teacher guidance for up to 10% of the time rather than longer. Furthermore, it appears that the majority of the teachers (57%) have students spend less than 10% of the weekly mathematics lesson time doing management tasks while a majority of the teachers (57%) spend longer than 10% of the weekly class time engaging students in other non-content related activities.

Calculator Use and Computer Access

The majority of the teachers (89%) reported that calculators are not permitted during mathematics lessons. Furthermore, they reported that calculators are never used at all to check answers, do routine

computations, solve complex problems or explore concepts. Also students have no computers for their use during their mathematics classes and no access to internet. Because there are no computers available for student use, students never use computers to discover mathematics principles and concepts, practice skills and procedures and/or look up ideas and information in mathematics.

Table 73: Percentage of Time Year 3 Students Spend on Learning Activities

	≤10%	10 – 20%
a. Doing individual or small group activities	71	29
b. Listening to you re-teach and clarify relevant Knowledge & Skills and Working Mathematically Processes	57	43
c. Reviewing homework	57	43
d. Taking tests or quizzes	57	43
e. Listening to lecture-style presentations	57	43
f. Solving problems with your guidance	57	43
g. Solving problems on their own without your guidance	57	43
h. Participating in classroom management tasks not related to the lesson' content / purpose (eg interruptions and keeping order)	57	43
j. Other student activities	43	57

Mathematics Content Related Activities

Frequency with which the Year 3 teacher asks students to do various content-related activities in mathematics are summarised in Table 74. For example, for the majority of the activities (except two) such as relating what they are learning in mathematics to daily life, modelling the four operations using concrete materials; identifying and modelling halves, quarters and eighths using sets, collections and objects; measuring things around their school environment using informal units; identifying, modelling and learning about shapes in pictures and the environment; and explaining their answers; the majority of the teachers (from 57% up to 72%) have their students engage with these activities in either every (almost every) or about half the lessons. With organising actual objects, pictures of objects or students themselves into a data display and memorising number facts and procedures, 57% of the teachers reported these only occur in some lessons or not at all and 43% reported these occur in about half to almost every lesson

Table 74: Percentage of Time Year 3 Students Spend on Content Related Activities

N=7	1 Every / almost every lesson	2 About half the lessons	3 Some lessons	4 never
j. Modelling addition, subtraction, multiplication, and division using concrete materials and mental strategies	57	14	29	0
k. Identifying and modelling halves, quarters and eighth using sets, collections and objects	43	14	43	0
l. Measuring things in the classroom and around the school using informal units	28	43	29	0
m. Organising actual objects, pictures of objects or students themselves into a data display	14	29	57	0
n. Identifying, modelling and learning about shapes such as circles, triangles, and rectangles in pictures and the environment	28	43	29	0
o. Explaining their answers	43	29	14	14
p. Relating what they are learning in mathematics to their daily life	43	29	14	14
q. Memorising number facts and procedures	43	0	43	14

Emphasis on Mathematics Content Areas

Teachers reported on the emphasis they put on mathematics content areas in terms of the percentage of time spent on each content area during the school year. The results, provided in Table 75, demonstrate that 60% of the teachers teach 'number and operations' topics for about 20 up to 30% of the school year while the rest teach the same topics in up to 15% of the school year. For the 'data

representation', 'measurement' and 'space & geometry' topics, 56% of the teachers spend about 15% of the school year on each content area. More or less the same percentage of teachers (around 42%) teaches 'number patterns' either less than 15% or at least 20% of the school year.

Table 75: Year 3 Percentage of Time Spent on Content Areas in a School Year

Percentage of the time	<15%	20% - 30%
Strand		
Number & Operations	40	60
Number Patterns	42	41
Data Representation	56	43
Measurement	56	43
Space & Geometry	56	43

Mathematics Homework

Eighty six percent (86%) of the teachers reported that homework is assigned to students. Forty three percent (43%) reported homework is assigned in every or almost every lesson, about half the lessons (14%) or some lessons (14%). The amount of homework assigned is expected to take an average student fewer than 15 minutes according to 14% of the teachers and 15 to 30 minutes as estimated by 43% of the teachers. Three of the teachers (43%) left blank responses.

Student Factors Limiting the Teaching of Mathematics Classes

Table 76 showed the percentage distribution of teachers' ratings of the five statements about student factors limiting mathematics instruction on a 4-point scale: *not at all/ not applicable* = 1; *a little* = 2; *some* = 3; and *a lot* = 4. Forty three percent of the teachers reported that students with different academic abilities limit their teaching to a little extent compared to 14% and 29% of the teachers who considered this factor limits their teaching of mathematics to some and a lot of extent respectively. While students with special needs is not a limiting factor to 43% of the teachers, another 43% viewed it as affecting their teaching to some extent. Also, the teachers are equally split between the impact of students of different language and economic backgrounds on their mathematics teaching; some claim it is not or a little problem (43%) and the others say it limits their teaching to some and a lot of extent (43%). Furthermore, uninterested students is a not a problem to 43% of the teachers but 29% and 14% find it limits their teaching to some and a lot of extent respectively. However, disruptive students affect the teaching of mathematics by the majority (58%) of teachers from some to a lot of extent.

Table 76: Year 3 Teachers' Reports on Student Factors Impacting the Teaching of Mathematics

In your view, to what extent do the following limit how you teach mathematics to your class?

	N = 7	1 Not at all	2 A little	3 some	4 A lot
a	Students with different academic abilities	0	43	14	29
b	Students who come from a wide range of backgrounds (eg, economic, language)	14	29	29	14
c	Students with special needs (eg, hearing, vision, speech impairment, physical disabilities, mental or emotional / psychological impairment)	43	0	43	0
d	Uninterested students	43	0	29	14
e	Disruptive students	0	14	29	29

Mathematics Topic Coverage

Teachers' report on when the mathematics topics covered in the test were taught, by content area, using a 3-point scale: *mostly taught before this year* = 1, *mostly taught this year* = 2, and *not yet taught or just introduced* = 3. The percentage distribution of teachers' endorsement of response categories are summarised in Table 77 and ranked by the 'mostly taught this year' percentage to highlight the prescribed Year 3 topics that have been taught already in the 2013 school year. According to the results,

62% of the topics ($\frac{23}{37}$) were indicated by at least half up to 86% of the teachers were 'mostly taught this year'. For the same topics, up to 29% of the teachers indicated these topics were 'mostly taught before this year' with another up to 29% of the teachers indicating the topics have 'not yet (being) taught or just introduced' this year.

Table 77: Year 3 Teachers' Report on Mathematics Topic Coverage

	Year 3 Topics	1 Mostly taught before this year	2 Mostly taught this year	3 Not yet taught or just introduced
1	MSg: Finding lines of symmetry for a givens shape	0	86	0
2	DAa: Reading data from tables, picture graphs, bar graphs, or pie charts	0	86	0
3	DAb: Using information from data displays and performing computations to answer questions	0	86	0
4	NRa: a. Partitioning and regrouping three-digit numbers	14	71	0
5	NRk: Decimal place value including writing decimals using numbers	0	71	14
6	PAa: Determining the correctness of number sentences involving two operations	14	71	0
7	NRm: Determining and modelling the equivalent of a quarter of an object	0	71	14
8	NRo: Equal sharing of objects resulting in shares that are simple fractions	0	71	14
9	SGa: a. Identifying a design after folding and cutting paper	0	71	14
10	NRj: Calculating number of items to buy in a transaction involving computation with decimals	0	71	14
11	NRb: b. Addition and subtraction of two-digit	14	57	0
12	NRd: d. Solving problems involving addition of two-digit numbers	29	57	0
13	NRg: g. Recording division problems using numerals and symbols	14	57	14
14	PAf: Finding missing digits in the subtraction of two-digit numbers	14	57	0
15	MSa: Knowing the appropriate device for measuring length	14	57	14
16	NRf: Using multiplication facts to compute given products	14	57	29
17	NRl: Solving problems involving computation with two-digit whole numbers	0	57	14
18	MSi: Telling time to the minute in digital notation	14	57	0
19	NRi: Constructing factor trees for a number	14	57	14
20	PAb: Identifying the correct number pattern given a word description	14	57	0
21	MSc: Using measurements of length to describe features of 2D shapes	14	57	14
22	SGc: Identifying the top view of a cone	0	57	14
23	MSh: Reading and estimating capacity from a calibrated measuring device	0	57	14
24	MSe: Finding and comparing areas of given shapes by counting squares	29	43	14
25	PAe: Determining missing digits in the addition of a three- and a two-digit number	14	43	14
26	MSb: Measuring and reading length from a ruler	29	43	0
27	NRh: Interpreting division problems without remainders and linking these to relationships between operations ´, + and ¸	0	43	29
28	MSf: Identifying designs after rotation	0	43	29
29	NRe: Developing mental fluency with number facts up to 10 ´ 10	14	43	29
30	NRn: n. Solving division problems with remainders	14	43	29
31	SGb: Using coordinates on a simple map to describe position	0	43	29
32	MSd: Finding perimeter of composite figures	29	43	14
33	PAd: Continuing a number pattern that increases	14	29	29
34	NRc: Forming two-digit numbers from a given set of 8 digits	14	29	56
35	PAc: Continuing a geometric pattern that increases	14	29	29
36	NRp: Comparing and predicting chance of an event in simple chance events	0	29	29
37	NRq: Performing simple calculations with money	14	29	29

Year 3 Teacher Professional Development Participation

The Year 3 teachers reported whether they participated in various types of professional development activities for mathematics teaching in the last two years. Teachers' responses showed 86% attended professional development activities on 'mathematics curriculum' while 71% attended professional development activities on 'mathematics content'. In comparison, only 57% attended those on 'mathematics pedagogy', 'improving students' critical thinking or problem solving skills' and 'mathematics assessment'. With the 'integrating information technology into mathematics' professional development activities, only 43% participated in the last two years.

Year 2 Teachers

Nine Year 2 teachers completed the questionnaires from the eight schools of the sample. All Year 2 teachers that completed the questionnaires are female teachers. The results provided in Table 78 show that 4 out of the 9 teachers (44%) are at least 40+ years of age with another 4 teachers between the ages of 25 and 39 years of age and only one teacher (11%) is under 25 years of age.

Table 78: Year 2 Teachers' Age

Age Group	Number	Percentage
Under 25	1	11
25-29	1	11
30-39	3	33.3
40-49	1	11
50-59	3	33.3

Teaching Experience

Forty four percent (44%) of the Year 2 teachers (see Table 79) in the study have at least twenty years of teaching experience with the majority of them (56%) having less than 5 years of teaching experience. Of the 9 Year 2 teachers, 67% of them have taught Year 2 classes for less than 5 years with the rest spread over the other categories of at least 5 up to 19 years (11% and 22% respectively) as shown in Table 79.

Table 79: Year 2 Teachers' Teaching Experience and Years Teaching Year 2

	N = 9	**1 <5yrs**	**2 5-9 yrs**	**3 10-19 yrs**	**4 20-29 yrs**	**5 30-39 yrs**
1	Total years of teaching	56%	0%	0%	22%	22%
2	Number of years teaching Year 2	67%	11%	22%	0%	0%

Teaching Certificate

Six of the 9 teachers (75%) reported they have a teaching certificate with the minimum formal education being either Form 5 (or School Certificate) and/or a Diploma of Education (Primary) for 4 of the 9 teachers (44%) while the five other teachers left blanks.

Year 2 Teacher Interactions

The frequency of various types of interactions the teacher has with colleagues are summarised in Table 80. The results indicate that collegial interactions to discuss teaching methods are infrequent activities occurring either 2 or 3 times a month for 44% of the teachers, or, 1 to 3 times a week for another 44% of the teachers. Relatively more interactions is reported by 56% of teachers happening weekly once to three times to discuss the preparation of instructional materials whilst this is more of a monthly occurrence for a third of the teachers. Visits to other classrooms to observe colleagues teaching never happens for a third of the teachers and 2 to 3 times a month for two of the teachers or 1 to 3 times a week for the other two teachers. Forty four percent of the teachers have informal observations of their

classroom by another teacher 2 to 3 times monthly or 1 to 3 times a week for 22% of the teachers while it was never (or almost never) for two other teachers.

Table 80: Year 2 Teacher Interactions

	N = 9	1 Never or almost never	2 2 or 3 times a month	3 1-3 times per week	4 Daily or Almost daily
1	Discussions about how to teach a particular concept	0%	44%	44%	0%
2	Working on preparing instructional materials	11%	33.3%	56%	0%
3	Visits to another teacher's classroom to observe his/her teaching	33.3%	22%	22%	0%
4	Informal observations of my classroom by another teacher	22%	44%	22%	0%

School Safety

Mathematics teachers' perception of safety in school summarises teachers' reports of how safe and secure they feel in their schools. Teachers responded to each item using a 4-point scale: *agree a lot* = 1, *agree* = 2, *disagree* = 3, and *disagree a lot* = 4 resulting in the percentage distribution of endorsement provided in Table 81. The evidence indicates that the majority of teachers agree their school is in a safe neighbourhood, they feel safe in school and that the school's security policies and practices are sufficient. Only one other teacher disagreed with the three safety items.

Table 81: Year 2 Teachers' Report on Safety in School

	N = 9	1 Agree a lot	2 Agree	3 Disagree	4 Disagree a lot
1	This school is located in a safe neighbourhood	33.3%	44.4%	11.1%	0%
2	I feel safe at this school	44.4%	33.3%	11.1%	0%
3	This school's security policies and practices are sufficient	33.3%	44.4%	0%	11.1%

Adequacy of School Facilities

Teachers' report of adequate working conditions summarizes teachers' perspectives on the availability of school resources and how these affect their capacity to provide effective mathematics instruction. Teachers rated problems (listed in Table 82) in their school by severity on a 3-point scale: *not a problem* = 1; *minor problem* = 2; and *serious problems* = 3. The percentage distribution of teachers' ratings indicated that 56% of teachers rated the need for significant repairs to school buildings to be not a problem with a third rating it as a minor problem while 11% viewed it as a serious problem. Classrooms as being overcrowded was considered by 22% of the teachers as not a problem with another 22% regarding it as a minor problem in their schools compared to a third of the teachers considering it to be a serious problem in their schools. Having inadequate workspace outside of their classrooms was considered as not a problem by the majority of the teachers (66%) with a 44% rating it as a minor problem. As for having computers available for staff use, the majority (67%) considered it not a problem with 22% rating it as a minor problem while one teacher rated it as a serious problem.

Table 82: Year 2 Teachers' Reports on Severity of School Facility Problems

	N = 9	1 Not a problem	2 Minor problem	3 Serious problem
a	The school building needs significant repair	56%	33.3%	11.1%
b	Classrooms are overcrowded	22.2%	22.2%	33.3%
c	Teachers do not have adequate workspace outside of their classroom	66%	44.4%	8
d	Computers are not available for staff use	67%	22.2%	11.1%

School Climate for Learning Mathematics

Teachers' perception of school climate summarises teachers' reports about their school and how supportive the climate is for learning in terms of their rating of job satisfaction, parental support and involvement, expectations for student achievement, students' desire to do well in school and their regard for school property. The summary percentage distribution of teachers' responses using a 5-point scale: *very high* = 1, *high* = 2, *medium* = 3, *low* = 4, and *very low* = 5 per attribute is provided in Table 83. The results indicate that the majority of the teachers rated all of the listed attributes as high priority in their schools.

Table 83: Year 2 Teachers' Report on School Climate

	N = 9	1 % Very high	2 % High	3 % Medium	4 % Low	5 % Very low
1	Teachers' job satisfaction	44.4	33.3	11.1	0	0
2	Teachers' understanding of the school's curricular Goals	33.3	44.4	22.2	0	0
3	Teachers' degree of success in implementing the school's curriculum	11.1	66.7	22.2	0	0
4	Teachers' expectations for student achievement	22.2	55.6	22.2	0	0
5	Parental support for student achievement	22.2	33.3	33.3	11.1	0
6	Parental involvement in school activities	33.3	33.3	22.2	11.1	0
7	Students' regard for school property	11.1	55.6	22.2	11.1	0
8	Students' desire to do well in school	22.2	55.6	11.1	11.1	0

Teachers' Preparedness to Teach Year 2 Mathematics

Teachers' perception of their preparedness to teach the prescribed numeracy and mathematics topics of the Year 2 curriculum (in Table 84) are rated on a 4-point scale: *very well-prepared* = 3, *somewhat prepared* = 2, *not well-prepared* = 1, and *not applicable* = 0. The summary percentage distribution of the teachers' responses by topic and by response category is provided in Table 85, in descending order of the 'very well-prepared' category percentage. The results indicate that at least up to 89% of the teachers considered that they were 'very well-prepared' to teach only 25% (14/57) of the 57 prescribed Year 2 topics. For the same topics, up to a third of the teachers perceived themselves to be 'somewhat prepared' and another up to a third of the teachers thought they were 'not well-prepared' while up to 11% considered the same topics to be 'not applicable' for Year 2.

Mathematics Class Size and Weekly Time Allocation

Total students in the sampled mathematics classes was 20+ for 38% of the teachers, 10+ with one class, one 30+ class, one with 40+, and another with 60+ students. The weekly total number of minutes a teacher teaches mathematics to her/his class ranged from 50 minutes (22%) to 100 minutes (11%), 150 minutes (11%), and 200 minutes (33%).

Mathematics Textbook and Resources

Seventy eight percent (78%) of the teachers used a mathematics textbook as a primary source (56%) or a supplementary resource (22%) while 56% of the teachers used the new teachers' manual as the primary basis (56%) or a supplementary resource (11%) for their lessons. Fifty six percent of the teachers also used PEMP student resources books and 44% used other resources such as SRA Mathematics and raw materials.

Table 84: Year 2 Prescribed Mathematics Topics

Number and Operations (NR)

a. Counting forwards to at least 150 and backwards by threes, fives and tens from any starting point
b. Counting forwards and backwards by tens, on and off the decade
c. Recognising, reading, partitioning, regrouping, ordering, and representing two- and three-digit numbers up to at least 150, using place value
d. Reading and using the ordinal names to at least 'thirty-first'
e. Modelling addition and subtraction using concrete materials
f. Illustrating addition and subtraction by using a variety of mental strategies and informal recording methods
g. Representing and recording number sentences using drawings, numerals, symbols and words
h. Rhythmic and skip counting by ones, twos, threes, fives and tens
i. Applying arrays, equal groups and repeated addition to model multiplication
j. Modelling and representing division by using the strategies of sharing, arrays and repeated subtraction
k. Recording multiplication and division using drawings, numerals, symbols and words
l. Constructing, explaining and interpreting a half or a quarter of a whole object
m. Constructing, explaining and interpreting a half or a quarter of a set or collection of objects
n. Representing half as ½ and quarter as ¼
o. Recognising, describing and ordering the element of chance in familiar daily activities
p. Describing the element of chance using everyday language such as impossible, possible, might, certain, and likely

Number Patterns (PA)

a. Generating, representing and extending a variety of number patterns and providing missing elements
b. Analysing and describing change in growing patterns and use tables to record or extend patterns
c. Modelling and extending quantitative relationships involving addition and subtraction facts up to at least 50
d. Making generalizations about number relationships
e. Recording equivalent number relationships using the 'equals' sign

Data Representation (DA)

a. Collecting and recording data using tallies
b. Representing data using concrete materials, pictures and bar and column graphs
c. Drawing pictographs that use one object, symbol or picture to represent one data value
d. Reading and making connections between lists and pictographs and bar and column graphs of data about themselves and explaining interpretations

Measurement (MS)

a. Estimating and measuring length and distance, by placing multiple copies of informal units of the same size, end-to-end without gaps or overlaps
b. Identifying and justifying the need for formal units (metres & yards), and using them to estimate and measure length and distance

Measurement (MS) *cont'd*

c. Recognising the need for smaller formal units such as centimetres and feet
d. Developing 'real-life' benchmarks for a length of one metre and one yard
e. Using number and type of informal or formal units to record measurements of length
f. Estimating area by placing copies of informal units of the same size, in rows or columns without gaps or overlaps
g. Informally measuring area by counting informal units and describe part left over
h. Informally comparing and ordering two or more areas by cutting and covering
i. Using number and type of informal units to record measurements
j. Developing common referents for measures using appropriate informal units to make comparisons and estimates of volume and capacity
k. Measuring, comparing and ordering capacities of at least two containers and volumes of at least two objects
l. Using number and type of informal units used to record measurements
m. Using an equal arm balance and appropriate uniform informal units to estimate and measure the mass of an object
n. Measuring, comparing and ordering masses of at least two objects and estimating differences in mass using informal units
o. Using number and type of informal units to record measurements
p. Identifying and choosing repeated informal units to measure and compare the duration of events
q. Stating and ordering the seasons of the year
r. Using calendar to identify day and order the months of the year
s. Telling time on the hour and half-hour on digital and analogue clocks

Space and Geometry (SG)

a. Identifying, labelling, explaining, classifying and representing cones, cubes, cylinders, spheres and prisms
b. Identifying and naming 3D objects in pictures and the environment, and presented in different orientations
c. Understanding, identifying and recognizing that 3D objects appear different from different views
d. Rearranging, labelling, comparing, describing, building models of, and drawing hexagons, rhombuses and trapeziums in different orientations
e. Using slides to create tessellating designs
f. Understanding and recognizing a line of symmetry of a rectangle and a square
g. Defining 2D shapes using the terms 'sides' and 'corners'
h. Identifying and naming parallel, vertical and horizontal lines in pictures and the environment
i. Understanding, recognizing and describing corners as angles
j. Understanding and recognizing arms and vertex of the angle in a corner
k. Placing one angle on top of another to directly compare angles
l. Using models and drawings to represent the position of objects
m. Using everyday language, including 'left' and 'right', to describe the position of objects

Table 85: Year 2 Teachers' Ranked Preparedness to Teach Year 2 Mathematics Topics

		Year 2 Topics	3 % Very well-prepared	2 Somewhat Prepared %	1 % Not well-prepared	0 % Not applicable
1	NRb	Counting forwards and backwards by tens, on and off the decade	89	0	11.1	0
2	NRa	Counting forwards to at least 150 and backwards by threes, fives and tens from any starting point	78	11	11.1	0
3	NRe	Modelling addition and subtraction using concrete materials	67	22	11.1	0
4	NRk	Recording multiplication and division using drawings, numerals, symbols and words	67	22	11.1	0
5	NRc	Recognising, reading, partitioning, regrouping, ordering, and representing two- and three-digit numbers up to at least 150, using place value	56	22	22.2	0
6	NRf	Illustrating addition and subtraction by using a variety of mental strategies and informal recording methods	56	22	11.1	11.1
7	NRi	Applying arrays, equal groups and repeated addition to model multiplication	56	11	33.3	0
8	PAa	Generating, representing and extending a variety of number patterns and providing missing elements	56	11	22.2	11.1
9	PAb	Analysing and describing change in growing patterns and use tables to record or extend patterns	56	22	22.2	0
10	PAc	Modelling and extending quantitative relationships involving addition and subtraction facts up to at least 50	56	33	11.1	0
11	MSr	Using calendar to identify day and order the months of the year	56	22	22.2	0
12	MSs	Telling time on the hour and half-hour on digital and analogue clocks	56	11	22.2	0
13	SGa	Identifying, labelling, explaining, classifying and representing cones, cubes, cylinders, spheres and prisms	56	33	11.1	0
14	SGg	Defining 2D shapes using the terms 'sides' and 'corners'	56	33	11.1	0
15	NRg	Representing and recording number sentences using drawings, numerals, symbols and words	44	33	11.1	11.1
16	NRh	Rhythmic and skip counting by ones, twos, threes, fives and tens	44	44	11.1	11.1
17	NRl	Constructing, explaining and interpreting a half or a quarter of a whole object	44	22	33.3	0
18	NRn	Representing half as ½ and quarter as ¼	44	11	33.3	11.1
19	PAe	Recording equivalent number relationships using the 'equals' sign	44	33	11.1	11.1
20	MSi	Using number and type of informal units to record measurements	44	33	22.2	0
21	SGb	Identifying and naming 3D objects in pictures and the environment, and presented in different orientations	44	44	11.1	0
22	SGc	Understanding, identifying and recognizing that 3D objects appear different from different views	44	33	22.2	0
23	NRd	Reading and using the ordinal names to at least 'thirty-first'	33	56	11.1	0
24	NRj	Modelling and representing division by using the strategies of sharing, arrays and repeated subtraction	33	33	33.3	0
25	NRm	Constructing, explaining and interpreting a half or a quarter of a set or collection of objects	33	33	11.1	22.2
26	NRo	Recognising, describing and ordering the element of chance in familiar daily activities	33	44	11.1	11.1
27	NRp	Describing the element of chance using everyday language such as impossible, possible, might, certain, and likely	33	56	11.1	0
28	DAa	Collecting and recording data using tallies	33	33	33.3	0
29	DAb	Representing data using concrete materials, pictures and bar and column graphs	33	33	33.3	0
30	MSa	Estimating and measuring length and distance, by placing multiple copies of informal units of the same size, end-to-end without gaps or overlaps	33	44	11.1	11.1
31	MSb	Identifying and justifying the need for formal units (metres & yards), and using them to estimate and measure length and distance	33	44	11.1	11.1
32	MSc	Recognising the need for smaller formal units such as centimetres and feet	33	44	11.1	11.1
33	MSe	Using number and type of informal or formal units to record measurements of length	33	56	11.1	0
34	MSg	Informally measuring area by counting informal units and describe part left over	33	44	11.1	11.1
35	MSk	Measuring, comparing and ordering capacities of at least two containers and volumes of at least two objects	33	33	33.3	0
36	MSq	Stating and ordering the seasons of the year	33	44	22.2	0
37	SGf	Understanding and recognizing a line of symmetry of a rectangle and a square	33	33	33.3	0
38	SGi	Understanding, recognizing and describing corners as angles	33	44	22.2	0
39	SGm	Using everyday language, including 'left' and 'right', to describe the position of objects	33	44	22.2	0
40	PAd	Making generalizations about number relationships	22	56	22.2	0

Table 85: Year 2 Teachers' Ranked Preparedness to Teach Year 2 Mathematics Topics - *continued*

41	MSd	Developing 'real-life' benchmarks for a length of one metre and one yard	22	67	11.1	0
42	MSf	Estimating area by placing copies of informal units of the same size, in rows or columns without gaps or overlaps	22	56	11.1	11.1
43	MSh	Informally comparing and ordering two or more areas by cutting and covering	22	56	11.1	11.1
44	MSj	Developing common referents for measures using appropriate informal units to make comparisons and estimates of volume and capacity	22	44	33.3	0
45	MSl	Using number and type of informal units used to record measurements	22	44	33.3	0
46	MSm	Using an equal arm balance and appropriate uniform informal units to estimate and measure the mass of an object	22	33	44.4	0
47	MSn	Measuring, comparing and ordering masses of at least two objects and estimating differences in mass using informal units	22	33	44.4	0
48	MSo	Using number and type of informal units to record measurements	22	44	33.3	0
49	SGh	Identifying and naming parallel, vertical and horizontal lines in pictures and the environment	22	44	22.2	11.1
50	SGl	Using models and drawings to represent the position of objects	22	56	22.2	0
51	DAc	Drawing pictographs that use one object, symbol or picture to represent one data value	11	56	33.3	0
52	DAd	Reading and making connections between lists and pictographs and bar and column graphs of data about themselves and explaining interpretations	11	67	11.1	11.1
53	MSp	Identifying and choosing repeated informal units to measure and compare the duration of events	11	56	33.3	0
54	SGd	Rearranging, labelling, comparing, describing, building models of, and drawing hexagons, rhombuses and trapeziums in different orientations	11	44	44.4	0
55	SGj	Understanding and recognizing arms and vertex of the angle in a corner	11	56	22.2	11.1
56	SGe	Using slides to create tessellating designs	0	56	33.3	11.1
57	SGk	Placing one angle on top of another to directly compare angles	0	67	33.3	0

Student Learning Activities in Mathematics

Teachers reported the percentage of time students spend doing various learning activities in a typical week of mathematics lessons. The results, shown in Table 86, indicate that more teachers tend to allocate between 10% and 20% of their mathematics lesson time during the week to enable students to do individual or small group activities. Also relatively more teachers have their students listen to lecture-style presentations and solve problems with or without teacher guidance for up to 10% of the time rather than longer. Furthermore, it appears that the majority of the teachers (55%) have students spend less than 10% of the weekly mathematics lesson time doing management and other non-content related activities.

Table 86: Percentage of Time Year 2 Students Spend on Learning Activities

		≤10%	10 – 20%
a	Doing individual or small group activities	11	44
b	Listening to you re-teach and clarify relevant Knowledge & Skills and Working Mathematically Processes	22	33
c	Reviewing homework	33	22
d	Taking tests or quizzes	33	22
e	Listening to lecture-style presentations	44	11
f	Solving problems with your guidance	44	11
g	Solving problems on their own without your guidance	44	11
h	Participating in classroom management tasks not related to the lesson' content / purpose (eg interruptions and keeping order)	55	0
i	Other student activities	55	0

Calculator Use and Computer Access

The majority of the teachers (89%) reported that calculators are not permitted during mathematics lessons. Furthermore, 89% of the teachers reported that calculators are never used at all to check answers, do routine computations, solve complex problems or explore concepts. Also students have no computers for their use during their mathematics classes and no access to internet. Because there are no computers available for student use, students never use computers to discover mathematics

principles and concepts, practice skills and procedures and/or look up ideas and information in mathematics.

Mathematics Content Related Activities

Frequency with which the Year 2 teacher asks students to do various content-related activities in mathematics are summarised in Table 87. For example, for the majority of the activities with the exception of relating what they are learning in mathematics to daily life, the majority of the teachers usually ask their students, in some to about half the lessons, to model the four operations using concrete materials; identify and model halves and quarters using sets, collections and objects; measure things around their school environment using informal units; organise actual objects, pictures of objects or students themselves into a data display; identify, model and learn about shapes in pictures and the environment; explain their answers; and memorise number facts and procedures. Two of the teachers indicated that their students never do these activities. Relating mathematics learning to their daily lives is what 44% of the teachers ask their students to do in about half to every (or almost every) lesson while it was only in some lessons for a third of the teacher and it is never the case for 22% of the teachers.

Table 87: Percentage of Time Year 2 Students Spend on Content Related Activities

	1 Every / almost every lesson	2 About half the lessons	3 Some lessons	4 never
r. Modelling addition, subtraction, multiplication, and division using concrete materials and mental strategies	11%	33%	33%	22%
s. Identifying and modelling halves and quarters using sets, collections and objects	11%	44%	22%	22%
t. Measuring things in the classroom and around the school using informal units	22%	22%	33%	22%
u. Organising actual objects, pictures of objects or students themselves into a data display	11%	22%	44%	22%
v. Identifying, modelling and learning about shapes such as circles, triangles, and rectangles in pictures and the environment	0%	44%	33%	22%
w. Explaining their answers	22%	22%	33%	22%
x. Relating what they are learning in mathematics to their daily life	33%	11%	33%	22%
y. Memorising number facts and procedures	11%	11%	56%	22%

Emphasis on Mathematics Content Areas

Teachers reported on the emphasis they put on mathematics content areas in terms of the percentage of time spent on each content area during the school year. The results, provided in Table 88, demonstrate that 66% of the teachers teach 'number and operations' and 'measurement' topics and 55% of the teachers teach space and geometry topics for about 20 and up to 30% of the school year. The same time emphasis appears to be the case for forty four percent of the teachers for number pattern topics. Relatively fewer teachers teach data representation topics for the same time allocation. For the rest of the teachers (i.e. a 11% up to 33%) teach the 5 content areas in a relatively shorter time frame of up to 15% of the school year.

Table 88: Year 2 Percentage of Time Spent on Content Areas in a School Year

Percentage of the time	**<15%**	**20% - 30%**
Strand		
Number & Operations	11	66
Number Patterns	33	44
Data Representation	33	22
Measurement	11	66
Space & Geometry	22	55

Mathematics Homework

Eighty nine percent (89%) of the teachers reported that homework is assigned to students. Forty four percent (44%) reported homework is assigned in every or almost every lesson, about half the lessons

(11%) or some lessons (44%). The amount of homework assigned is expected to take an average student 15 to 20 minutes according to 67% of the teachers and less than 15 minutes as estimated by 22% of the teachers. One of the 9 teachers reported that s/he assigns homework that would take an average student at least half an hour to an hour to complete.

Student Factors Limiting the Teaching of Mathematics Classes

Table 89 showed the percentage distribution of teachers' ratings of the five statements about student factors limiting mathematics instruction on a 4-point scale: *not at all/ not applicable* = 1; *a little* = 2; *some* = 3; and *a lot* = 4. Collapsing the original four categories to two, namely, *not at all – a little* and *some – a lot*, the resulting percentages (in Table 89b) showed that slightly more (at least 11% up to 22%) teachers considered 3 of the 5 listed student factors (i.e. students' different academic abilities, specials needs and disruptive students) to be not limiting or only limiting to a little extent their teaching of mathematics. For the two factors (i.e. different backgrounds and uninterested students), slightly more teachers rated these factors as limiting their teaching of mathematics from some to a lot of extent.

Table 89: Year 2 Teachers' Reports on Student Factors Impacting the Teaching of Mathematics

In your view, to what extent do the following limit how you teach mathematics to your class?

(a) Four Categories

	N = 9	1 Not at all	2 A little	3 some	4 A lot
a	Students with different academic abilities	33.3	22.2	22.2	22.2
b	Students who come from a wide range of backgrounds (eg, economic, language)	33.3	11.1	44.4	11.1
c	Students with special needs (eg, hearing, vision, speech impairment, physical disabilities, mental or emotional / psychological impairment)	33.3	11.1	33.3	0
d	Uninterested students	22.2	11.1	44.4	0
e	Disruptive students	22.2	22.2	22.2	0

(b) Two Merged Categories

		Not at all – a little	Some – a lot
a	Students with different academic abilities	55.5	44.4
b	Students who come from a wide range of backgrounds (eg, economic, language)	44.4	55.5
c	Students with special needs (eg, hearing, vision, speech impairment, physical disabilities, mental or emotional / psychological impairment)	44.4	33.3
d	Uninterested students	33.3	44.4
e	Disruptive students	44.4	22.2

Mathematics Topic Coverage

Teachers' report on when the mathematics topics covered in the test were taught, by content area, using a 3-point scale: *mostly taught before this year* = 1, *mostly taught this year* = 2, and *not yet taught or just introduced* = 3. The percentage distribution of teachers' endorsement of response categories are summarised in Table 90 ranked in terms of percentage 'mostly taught this year' to highlight those topics that are of the prescribed Year 2 mathematics curriculums taught in the 2013 school year and assessed by Test 2 and yet were not taught at all or classified as being taught the previous year. In fact, a majority (56% up to 67%) of the teachers indicated that only 21% ($\frac{9}{42}$) of the 42 assessed topics were 'mostly taught this year'. For the same topics, up to 44% of the teachers indicated these were 'mostly taught before this year' with another up to 33% responded these have 'not yet (being) taught or just introduced' this year.

Table 90: Year 2 Teachers' Ranked Mathematics Topic Coverage

			Mostly taught		not yet taught
			before this year	this year	or just introduced
	STRAND	**TOPICS**	**1**	**2**	**3**
1	SG	d. Counting corners of three-dimensional solids	0	67	11
2	NR	a. Counting objects in a picture	33	67	0
3	NR	g. Counting on from the larger number to add two numbers	33	67	0
4	NR	m. Sharing objects equally to a given number of people	11	56	33
5	NR	u. Ordering chance events based on numbers of objects in a bottle	11	56	33
6	MS	h. Finding and ordering area by counting the number of units	11	56	33
7	SG	c. Identifying the top view of a cone	11	56	33
8	NR	b. Identifying the number before and after given numbers	44	56	0
9	NR	d. Addition and subtraction of two-digit numbers	44	56	0
10	DA	a. Interpreting information presented in a data display	0	44	55
11	SG	a. Identifying a hexagon from a picture of different shapes	0	44	55
12	MS	f. Reading and telling time to the quarter-hour on digital clocks	11	44	44
13	NR	l. Recording multiplication in words and numerals	22	44	33
14	NR	r. Modelling equal shares that are simple fractions	22	44	33
15	NR	x. Predicting chance of an event in a simple chance experiment	22	44	33
16	PA	d. Continuing a geometric pattern that increases	22	44	33
17	NR	k. Recording the addition of equal groups in a number sentence	33	44	22
18	NR	p. Representing half as ½	33	44	22
19	NR	c. Finding the position of an object in a picture	44	44	11
20	NR	i. Modelling multiplication as repeated addition	44	44	11
21	PA	a. Continuing a repeating geometric pattern	44	44	11
22	PA	b. Continuing a number pattern that decreases	44	44	11
23	PA	c. Continuing a number pattern that increases	44	44	11
24	NR	o. Distributing an odd number of objects according to a given fraction	11	33	55
25	NR	s. Calculating change in a simple transaction	11	33	55
26	NR	t. Distinguishing between possible and impossible events	11	33	55
27	MS	d. Reading capacity of milk (in mL) in a baby bottle	11	33	55
28	SG	b. Identifying a pyramid	11	33	55
29	SG	e. Using coordinates on a simple map to describe position	11	33	55
30	NR	e. Identifying an equivalent addition number statement	22	33	44
31	NR	f. Using the strategy 'counting on' to determine 'how many more'	22	33	44
32	NR	q. Modelling quarters of an object as four equal parts	22	33	44
33	MS	e. Measuring area by placing informal units without gaps or overlaps	22	33	44
34	NR	j. Modelling division as repeated subtraction	33	33	33
35	NR	n. Finding the number of equal groups for a given amount	33	33	33
36	NR	v. Ordering events from least likely to most likely	33	33	33
37	NR	w. Comparing likelihood of every day events	33	33	33
38	MS	a. Identifying the tallest tree from pictures of trees	33	33	33
39	MS	b. Knowing the appropriate device for measuring length	33	22	44
40	NR	h. Identifying equal and unequal sets	44	22	33
41	MS	g. Measuring the mass of an object in kilograms	11	11	77
42	MS	c. Identifying the appropriate equipment to measure mass	22	11	66

Year 2 Teacher Professional Development Participation

The teachers reported whether they participated in various types of professional development activities for mathematics teaching in the last two years. The results showed 78% of the teachers attended professional development activities on 'mathematics content', 'mathematics curriculum' and 'improving students' critical thinking or problem solving skills', 67% attended 'mathematics assessment' workshops with 56% participating in 'mathematics pedagogy and instruction' and 'integrating information technology into mathematics' type of professional development activities in the last two years.

Year 1 Teachers

Twelve Year 1 teachers completed the questionnaires from the eight schools of the sample. With the exception of one teacher, all are female teachers. The results provided in Table 91 show that half of the Year 1 teachers are at least 50+ years of age with 17% in their forties and a quarter in their thirties with only one teacher (8%) under 30 years of age.

Table 91: Year 1 Teachers' Age

Age Group	Number	Percentage
Under 25	0	0
25-29	1	8
30-39	3	25
40-49	2	17
50-59	3	25
60 or older	3	25

Teaching Experience

The majority of the Year 1 teachers (25% plus 33.3%, Table 92) in the study have at least twenty years of teaching experience with a quarter and 17% of them having less than 5 years and at least 10 (but less than 20) years respectively, of teaching experience. Of the 12 Year 1 teachers, 58% of them have taught Year 1 classes for less than 5 years with the rest spread over the other categories as shown in Table 92.

Table 92: Year 1 Teachers' Teaching Experience

	N = 12	**1 <5yrs**	**2 5-9 yrs**	**3 10-19 yrs**	**4 20-29 yrs**	**5 30-39 yrs**
1	Total years of teaching	25%	0%	17%	25%	33.3%
2	Number of years teaching Year 1	58%	8%	17%	8%	8%

Teaching Certificate

All of the 12 teachers reported they have a teaching certificate with the minimum formal education being either Form 5 (or School Certificate) and/or a Diploma of Education (Primary).

Teacher Interactions

The frequency of various types of interactions the teacher has with colleagues are summarised in Table 93. The results indicate that collegial interactions to discuss teaching methods and preparation of instructional materials are infrequent activities occurring either 2 or 3 times a month or 1 to 3 times a week for at least third of the teachers. Visits to other classrooms to observe colleagues teaching never happens for a third of the teachers and 2 to 3 times for another third. Half the teachers never have informal observations of their classroom by another teacher with monthly interactions 2 or 3 times with two of the teachers and weekly interactions once to three times for another teacher.

Table 93: Year 1 Teacher Interactions

	N = 12	1 Never or almost never	2 2 or 3 times a month	3 1-3 times per week	4 Daily or Almost daily
1	Discussions about how to teach a particular concept	17%	42%	33.3%	8%
2	Working on preparing instructional materials	17%	33.3%	33.3%	8%
3	Visits to another teacher's classroom to observe his/her teaching	33.3%	33.3%	8%	0%
4	Informal observations of my classroom by another teacher	50%	17%	8%	0%

School Safety

The report of mathematics teachers' perception of safety in school summarises teachers' reports of how safe and secure they feel in their schools. Teachers responded to each item using a 4-point scale: *agree a lot* = 1, *agree* = 2, *disagree* = 3, and *disagree a lot* = 4 resulting in the percentage distribution of endorsement provided in Table 94. The evidence indicates that the majority of teachers agree their school is in a safe neighbourhood, they feel safe in school and that the school's security policies and practices are sufficient.

Table 94: Year 1 Teachers' Report on Safety in School

	N = 12	1 Agree a lot	2 Agree	3 Disagree	4 Disagree a lot
1	This school is located in a safe neighbourhood	33.3	58	0	8
2	I feel safe at this school	58	25	17	0
3	This school's security policies and practices are sufficient	25	58	17	0

Adequacy of School Facilities

Teachers' report of adequate working conditions summarizes teachers' perspectives on the availability of school resources and how these affect their capacity to provide effective mathematics instruction. Teachers rated problems in their school by severity on a 3-point scale: *not a problem* = 1; *minor problem* = 2; and *serious problems* = 3. The three questionnaire statements are as listed in Table 95. The percentage distribution of teachers' ratings indicated that 42% of teachers rated the need for significant repairs to school buildings to be a minor problem with a third rating it as a serious problem while 17% viewed it as not a problem. Classrooms as being overcrowded was considered by 42% of the teachers as a serious problem with a quarter regarding it as a minor problem in their schools compared to another quarter who considered it to be not a problem in their schools. Having inadequate workspace outside of their classrooms was considered as a serious problem by only 8% of the teachers with a 17% rating it as a minor problem while 67% considered it as not a problem. As for having computers available for staff use, a third considered it as a minor problem with 42% rating it as not a problem at all while 17% rated it as a serious problem.

Table 95: Year 1 Teachers' Reports on Severity of School Facility Problems

	N = 12	1 Not a problem	2 Minor problem	3 Serious problem
a	The school building needs significant repair	17	42	33.3
b	Classrooms are overcrowded	25	25	42
c	Teachers do not have adequate workspace outside of their classroom	67	17	8
d	Computers are not available for staff use	42	33.3	17

School Climate for Learning Mathematics

The report of teachers' perception of school climate summarize teachers' reports about their school and how supportive the climate is for learning in terms of their rating of job satisfaction, parental support and involvement, expectations for student achievement, students' desire to do well in school and their regard for school property. The summary percentage distribution of teachers' responses on a 5-point scale: *very high* = 1, *high* = 2, *medium* = 3, *low* = 4, and *very low* = 5 per attribute is provided in Table 96. The majority of the teachers rated all attributes as medium to high priority in their schools.

Table 96: Year 1 Teachers' Report on School Climate

	N = 12	1 % Very high	2 % High	3 % Medium	4 % Low	5 % Very low
1	Teachers' job satisfaction	8	58	25	0	0
2	Teachers' understanding of the school's curricular goals	25	42	33.3	0	0
3	Teachers' degree of success in implementing the school's curriculum	0	42	42	8	0
4	Teachers' expectations for student achievement	8	58	33	0	0
5	Parental support for student achievement	8	25	50	17	0
6	Parental involvement in school activities	8	33.3	42	17	0
7	Students' regard for school property	0	33.3	33.3	17	8
8	Students' desire to do well in school	0	50	33.3	17	0

Teachers' Preparedness to Teach Year 1 Mathematics

Teachers' perception of their preparedness to teach the prescribed numeracy and mathematics topics of the Year 1 curriculum (in Table 97) are rated on a 4-point scale: *very well-prepared* = 3, *somewhat prepared* = 2, *not well-prepared* = 1, and *not applicable* = 0. The summary percentage distribution of the teachers' responses by topic and by response category, is provided in) are rated on a 4-point scale: *very well-prepared* = 3, *somewhat prepared* = 2, *not well-prepared* = 1, and *not applicable* = 0. The summary percentage distribution of the teachers' responses by topic and by response category is provided in Table 98, in descending order of the 'very well-prepared' percentage. The results show that half up to 83% of the teachers perceived themselves 'very well-prepared' to teach 48% ($\frac{20}{42}$) of the 42 prescribed Year 1 topics. For the same topics, up to half the teachers consider themselves 'somewhat prepared' and up to 8% think they are 'not well-prepared' with another up 8% perceiving the topics as being 'not applicable'.

Mathematics Class Size and Weekly Time Allocation

Number of students in the sampled mathematics classes was 20+ for a third of the teachers, 30+ for 58% of the teachers and one teacher had 60+ students in her class. The weekly total number of minutes a teacher teaches mathematics to her/his class ranged from 50 minutes (17%) to 150 minutes (33%), 220 minutes (42%) and up to 300 minutes (8%).

Mathematics Textbook and Resources

Ninety two percent (92%) of the teachers used the new teachers' manual as the primary basis (75%) or a supplementary resource (17%) for their lessons. Three-quarters of the teachers also used a mathematics textbook as a primary source (42%) or a supplementary resource (33%) while only 58% of the teachers used PEMP student resources books as a primary basis (20%) or a supplementary resource (40%) for the teaching of mathematics. Other resources (eg SRA Mathematics and raw materials) are used by 92% of the teachers as the primary basis (33%) or a supplementary resource (58%) for their lessons.

Table 97: Year 1 Prescribed Mathematics Topics

Number and Operations (NR)

a. Counting forwards and backwards by ones and twos from any starting point in the range 0 to 50
b. Recognising, comparing, ordering, reading and representing whole numbers up to 50 including the use of place value to partition numbers into tens and units
c. Reading and using the ordinal names to at least 'tenth'
d. Modelling addition by combing sets and modelling subtraction by taking away part of a set
e. Using 'counting on' or 'counting down' strategies to determine 'how many more' when comparing sets or collections
f. Modelling multiplication by using 'equal groups' and modelling division by 'sharing equally'
g. Constructing and modelling two equal parts of an object, set or collections
h. Representing halves by words, numbers, or models
i. Recognising, describing and ordering Samoan coins
j. Identifying, recognising and describing chance in familiar activities

Number Patterns (PA)

a. Identifying, describing, generating and extending repeating patterns of sounds and/or actions, shapes and numbers
b. Modelling and extending simple number patterns that decrease up to 50 or decrease from 50
c. Analysing change and describing how growing patterns are generated

Data Representation (DA)

a. Designing an investigation, collecting and organizing data to answer a specific question
b. Organising actual objects, pictures of the objects or students themselves into a data display
c. Recording and reading data from tables, pictographs, and people graphs

Measurement (MS)

a. Recognising and describing the attribute of length
b. Directly comparing lengths by placing objects side-by-side and aligning ends

Measurement (MS) *cont'd*

c. Recognising and describing the attribute of area
d. Directly comparing areas by direct comparison and superimposing
e. Recognising and explaining the attributes of volume and capacity
f. Measuring length, area, volume and capacity using informal means
g. Informally recording length, area, volume and capacity
h. Recognising and explaining the attribute of mass
i. Directly comparing two objects by pushing, pulling or hefting or an equal arm balance and order objects according to their masses
j. Informally recording mass using drawings and words
k. Using everyday language to describe duration of events, and identify and order events in time
l. Classifying days into week-days and week-ends and read time on the hour

Space and Geometry (SG)

a. Arranging and sorting three-dimensional objects in the environment
b. Using everyday language to describe their features and recognizing and using informal names for 3D objects
c. Rearranging, classifying and explaining properties of two dimensional shapes
d. Identifying and naming circles, squares, triangles and rectangles in pictures and the environment and presented in different orientations
e. Constructing an modelling 2D shapes using a range of materials
f. Using flips to create tessellating designs
g. Reorganising and arrangement by combining and partitioning to form new shapes
h. Recognising, identifying and sketching straight and curved lines
i. Recognising, identifying and defining closed shapes and open lines
j. Understanding and recognizing different types of corner
k. Comparing and classifying corners into groups
l. Providing and following simple directions
m. Identifying, comparing and describing angles
n. Describing positions using everyday language

Student Learning Activities in Mathematics

Teachers reported the percentage of time students spend doing various learning activities in a typical week of mathematics lessons. The results are shown in Table 99. The majority of the teachers reported they spend between 5% and 10% of lesson time doing the listed activities.

Calculator Use and Computer Access

The majority of the teachers (83.3%) reported that calculators are not permitted during mathematics lessons. Furthermore, 92% of the teachers reported that calculators are never used at all to check answers, do routine computations, solve complex problems or explore concepts. Also students have no computers for their use during their mathematics classes and no access to internet. Because there are

no computers available for student use, students never use computers to discover mathematics principles and concepts, practice skills and procedures and/or look up ideas and information in mathematics.

Table 98: Year 1 Teachers' Ranked Preparedness to Teach Year 1 Mathematics Topics

		3 % Very well-prepared	2 % Somewhat prepared	1 % Not well-prepared	0 % Not applicable
1	NRa: Counting forwards and backwards by ones and twos from any starting point in the range 0 to 50	83	17	0	0
2	NRh: Representing halves by words, numbers, or models	83	17	0	0
3	PAa: Identifying, describing, generating and extending repeating patterns of sounds and/or actions, shapes and numbers	75	25	0	0
4	MSa: Recognising and describing the attribute of length	75	25	0	0
5	NRd: Modelling addition by combing sets and modelling subtraction by taking away part of a set	67	33	0	0
6	PAb: Modelling and extending simple number patterns that decrease up to 50 or decrease from 50	67	33	0	0
7	PAc: Analysing change and describing how growing patterns are generated	67	25	0	0
8	MSk: Using everyday language to describe duration of events, and identify and order events in time	67	33	0	0
9	SGa: Arranging and sorting three-dimensional objects in the environment	67	33	0	0
10	SGb: Using everyday language to describe their features and recognizing and using informal names for 3D objects	67	33	0	0
11	SGd: Identifying and naming circles, squares, triangles and rectangles in pictures and the environment and presented in different orientations	67	33	0	0
12	NRg: Constructing and modelling two equal parts of an object, set or collections	58	33	0	0
13	NRi: Recognising, describing and ordering Samoan coins	58	42	0	0
14	MSb: Directly comparing lengths by placing objects side-by-side and aligning ends	58	42	0	0
15	MSf: Measuring length, area, volume and capacity using informal means	58	42	0	0
16	MSj: Informally recording mass using drawings and words	58	42	0	0
17	SGc: Rearranging, classifying and explaining properties of two-dimensional shapes	58	33	0	8
18	SGn: Describing positions using everyday language	58	25	8	0
19	MSc: Recognising and describing the attribute of area	50	42	0	0
20	SGh: Recognising, identifying and sketching straight and curved lines	50	50	0	0
21	NRe: Using 'counting on' or 'counting down' strategies to determine 'how many more' when comparing sets or collections	42	50	0	0
22	NRf: Modelling multiplication by using 'equal groups' and modelling division by 'sharing equally'	42	50	0	0
23	MSi: Directly comparing two objects by pushing, pulling or hefting or an equal arm balance and order objects according to their masses	42	50	0	8
24	MSl: Classifying days into week-days and week-ends and read time on the hour	42	58	0	0
25	SGe: Constructing an modelling 2D shapes using a range of materials	42	50	0	8
26	NRc: Reading and using the ordinal names to at least 'tenth'	42	42	8	0
27	NRb: Recognising, comparing, ordering, reading and representing whole numbers up to 50 including the use of place value to partition numbers into tens and units	33.3	67	0	0
28	NRj: Identifying, recognising and describing chance in familiar activities	33.3	67	0	0
29	DAb: Organising actual objects, pictures of the objects or students themselves into a data display	33.3	58	0	8
30	MSe: Recognising and explaining the attributes of volume and capacity	33.3	58	0	8
31	MSg: Informally recording length, area, volume and capacity	33.3	67	0	0
32	SGj: Understanding and recognizing different types of corners	33.3	50	0	17
33	SGl: Providing and following simple directions	33.3	50	0	8
34	SGi: Recognising, identifying and defining closed shapes and open lines	33.3	50	8	8
35	SGm: Identifying, comparing and describing angles	33.3	42	8	8
36	DAa: Designing an investigation, collecting and organizing data to answer a specific question	25	67	0	8
37	SGg: Reorganising and arrangement by combining and partitioning to form new shapes	25	67	8	0
38	DAc: Recording and reading data from tables, pictographs, and people graphs	17	75	0	8
39	MSh: Recognising, identifying and sketching straight and curved lines	17	67	0	17
40	MSd: Directly comparing areas by direct comparison and superimposing	17	75	8	0
41	SGk: Comparing and classifying corners into groups	8	75	0	17
42	SGf: Using flips to create tessellating designs	0	67	17	17

Table 99: Percentage of Time Year 1 Students Spend on Learning Activities

	5%	10%	15%	20%	25%
Reviewing homework	33.3	42	0	8	0
Listening to lecture-style presentations	25	25	0	25	0
Solving problems with your guidance	8	42	8	8	17
Solving problems on their own without your guidance	8	50	17	8	0
Doing individual or small group activities	8	42	25	8	0
Listening to you re-teach and clarify relevant Knowledge & Skills and Working Mathematically Processes	17	42	17	8	0
Taking tests or quizzes	33	33	8	8	0
Participating in classroom management tasks not related to the lesson' content / purpose (eg interruptions and keeping order)	33	33	17	0	0
Other student activities	33	42	8	0	0

Mathematics Content Related Activities

Frequency with which the teacher asks students to do various content-related activities in mathematics are summarised in Table 100. For example, the majority (half up to 75%) of the teachers have their students model the four operations using concrete materials; identify and model halves using sets, collections and objects; identify, model and learn about shapes; and measure things around their school environment using informal units for some lessons. In every or almost every lesson, the majority (half up to 58%) of teachers have their students explain their answers and relate what they are learning in mathematics to daily life. As for memorising number facts and procedures, a quarter of the teachers reported they do this in every or almost every lesson with another quarter reporting that his/her students never do it and 42% indicated their students do this in some lessons.

Table 100: Percentage of Time Year 1 Students Spend on Content Related Activities

	1 Every / almost every lesson	**2 About half the lessons**	**3 Some lessons**	**4 never**
Modelling addition, subtraction, multiplication, and division using concrete materials and mental strategies	25%	17%	50%	0
Identifying and modelling halves using sets, collections and objects	17%	0	75%	0
Measuring things in the classroom and around the school using informal units	17%	8%	58%	8%
Organising actual objects, pictures of objects or students themselves into a data display	25%	17%	33%	17%
Identifying, modelling and learning about shapes such as circles, triangles, and rectangles in pictures and the environment	33%	8%	50%	0
Explaining their answers	58%	0	25%	8%
Relating what they are learning in mathematics to their daily life	50%	8%	25%	8%
Memorising number facts and procedures	25%	0	42%	25%

Emphasis on Mathematics Content Areas

Teachers reported on the emphasis they put on mathematics content areas in terms of the percentage of time spent on each content area during the school year. The results, provided in Table 101, demonstrate that, for Number & Operations topic areas, about a third of the teachers (8% and 25%) spend between 15% and 20% of the school year teaching it compared to even more teachers (42%) that devote 30% of the school year teaching number and operations. For the other strands, the vast majority of teachers spend between 15% and 20% of their time teaching each content area.

Table 101: Year 1 Percentage of Time Spent on Content Areas in a School Year

Percentage of the time	5%	10%	15%	20%	25%	30%
Strand						
Number & Operations	8	0	8	25	0	42
Number Patterns	0	0	33.3	42	8	0
Data Representation	0	8	25	50	0	0
Measurement	0	8	17	58	0	0
Space & Geometry	0	17	33.3	33.3	0	0

Mathematics Topic Coverage

Teachers' report on when the mathematics topics covered in the test were taught, by content area, using a 3-point scale: *mostly taught before this year* = 1, *mostly taught this year* = 2, and *not yet taught or just introduced* = 3. The percentage distribution of teachers' endorsement of response categories are summarised in Table 102 and ranked by the 'mostly taught this year' percentage to highlight the prescribed Year 1 topics that have been taught already this year and assessed by Test 1 and yet may have not have been taught at all by the teachers. The results demonstrate that half up to three-quarters of the teachers indicated they 'mostly taught this year' 40% ($\frac{17}{42}$) of the 42 topics from the Year 1 prescribed mathematics curriculum. For the same topics, up to 9% of the teachers responded they were 'mostly taught before this year' with another up to a third of the teachers indicated they were 'not taught or just introduced' this year.

Mathematics Homework

Seventy five percentage (75%) of the teachers reported that homework is assigned to students in every or almost every lesson (33%) or in some lessons (42%). The amount of homework assigned is expected to take an average student 15 to 30 minutes according to half the teachers and less than 15 minutes as rated by a quarter of the teachers.

Student Factors Limiting the Teaching of Mathematics Classes

Table 103a showed the percentage distribution of teachers' ratings of the five statements about student factors limiting mathematics instruction on a 4-point scale: *not at all/ not applicable* = 1; *a little* = 2; *some* = 3; and *a lot* = 4. Collapsing the original four categories to two, namely, *not at all – a little* and *some – a lot*, the resulting percentages (in Table 103b) showed that at least half the teachers considered 3 of the 5 listed student factors (i.e. students' different academic abilities, wide range of language and economic backgrounds and specials needs) to be limiting their teaching of mathematics from some to a lot of extent whereas only half the teachers rated 'uninterested' and 'disruptive' students as limiting their teaching of mathematics.

Year 1 Professional Development Participation

The teachers reported whether they participated in various types of professional development activities for mathematics teaching in the last two years. Teachers' responses showed a third (33.3%) of the teachers attended professional development activities on 'mathematics pedagogy and instruction' with forty two percentage (42%) participating in 'mathematics content' and 'integrating information technology into mathematics' professional development activities. With 'improving students' critical thinking or problem solving skills' professional development activities, half the teachers attended while 67% attended 'mathematics assessment' type activities. A vast majority of the teachers (83%) reported attending 'mathematics curriculum' professional development activities in the last two years.

Table 102: Year 1 Teachers' Ranked Mathematics Topic Coverage

	Strand	Topics	1 Most taught before this year	2 Most taught this year	3 Not at all taught this year or just introduced
1	NR	f. Using the strategy 'counting on' to determine 'how many more'	0	75	8
2	NR	h. Identifying equal and unequal sets	0	75	8
3	NR	b. Identifying the number before and after given numbers	8	67	8
4	MS	a. Identifying the tallest tree from pictures of trees	8	67	8
5	NR	c. Finding the position of an object in a picture	9	64	9
6	NR	a. Counting objects in a picture	8	58	8
7	NR	d. Addition and subtraction of two-digit numbers	0	58	25
8	NR	e. Identifying an equivalent addition number statement	0	58	25
9	NR	g. Counting on from the larger number to add two numbers	8	58	17
10	NR	j. Modelling division as repeated subtraction	0	58	25
11	NR	n. Finding the number of equal groups for a given amount	8	58	17
12	NR	o. Distributing an odd number of objects according to a given fraction	8	58	17
13	NR	q. Modelling quarters of an object as four equal parts	8	58	17
14	NR	l. Recording multiplication in words and numerals	0	55	27
15	NR	k. Recording the addition of equal groups in a number sentence	0	50	33.3
16	NR	m. Sharing objects equally to a given number of people	0	50	33.3
17	NR	r. Modelling equal shares that are simple fractions	8	50	25
18	NR	i. Modelling multiplication as repeated addition	17	42	25
19	NR	w. Comparing likelihood of every day events	17	42	25
20	MS	e. Measuring area by placing informal units without gaps or overlaps	0	42	33.3
21	MS	h. Finding and ordering area by counting the number of units	0	42	42
22	SG	c. Identifying the top view of a cone	8	42	33.3
23	NR	v. Ordering events from least likely to most likely	17	33.3	33.3
24	PA	b. Continuing a number pattern that decreases	17	33.3	33.3
25	PA	c. Continuing a number pattern that increases	17	33.3	33.3
26	MS	b. Knowing the appropriate device for measuring length	8	33.3	42
27	MS	c. Identifying the appropriate equipment to measure mass	8	33.3	42
28	SG	e. Using coordinates on a simple map to describe position	8	33.3	42
29	NR	p. Representing half as ½	0	25	50
30	PA	a. Continuing a repeating geometric pattern	17	25	41
31	PA	d. Continuing a geometric pattern that increases	17	25	42
32	DA	a. Interpreting information presented in a data display	8	25	50
33	MS	g. Measuring the mass of an object in kilograms	0	17	67
34	NR	s. Calculating change in a simple transaction	9	9	64
35	NR	t. Distinguishing between possible and impossible events	8	8	67
36	NR	u. Ordering chance events based on numbers of objects in a bottle	17	8	58
37	NR	x. Predicting chance of an event in a simple chance experiment	17	8	58
38	MS	f. Reading and telling time to the quarter-hour on digital clocks	17	8	58
39	SG	d. Counting corners of three-dimensional solids	8	8	67
40	MS	d. Reading capacity of milk (in mL) in a baby bottle	17	0	67
41	SG	a. Identifying a hexagon from a picture of different shapes	17	0	67
42	SG	b. Identifying a pyramid	17	0	67

Table 103: Year 1 Teachers' Reports on Student Factors Impacting the Teaching of Mathematics

In your view, to what extent do the following limit how you teach mathematics to your class?

(a) Four Categories

	N = 12	Blank	1 Not at all	2 A little	3 some	4 A lot
a	Students with different academic abilities	25	25	0	50	0
b	Students who come from a wide range of backgrounds (eg, economic, language)	17	17	8	17	42
c	Students with special needs (eg, hearing, vision, speech impairment, physical disabilities, mental or emotional / psychological impairment)	17	8	8	33	33
d	Uninterested students	17	33	17	8	25
e	Disruptive students	17	33	17	33	0

(b) Two Merged Categories

		Not at all – a little	Some – a lot
a	Students with different academic abilities	25	50
b	Students who come from a wide range of backgrounds (eg, economic, language)	25	59
c	Students with special needs (eg, hearing, vision, speech impairment, physical disabilities, mental or emotional / psychological impairment)	16	66
d	Uninterested students	50	33
e	Disruptive students	50	33

Summary of Teachers' Questionnaires

Of all the 36 Years 1 to 4 teachers that completed the questionnaires in the sample, 94% ($\frac{34}{36}$) are females. Regarding their age, 31% of the teachers are in their thirties, a quarter in their fifties, 19% are in their forties and 16.6% in their twenties with 8.3% of the teachers is over 60 years old as shown in Figure 33.

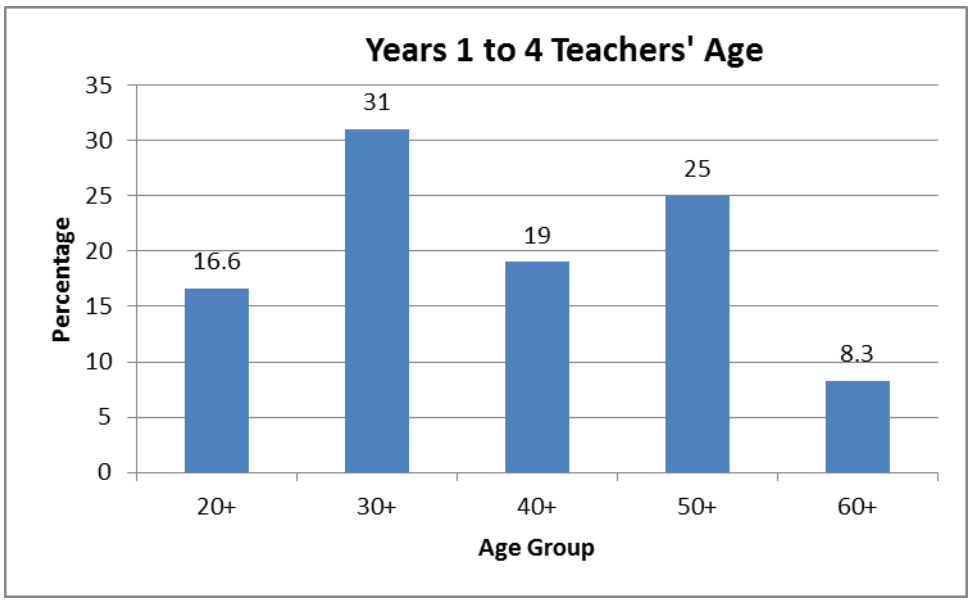


Figure 33: Years 1 to 4 Teacher Age Groups

The percentage distribution of the 36 teachers in terms of years of teaching experience and years teaching at the current Year Levels is shown in Figure 34. Evidently, 39% of the teachers have taught for less than five years followed by those with 20+ (28%) and 30+ (17%) years of teaching experience. However, the majority of them (73%) have less than 5 years of teaching at their current Year Level with 19% of them with 10 to 19 years of teaching at the same Year Level.

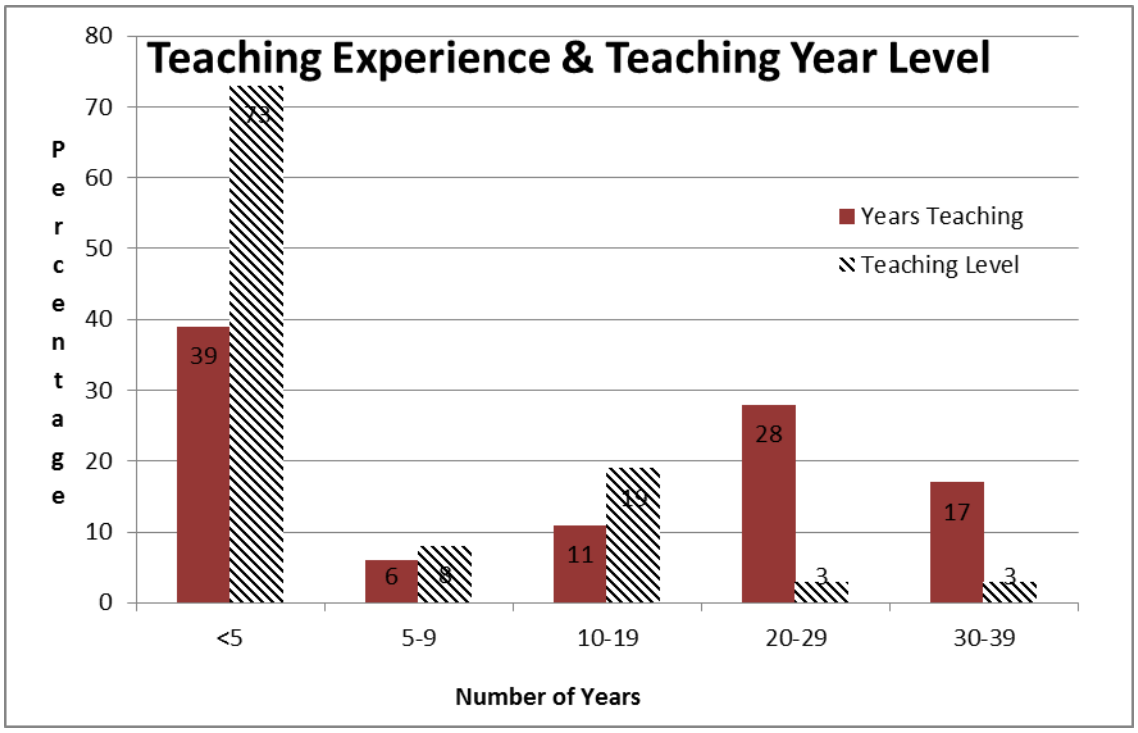


Figure 34: Years 1 to 4 Teachers Teaching Experience and Teaching Year Level

The percentage distribution of the 36 Years 1 to 4 teachers' participation in the various professional development training and workshops in the last two years is summarised in Figure 35.

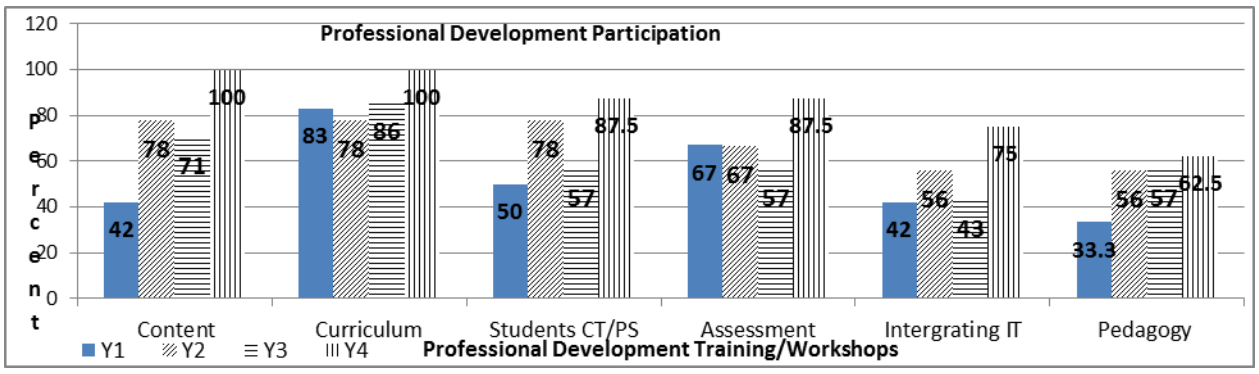


Figure 35: Professional Development Participation

It appears that participation in all of these different activities seemed to be, on one hand, more readily available for Year 4 teachers than the rest as indicated by its consistently highest participation percentages for each activity type. On the other hand at the other end with the least participation rates

are those for Year 1 teachers. Furthermore, of the six different types of activities, 'content' and 'curriculum' types are the most frequently offered types of professional development activities followed by those for 'improving students' critical thinking and problem solving' while those focussing on 'integrating information technology in mathematics' and 'pedagogy and instruction' are the least frequently offered ones.

The summary results from the questions on teachers' perceived level of preparedness, Test assessed topics and topics actually taught in 2013 are displayed in Figure 36 by Year Level. The summary results are displayed as percentages of the Year Level prescribed topics that form the respective Year Level Achievement Standards. For example, for Year 1, the majority (half up to 83%) of the teachers reported they felt 'very well prepared' to teach only 48% ($\frac{20}{42}$) of the prescribed Year topics. In Test 1, 74% ($\frac{31}{42}$) of these prescribed topics were assessed. From Year 1 teachers' responses, the majority (half up to 75%) reported they only taught an equivalent of 38% ($\frac{16}{42}$) of the prescribed topics. Of interest is the relationship between the two percentages, namely, one, that of topics teachers perceived they were very well prepared to teach (eg 48%) and the other, that of topics actually taught in 2013 (i.e. 38%) where the latter is lower than the former as shown in Figure 36.

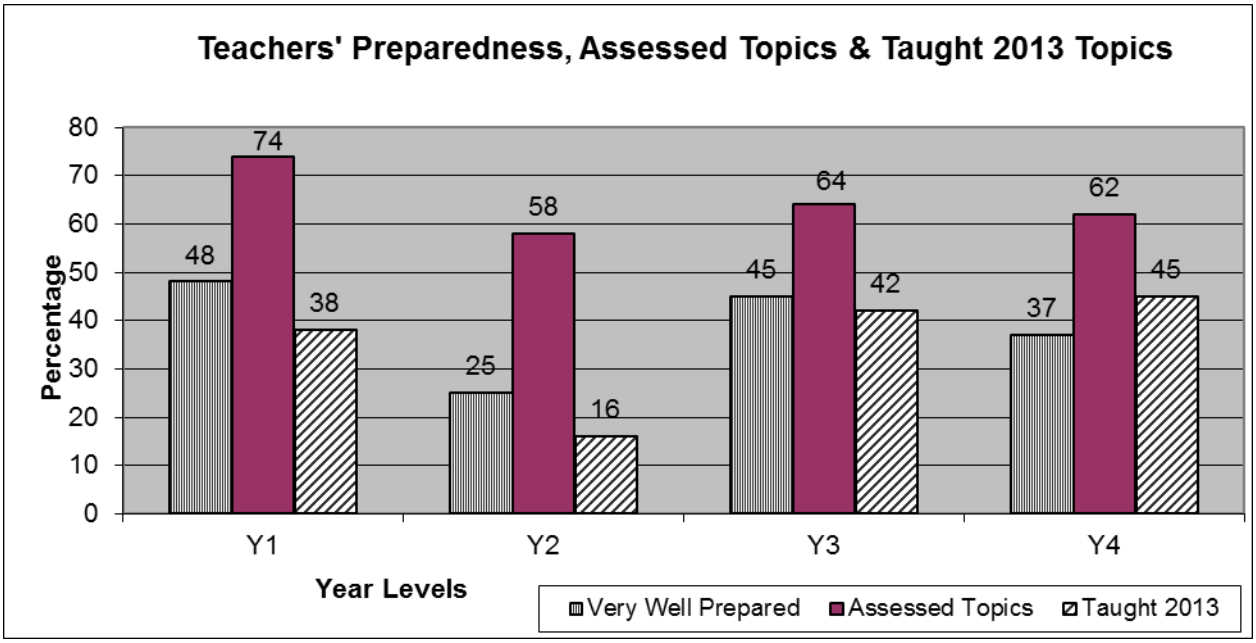


Figure 36: Teachers' Perceived Preparedness, Assessed Topics and 2013 Taught Topics

For Year 2, the majority (half up to 89%) of the teachers reported they felt 'very well prepared' to teach only 25% ($\frac{14}{57}$) of the prescribed Year topics. In Test 2, 58% ($\frac{33}{57}$) of these prescribed topics were assessed. From Year 2 teachers' responses, the majority (56% up to 67%) reported they only taught an equivalent of 16% ($\frac{9}{57}$) of the prescribed topics. Of interest is the relationship between the two percentages, namely, one, that of topics teachers perceived they were very well prepared to teach (eg 25%) and the other, that of topics actually taught in 2013 (i.e. 16%) where the latter is lower than the former as shown in Figure 36.

For Year 3, the majority (half up to 100%) of the teachers reported they felt 'very well prepared' to teach only 45% ($\frac{25}{55}$) of the prescribed Year topics. In Test 3, 64% ($\frac{35}{55}$) of these prescribed topics were

assessed. From Year 3 teachers' responses, the majority (56% up to 67%) reported they only taught an equivalent of 42% ($\frac{23}{55}$) of the prescribed topics. Of interest is the relationship between the two percentages, namely, one that of topics teachers perceived they were very well prepared to teach (eg 45%) and the other, that of topics actually taught in 2013 (i.e. 42%) where the latter is lower than the former as shown in Figure 36.

For Year 4, the majority (half up to 75%) of the teachers reported they felt 'very well prepared' to teach only 37% ($\frac{22}{60}$) of the prescribed Year topics. In Test 4, 62% ($\frac{37}{60}$) of these prescribed topics were assessed. From Year 4 teachers' responses, the majority (56% up to 65%) reported they only taught an equivalent of 45% ($\frac{27}{60}$) of the prescribed topics. Of interest is the relationship between the two percentages, namely, one that of topics teachers perceived they were very well prepared to teach (eg 37%) and the other, that of topics actually taught in 2013 (i.e. 45%) where the latter is higher than the former as shown in Figure 36.

Overall, the results consistently show, for each of the four Year Levels, that the majority of the teachers perceived that they are *not* very well-prepared to teach the majority of the prescribed Year Level topics. Also, of the test-assessed topics, the majority of the teachers have taught in the 2013 school year an equivalent percentage of prescribed topics that is, in 3 out of 4 levels, consistently lower than that of their 'perceived' preparedness. For the Year 4 teachers, topics actually taught in 2013 appeared more than their 'perceived' preparedness percentage.

Principal Questionnaires

The principals reported on the school context and resources available for mathematics instruction as presented below.

The majority (67%) of the principals reported that 26 to 50% of their students are from economically disadvantaged homes while it was more than half of their students according to a third of the principals. A majority of the principals (83%) reported that up to a quarter of their students are from economically affluent homes compared to 26% up to half the students for 17% of the principals.

All principals reported parents are often involved with school events, projects and programs and parents often ensure that their children complete their homework. Only 58% of the principals reported parental involvement with fundraising for the schools.

As for the attributes characterising their school climate for learning, just over seventy percent of the principals considered teacher expectation for student achievement and student regard for school property to be high to very high priority in their schools. Around sixty percent of the principals rated teacher job satisfaction, teachers' curricular goals and students' desire to do well in from high to very high priority while for 71% of the principals; teachers' success in implementing the curriculum was medium priority. With parental support for students achievement and involvement in school activities only about 43% of the principals rated this high to very high priority with the rest rating it low to medium priority.

Mathematics students are grouped by ability according to 57% of the principals with 71% indicating that they offer enrichment in mathematics and all principals reported the offering of remedial mathematics for their students; see Figure 37.

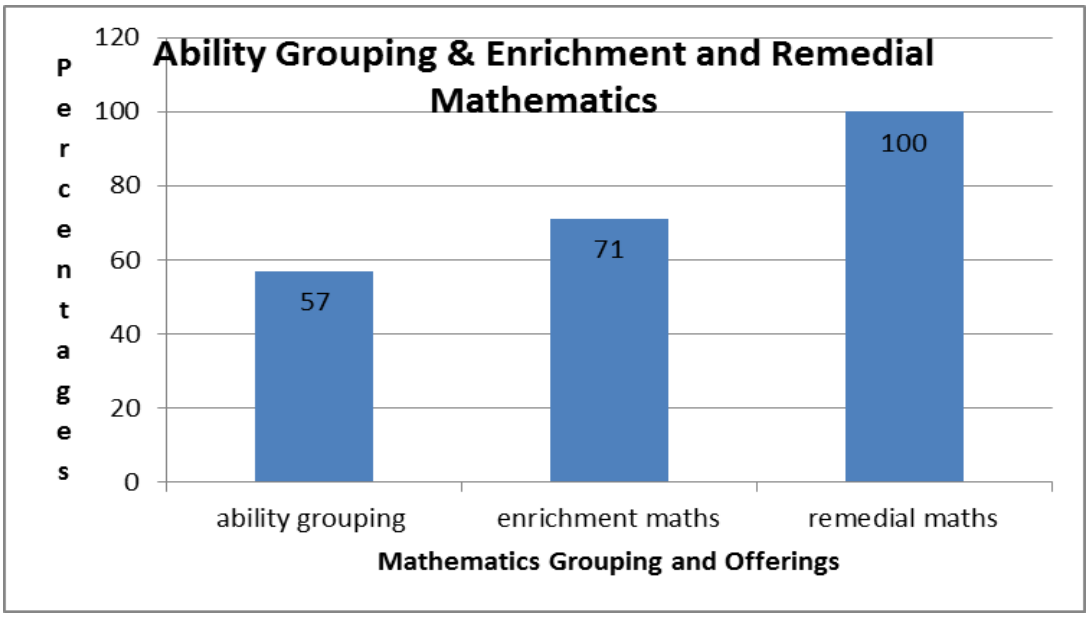


Figure 37: Mathematics Grouping and Offerings

Forty three percent of the principals reported that 26 to 50% of their Years 1 to 4 staff participated in professional development activities that supported the implementation of the new national curriculum, another 43% said only 51 to 75% of their teachers were involved and 14% reported 76 up to 100% of their staff participated, see Figure 38.

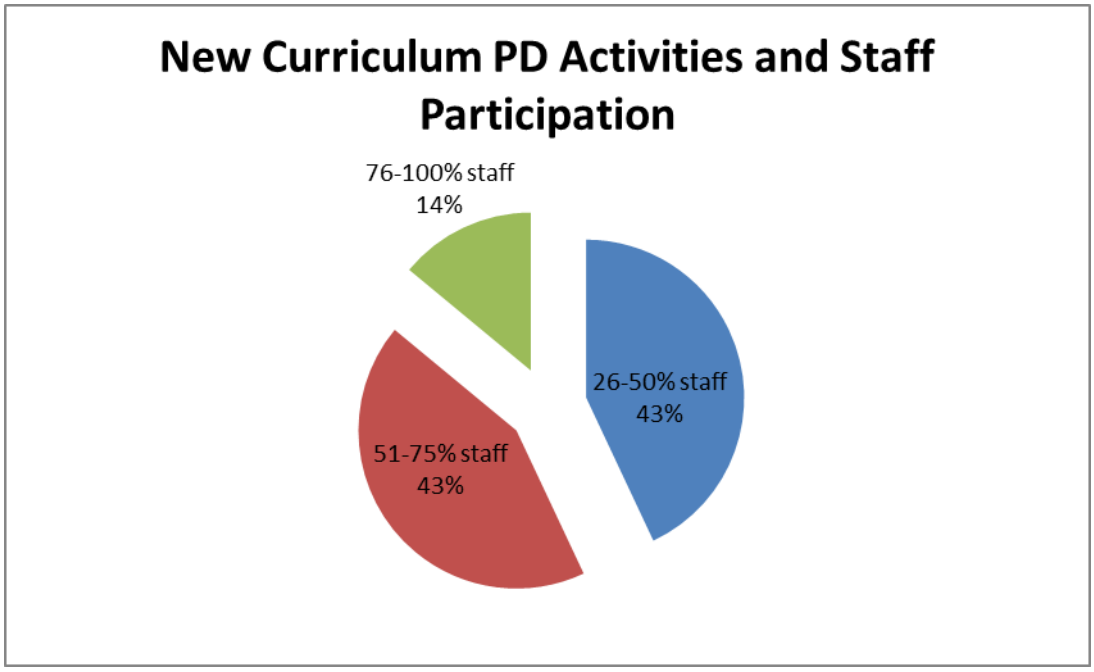


Figure 38: Staff Participation in New Curriculum PD Activities

Similar percentages were also reported for designing or supporting the school's own improvement goals. Twenty nine to forty three percent of the principals reported that a quarter up to a half of their teachers participated in professional development on improving content knowledge and teaching skills. For professional development on using information and communication technology for educational purposes, 86% of the principals said only a quarter up to a half of their staff were involved.

To evaluate the practice of Years 1 to 4 teachers, all principals reported student achievement is used followed by observations by principal or senior staff and teacher peer review according to 86% of the principals with 71% of the principals teacher reported practice is evaluated by observations from external personnel such as school review officers and others, as displayed in Figure 39.

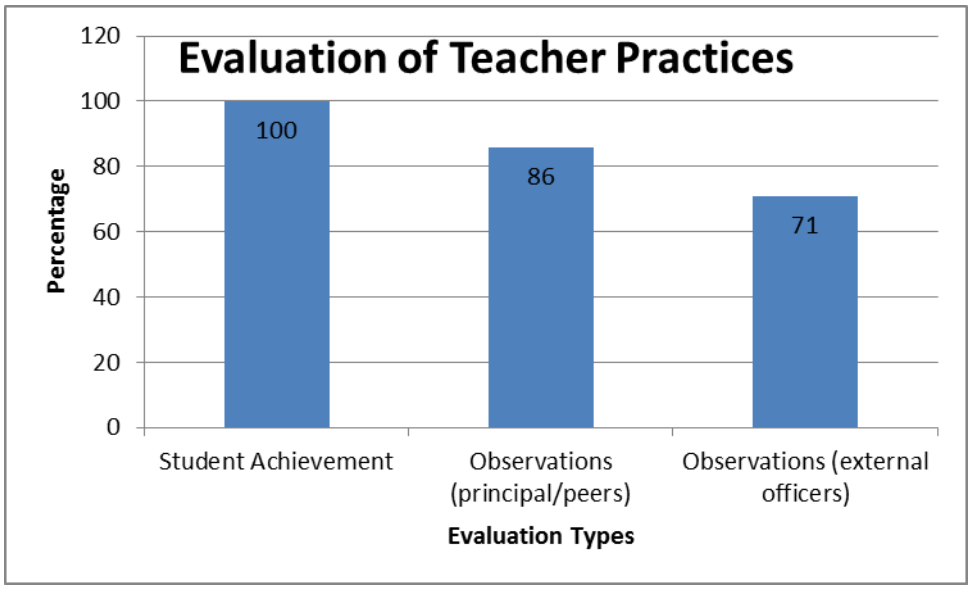


Figure 39: Evaluation of Teacher Practices

Half the principals reported it is somewhat difficult to fill Year 1 to 4 teaching vacancies and 17% claimed it is extremely difficult with a third reporting no vacancies at their schools. The majority of the principals (86%) reported there are currently no incentives to recruit or retain Years 1 to 4 teachers while 14% said there are some incentives.

School's capacity to provide instruction is affected from some to a lot of extent by a shortage or inadequacy of a budget for supplies (stationery), lighting systems, continuous water supply, instructional space (classrooms), hygienic toilets, and schools buildings and grounds according to 43% up to 72% of the principals; see Figure 40. Seventy one percent of the principals reported that the shortage or lack of student resource books and mathematics textbooks affect the teaching of mathematics to a little extent while it was to some extent for 29% of the principals. As for teachers' manuals, 57% of the principals indicated that the shortage or inadequate supplies affected mathematics teaching to some extent while it was none to a little extent for 43% of the principals. Twenty nine percent up to 57% of the principals reported that the lack of computers and computer software, calculators, relevant library materials and audio visual resources affect the teaching of mathematics to a little extent compared to 14% indicating it affects mathematics teaching to some extent; see Figure 40.

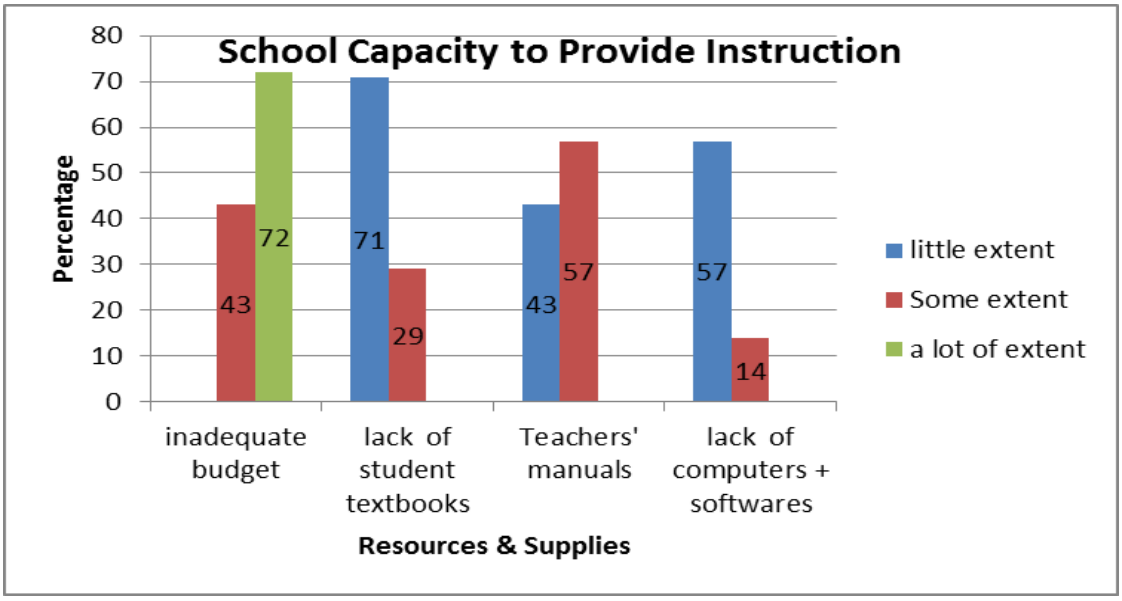


Figure 40: School Capacity to Provide Instruction

Part 3: Student and Teacher Interviews

Student Interviews

This section provides an overview of student responses to the interview assessment (IA) tasks. Teacher-selected students from each Year Level class per school were interviewed on a one-on-one basis. The IA tasks were developed for each Year Level based on the relevant Year Level Achievement Standards primarily to assess students' Knowledge and Skills (K&S) Learning and WM Outcomes given a mathematical situation. Findings from the pilot study guided the finalisation of each IA task for each Year Level with each activity comprising only 3 sub-parts. For example, the first part required students to solve a mathematical situation/problem, and the last two sub-part questions required students to communicate mathematically by explaining the strategy they used to get their answers, providing a different strategy to solve the same task, drawing a diagram or using an empty number line to illustrate their/another strategy, posing their own question using the given information/diagram and providing their own answers, and/or solving an extension or variation of the given mathematical situation. A total of approximately 25 activities were finalised for each Year Level. Shown in Table 104 are the student numbers and marks achieved by the selected students by school and by Year Level. Marks from each school were also averaged and the results are as shown in columns 4 and 8 of Table 104 and graphed in Figure 41.

Table 104: School Student Numbers and Marks by Year Level

Year level	# of students	Student marks out of 100	Average	Year level	# of students	Student marks out of 100	Average
LOT Y1	6	39,34,31,29,20,18	28.5	LOT Y3	6	15,16,19,20,21,29	20
STM Y1	6	23,7,19,18,17,14	16.3	STM Y3	6	30,25,22,19,15,8	19.8
VAM Y1	9	15,21,30,31,21,11,7,22,12	18.9	VAM Y3	6	16,26,30,20,15,35	23.7
FLS Y1	9	4,9,11,12,20,22,27,28,29	18	FLS Y3	7	3,15,16,16,18,18,18	14.9
SLV Y1	6	20,16,11,27,19,18	18.5	SLV Y3	3	12,30,23	21.7
STP Y1	6	35,34,29,28,38,27	31.8	STP Y3	3	11,26,28	21.7
SPU Y1	3	19,20,34	24.3	SPU Y3	3	18,22,24	21.3
MAN Y1	3	16,20,23	19.7	MAN Y3	3	28,22,32	27.3
Total -	**Year 1**	**48**		**Total –**	**Year 3**	**37**	
LOT Y2	6	22,22,21,21,20,20	21	LOT Y4	6	9,15,17,19,25,28	18.8
STM Y2	6	33,27,27,27,26,21	26.8	STM Y4	6	46,29,27,24,24,21	29
VAM Y2	6	15,16,21,22,22,23	19.8	VAM Y4	6	15,16,20,20,12,18	16.8
FLS Y2	5	8,12,25,29,36	22	FLS Y4	6	4,5,13,17,21,22	13.7
SLV Y2	3	26,27,31	28	SLV Y4	3	31,36,40	35.7
STP Y2	6	15,25,18,23,24,25	21.7	STP Y4	6	26,18,12,22,20,27	20.8
SPU Y2	3	21,34,34	29.7	SPU Y4	3	13,22,27	20.7
MAN Y2	3	17,19,25	20.3	MAN Y4	4	0,31,34,35	25
Total -	**Year 2**	**38**		**Total –**	**Year 4**	**40**	

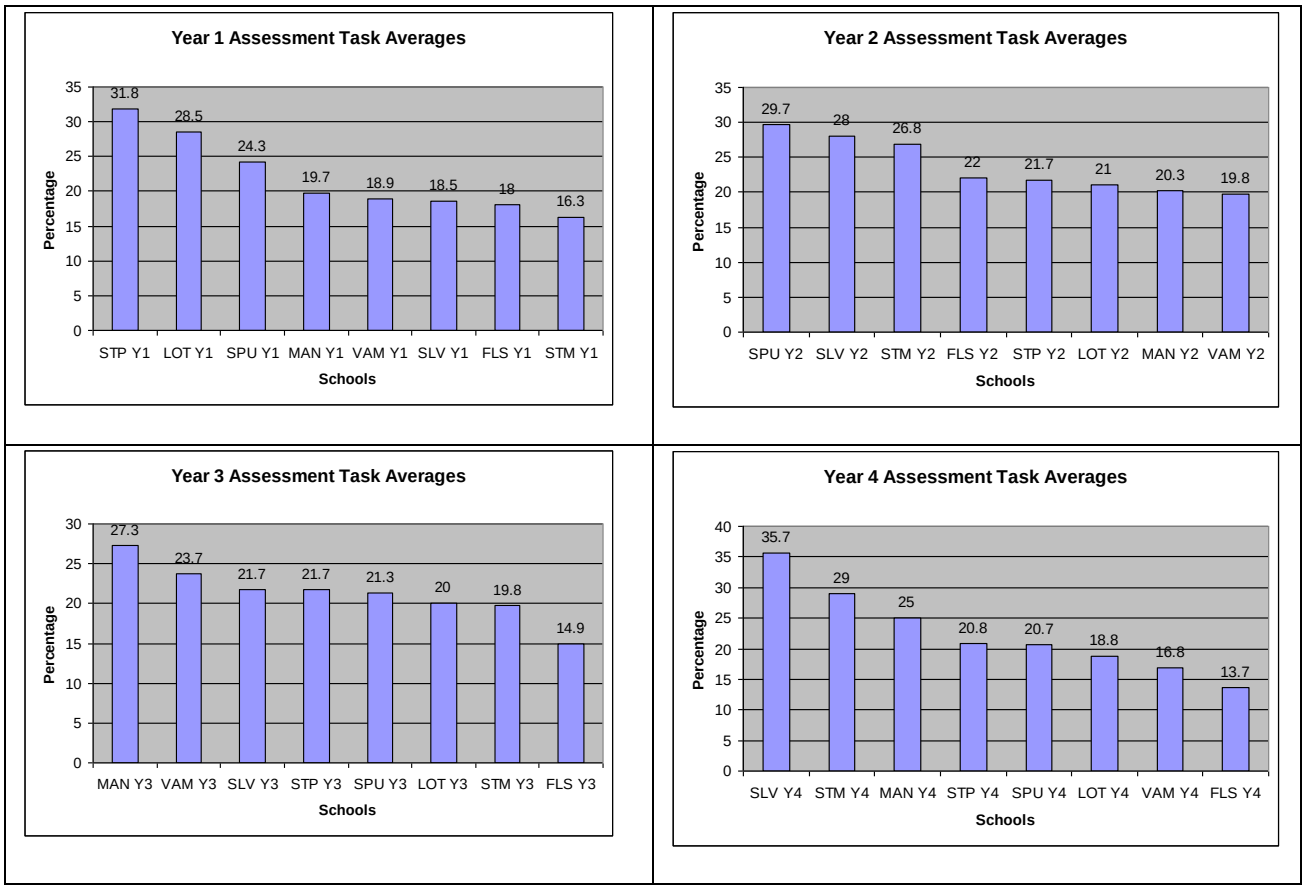


Figure 41: Years 1 to 4 Ranked Assessment Task Averages

The results in Figure 41 illustrate that the school averages are all below 36% demonstrating that students interviewed from each Year Level across the eight schools, on average, did not achieve their Year Level Knowledge & Skills Learning Outcomes and Working Mathematically Outcomes as assessed by the interview assessment tasks.

The percentage of students who successfully completed each activity was determined and the results organised into five bands of difficulty levels, namely, Well Done (80-100%), Above Average (60 - 79%), Average (40 - 59%), Below Average (20 - 39%) and Poorly Done (0 - 19%). The next sections provide brief overviews of each Year Level assessment tasks and relevant K&S and WM outcomes first before providing a summary table of student performances.

Year 1 Interview Assessment Tasks

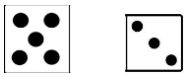
Activity 1 **Which of these boxes are the positions for 26 and 30?**

23										33

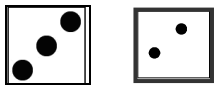
Activity 1 assessed students' K&S and WM abilities and strategies in determining positions of two numbers given two end numbers less than 50.

Activity 2

i. **What number sentence describes the total number of balls in the first picture and second picture?**



b. **What number sentence describes the total number of balls in the first picture and second picture?**



c. **Which number sentence has the larger total?**

Activity 2 assessed students' K&S and WM abilities and strategies in counting objects in 4 different pictures and representing the results as number sentences.

Activity 3 **Starting number is 29, jump forward 2 numbers, what are the next five numbers of the pattern?**

Activity 4 **Starting number is 68, jump backward 2, what are the next six numbers?**

Activities 3 and 4 assessed students' K&S and WM abilities and strategies in generating increasing and decreasing number patterns given start numbers and jump numbers.

Activity 5 **Given the picture below of two lines of dogs, how many more dogs does Line 1 have?**

Activity 5 assessed students' K&S and WM abilities and strategies in applying one-to-one direct comparison of objects in a picture to determine 'how many more' one line has compared to the other.

Activity 6 **What is the meaning of 4 + 3? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of 4 + 3?**

Activity 6 assessed students' K&S and WM abilities and strategies to interpret and illustrate their understanding of the given number statement: 4 + 3.

Activity 7 **Tina had forty six apples in the given box. She bought eight more apples. Write a number sentence to show the apples inside the box and the ones bought.**

Activity 7 assessed students' K&S and WM abilities and strategies to interpret and represent descriptions of quantitative relationships as number statements and sentences.

Activity 8 **What is the meaning of 8 ÷ 2? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of 8 ÷ 2?**

Activity 8 assessed students' K&S and WM abilities and strategies to interpret and illustrate their understanding of the given number expression: $8 \div 2$.

Activity 9 **What numbers are the same as: 5 tens and 9 units; 10 tens; 5 multiplied by 9 add one; and 55 plus 9 subtract two?**

Activity 9 assessed students' K&S and WM abilities and strategies in interpreting and computing number descriptions to determine equivalent numbers.

Activity 10 **What is the meaning of 4 – 3? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of 4 – 3?**

Activity 10 assessed students' K&S and WM abilities and strategies to interpret and illustrate their understanding of the given number expression.

Activity 11 **What is the meaning of ½? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of ½?**

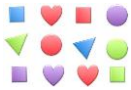
Activity 11 assessed students' K&S and WM abilities and strategies to interpret and illustrate their understanding of the given fraction.

Activity 12 **How many cubes in the picture?**

Write a number sentence to show the number of cubes in the three given pictures?

Activity 12 assessed students' K&S and WM abilities and strategies in counting building blocks of three-dimensional objects and in recognising situations where repeated addition or multiplication is applicable.

Activity 13 **How many squares in the picture? Circles?**



Activity 13 assessed students' K&S and WM abilities and strategies in recognising shapes and counting objects in a picture.

Activity 14 **Which shape has the least number of sides?**

Which of these shapes has the most number of angles and how many is this?

Activity 15 **Which of these shapes has two parts and what are these parts called?**

How many circles are divided into 3 parts?

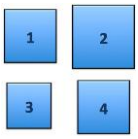
Activities 14 and 15 assessed students' K&S and WM abilities and strategies in identifying sides and angles of two-dimensional shapes, understanding the quantitative difference between 'least' and 'most' and in distinguishing between equal and non-equals parts of a whole shape.

Activity 16 **Which of the nets can be used to construct the cube in the picture without overlapping? Justify your answer.**

Activity 17 **Which tower had the most building blocks: left, middle or right one and how many blocks are there?**

Activities 16 and 17 assessed students' K&S and WM abilities and strategies in identifying the net of a cube and counting building blocks of three-dimensional figures.

Activity 18



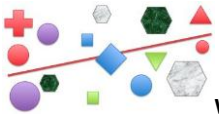
Which of the shapes have the same size? Why?

Which shape is the biggest? Why?

What is order of shapes from smallest to biggest?

Activity 18 assessed students' K&S and WM abilities and strategies in ordering, different sized shapes and to justify their choices appropriately.

Activity 19 **Which triangle is the closest to the line? Justify your answer.**



Which shape is the furthest from the line? Justify your answer.

Activity 19 assessed students' K&S and WM abilities and strategies in estimating distances between objects and justifying their answers.

Activity 20 **Which of these is the heaviest? Why?**

Which fruit is the lightest? Why? Which shape is the biggest? Why?

Activity 20 assessed students' K&S and WM abilities and strategies in assessing the heaviest and lightest objects from pictures of common and familiar fruits and in justifying their choices.

Activity 21

Which arrow is pointing down? Justify your answer.

Which arrow is pointing to the right? Pose a question using the given picture. What is your answer?

Activity 21 assessed students' K&S and WM abilities in identifying directions: down, up, left and right and communicating mathematically.

Activity 22

Which picture shows two equal parts? Justify your answer.

Which picture shows the bigger part on the right side?

Activity 22 assessed students' K&S and WM abilities and strategies in recognising equal and non-equal parts of a whole and communicating mathematically.

Activity 23

How many kittens' ears altogether in the picture. Explain your answer.

How many kittens' legs in the picture. Explain your answer.

How many kittens' legs if the number of kittens doubles?

Activity 23 assessed students' K&S and WM abilities and strategies in counting familiar objects and communicating mathematically.

Activity 24

The picture shows horses' legs. How many horses are there? Explain your answer. How many ears altogether for these horses?

Activity 24 assessed students' K&S and WM abilities and strategies in applying their knowledge of animals and reasoning to solve problems and communicating mathematically.

Activity 25 **I am third in the queue (line), and there are two behind me. How many people in the queue?**

Activity 25 assessed students' K&S and WM abilities and strategies to apply their knowledge and skills about position in a queue (line) to determine the total number in the queue.

Provided in Table 105 is a summary of Year 1 students' performance in terms of the 5 difficulty levels. The summary results demonstrate that Year 1 students have difficulties solving assessment tasks that involve distinguishing between equal and non-equal parts of a whole; interpreting and illustrating in multiple ways their knowledge and understanding of simple fractions and number sentences with one operation (eg ½, 8 ÷ 2, 4 – 3, 4 + 3); generating increasing and decreasing number patterns given start and jump numbers; identifying and counting the number of sides and angles of 2D shapes; applying their knowledge of common animals and reasoning to solve problems on counting total body parts of up to 3 animals; interpreting number descriptions and computing equivalent numbers; and determining the total number in a queue given descriptions of how many in the front and back of a position.

Table 105: Summary of Year 1 Students' Assessment Tasks Performance by Difficulty Level

1	2	3	4	5
Well done	**Above Average**	**Average**	**Below Average**	**Poorly Done**
80 – 100%	**60 – 79%**	**40 – 59%**	**20 – 39%**	**0 – 19%**
Activity 13 Recognising and counting shapes in pictures **Activity 17** Counting building blocks of towers and identifying the one with the most blocks **Activity 2** Counting objects in 4 different pictures, representing results as number sentences and identifying the one with the largest total **Activity 7** Interpreting and representing descriptions of quantitative relationships as number sentences and providing the correct number sentence for the total **Activity 18** Ordering different sized shapes and identifying shapes with the same size	**Activity 15** Identifying the number of equal parts of division of circles **Activity 21** Identifying directions: arrow pointing down, up left, right **Activity 23i** Counting familiar objects (kittens' ears) **Activity 1** Positioning of two numbers between two given end numbers (<50) **Activity 23ii-iii** Applying knowledge of animals and reasoning to solve problems and arrive at reasonable conclusions **Activity 19** Estimating distances between objects visually or using informal measures	**Activity 20** Assessing the heaviest and lightest objects from pictures of common familiar fruits and justifying their choices. **Activity 5** Direct comparison of objects in a picture to determine 'how many more' one line has compared to the other **Activity 12** Counting building blocks of three dimensional figures and recognising situations where repeated addition or multiplication is applicable **Activity 20(ii)** Interpreting quantitative information from pictures **Activity 14** Identifying sides and angles of 2-D shapes	**Activity 15** Distinguishing between equal and non-equal parts of a circle **Activity 8** To interpret and illustrate their understanding of the number expression $8 \div 2$ **Activities 3 & 4** Generating increasing and decreasing number patterns given start numbers and jump numbers. **Activity 10** To interpret and illustrate their understanding of the given number expression $4 - 3$ **Activity 14** Identifying sides and angles of 2-D shapes **Activity 22** Recognising equal and non-equal parts of a whole **Activity 24** Applying their knowledge of animals and reasoning to solve problems.	**Activities 3 & 4** Generating increasing and decreasing number pattern given start numbers and jump numbers **Activity 6** To interpret and illustrate their understanding of the number statement 4 + 3 **Activity 9** Interpreting and computing number descriptions to determine equivalent numbers **Activity 11** Interpreting and illustrating their understanding of the given fraction ½ **Activity 14** Identifying sides and angles of 2-D shapes **Activity 16** Identifying the net of a cube and counting building blocks of 3-D figures **Activity 22** Recognising equal and non-equal parts of a whole **Activity 24** Applying their knowledge of animals and reasoning to solve problems. **Activity 25** Apply their knowledge and skills about position in a queue to determine the total number in the queue.

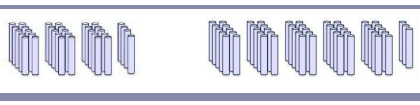
Year 2 Interview Assessment Tasks

Activity 1 **Which of these boxes are the positions for 139 and 142? Pose a question that uses the empty number line and the given numbers.**

137										147

Activity 1 assessed students' K&S and WM abilities and strategies in determining positions of two numbers given two end numbers that are less than 150.

Activity 2



What number sentence describes the total number of sticks in each of the pictures? What is the total number of sticks in the two pictures?

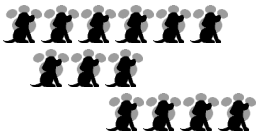
Activity 2 assessed students' K&S and WM abilities and strategies in counting objects displayed in pictures and representing the results as number statements.

Activity 3 **Pattern starts at 218 and jumps forward by 3 numbers. What are the next 5 numbers after 218? How did you get the 5 numbers? Use the empty number line to illustrate your strategy.**

Activity 4 **Pattern starts at 486 and jumps backwards by 5 numbers, what the next 5 numbers after 486? How did you get the 5 numbers? Pose a question using the given number sequence.**

Activities 3 and 4 assessed students' K&S and WM abilities and strategies in generating increasing and decreasing number patterns given start numbers and jump numbers.

Activity 5



How many more dogs does Line 1 have compared to Line 3?

What strategy did you use?

What is another different strategy to find your answer?

Activity 5 assessed students' K&S and WM abilities and strategies to apply one-to-one direct comparison of objects in a picture to determine 'how many more' one line has compared to the other.

Activity 6

I II III

How many matchsticks in picture 1? Explain your strategy. How many matchsticks in picture III? What strategy did you use?

Write a number sentence to show the total number of matchsticks in all three pictures.

Activity 6 assessed students' K&S and WM abilities and strategies in counting objects in pictures and representing the results as number sentences and communicating mathematically.

Activity 7 **What is the meaning of 24 + 3? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of 24 + 3?**

Activity 7 assessed students' K&S and WM abilities and strategies in interpreting and illustrating their understanding of the given number expression.

Activity 8 **Tina had 337 apples in a box. She bought 15 more apples. Write a number sentence to show the number of apples in the box plus those she just bought.**
What is the total number of Tina's apples? What strategy did you use? Explain.
Tina gave away to her sister Mele 48 apples, how many apples are left for Tina?

Activity 8 assessed students' K&S and WM abilities and strategies in interpreting and representing given descriptions of quantitative relationships as number statements and sentences.

Activity 9 **What is the meaning of 24 ÷ 3? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of 24 ÷ 3?**

Activity 9 assessed students' K&S and WM abilities and strategies in interpreting and illustrating their understanding of the given number expression.

Activity 10

If the given numbers are arranged from the smallest to the biggest, what is the sequence of numbers?
What is the third number in the sequence?
If we add 4 to the numbers, where do you position 4 in the sequence of numbers from smallest to the biggest?

Activity 10 assessed students' K&S and WM abilities and strategies in ordering numbers, identifying positions of numbers, continuing patterns, and posing questions.

Activity 11 **What numbers are equivalent to these number descriptions: two less than 16; 3 more than eleven; and 10-digit in the number 354?**

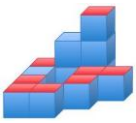
Activity 11 assessed students' K&S and WM abilities and strategies in interpreting and computing number descriptions to determine equivalent numbers.

Activity 12 **What is the meaning of 24 – 3? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of 24 – 3?**

Activity 12 assessed students' K&S and WM abilities and strategies in interpreting and illustrating their understanding of the given number statement.

Activity 13 **What is the meaning of ¼? Use the spaces of the given rectangle to provide 4 different interpretations and/or examples to illustrate your understanding of ¼?**

Activity 13 assessed students' K&S and WM abilities and strategies in interpreting and illustrating their understanding of the given fraction.

Activity 14  **How many cubes in the picture?**

Write a number sentence to show the total number of cubes in the three pictures below?

Activity 14 assessed students' K&S and WM abilities and strategies in counting building blocks of three-dimensional objects and in recognising situations where repeated addition or multiplication is applicable.

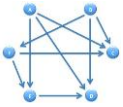
Activity 15  **Which shape has the most number of sides? Write a number sentence to show the number of sides of each shape and the total number of shapes in the given picture.**

Which of these shapes  **has the same number of angles?**

Activity 15 assessed students' K&S and WM abilities and strategies in recognising, identifying and counting sides of two-dimensional shapes in pictures and representing the results as addition number sentences. The last question assessed students' K&S and WM abilities and strategies in recognising, identifying and counting angles of two-dimensional shapes in pictures.

Activity 16  **Which of these shapes is divided into three equal parts and what is the name of this part? Which other shape is divided into equal parts? Pose a question using this picture.**

Activity 16 assessed students' K&S and WM abilities and strategies in identifying equal and non-equal parts of a whole and labelling equal parts of a whole.

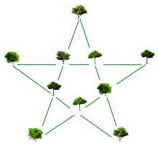
Activity 17  **How many arrows are shown in the picture?**

Pose a question using this picture.

 **How many circles outside of the square in the picture?**

Activity 17 assessed students' K&S and WM abilities and strategies in recognising, identifying and counting objects/shapes in pictures, which satisfy given conditions.

Activity 18



How many trees are on the line between two other trees?

What is the total amount of money in the picture?

Pose a question using any of the pictures

Activity 18 assessed students' K&S and WM abilities and strategies in recognising and identifying objects in a picture which satisfy given conditions and operating with money.

Activity 19

Aleki told Peta to move away from him by one step. If Aleki is standing on the second step, which step is Peta moving to? What strategy did you use?

Pose a question using this picture.

Activity 19 assessed students' K&S and WM abilities in reasoning and thinking strategically to interpret and represent quantitative relationships and communicate mathematically.

Activity 20

What is the difference between the points of Team E and Team O?

Which two teams have a point difference of 4? Justify your answer.

Pose your own question using the given information.

Au Taalo	Ai
A	15
E	14
I	10
O	5
U	4

Activity 20 assessed students' K&S and WM abilities in reasoning and thinking strategically in computing differences between numbers from information presented in a table and communicating mathematically.

Activity 21

If there are five claws on a kitten's foot, how many claws does a kitten have?

Draw a diagram of the strategy you used.

How many claws altogether do 3 kittens have? Explain your strategy.

Activity 21 assessed students' K&S and WM abilities in reasoning and thinking strategically while interpreting and representing word descriptions of mathematical relationships, recognising situations where repeated addition or multiplication is applicable and communicating mathematically.

Activity 22

The first classroom is 3 metres long. The second classroom is twice as long. What is the length of the second classroom?

Draw a diagram to show the length of the two rooms.

The third classroom is four times the length of the second classroom. What is the length of the third room?

Activity 22 assessed students' K&S and WM abilities in reasoning and thinking strategically while interpreting quantitative descriptions and relationships.

Activity 23 **Ana, Tavita, Tanu and Keli each had two mangoes. They ate one mango each. What is the total number of mangoes left? Draw a diagram to show your strategy.**
If Tanu and Keli each got 4 more mangoes while Ana and Tavita got one each, what is the total number of mangoes?

Activity 23 assessed students' K&S and WM abilities in reasoning and thinking strategically while interpreting quantitative descriptions and additive relationships.

Activity 24 **Write 3 number sentences whose answer is 15.**

Activity 24 assessed students' K&S and WM abilities in reasoning and thinking strategically to create equivalent number sentences.

Activity 25 **Ana has 9 eggs. She has 3 boxes which can hold four eggs each. How many more eggs does she need to fill all three boxes?**
Ana got 8 more eggs, how many more boxes does she need for her additional eggs? What is the basis of your answer?

Activity 25 assessed students' K&S and WM abilities in reasoning and thinking strategically in identifying situations where 'equal groupings' are applicable, forming and counting number of equal groups and determining 'how many more' objects are needed to form equal groups.

Provided in Table 106 is a summary of Year 2 students' performance in terms of the 5 difficulty levels. The summary results demonstrate that Year 2 students have difficulties solving assessment tasks that involve interpreting and illustrating in multiple ways their knowledge and understanding of simple fractions and number sentences with one operation (eg ¼, 125 ÷ 5, 24 – 3, 24 + 3); generating increasing and decreasing number patterns given start and jump numbers; identifying and counting objects in pictures that satisfy given conditions; determining 'how many more' one line has when directly compared to another line; writing a number sentence to illustrate the results of counting objects or sides of 2D shapes in pictures and its sum total; representing quantitative descriptions as number statements and sentences; creating equivalent number sentences; counting building blocks of 3D figures or interpreting quantitative descriptions and relationships and recognising situations where repeated addition or multiplication is applicable; recognising situations where 'equal groupings' are applicable; and computing with quantitative information displayed in a simple table or a picture.

Table 106: Summary of Year 2 Students' Assessment Tasks Performance by Difficulty Level

1	2	3	4	5
Well done	Above Average	Average	Below Average	Poorly Done
80 – 100%	60 – 79%	40 – 59%	20 – 39%	0 – 19%
Activity 2(iii) Counting objects displayed in pictures and displaying results as a sum of all objects. **Activity 10(i)&(ii)** Ordering numbers, identifying positions of numbers.	**Activity 1** Determining positions of two numbers given two end numbers (<150) **Activity 2(i)** Counting objects in pictures and representing the results as addition number sentences **Activity 11** Interpreting word descriptions to compute equivalent numbers **Activity 6(i)&(ii)** Recognising, identifying and counting objects/shapes in pictures **Activity 19** Interpreting and representing word descriptions of mathematical relationships. **Activity 24(i)** Reasoning and thinking strategically to create equivalent number sentences **Activity 10(iii)** Ordering numbers, identifying position of numbers, continuing patterns and posing questions	**Activity 15i** Recognising, identifying and counting sides of 2-D shapes in pictures **Activity 16** Identifying equal and non-equal parts of a whole and labelling equal parts. **Activity 25(i)** Reasoning and thinking strategically in identifying situations where 'equal groupings' are applicable, forming/counting numbers of equal groups	**Activity 18** Recognising and identifying objects in a picture which satisfy given conditions and operating with money. **Activity 15ii** Recognising, identifying and counting sides of 2-D shapes in pictures and representing the results as addition number sentences. **Activity 5** Apply one to one direct comparison of objects in a picture to determine how many more one line of objects has compared to the other. **Activity 14** Counting building blocks of 3-D objects and recognising situations where repeated addition or multiplication is applicable **Activity 17** Reasoning to interpret relationships and count shapes in pictures which satisfy given conditions. **Activity 24(ii)** Reasoning and thinking strategically to create equivalent number sentences **Activity 25(ii)** Identifying situations where 'equal groupings' are applicable and forming/counting numbers of equal groups **Activity 2(ii)** Counting objects displayed in pictures and displaying results as a number statement. **Activity 6(iii)** Recognising, identifying and counting objects/shapes in pictures, and displaying the result as the sum of all matchsticks	**Activities 3** Generating increasing number patterns given start numbers and jump numbers **Activity 4** Generating decreasing number patterns given start numbers and jump numbers **Activity 7** Interpreting and showing their understanding of the given number expression 24 + 3. **Activity 8** Interpreting and representing quantitative descriptions of relationships as number statements and sentences. **Activity 12** Interpreting and showing their understanding of the given number statement 24 – 3 **Activity 13** Interpreting and showing their understanding of the fraction ¼ **Activity 20** Computing differences between numbers from information presented in tables. **Activity 24(iii)** Reasoning and thinking strategically to create equivalent number sentences **Activity 25(iii)** Identifying situations where 'equal groupings' are applicable, forming/counting numbers of equal groups and the reasoning behind the answer **Activity 22** Reasoning and thinking strategically in interpreting quantitative descriptions and relationships **Activity 23** Interpreting quantitative descriptions and additive relationships **Activity 9** Interpreting and illustrating their understanding of the number expression: 125 ÷ 5. **Activity 21** Interpreting and representing word descriptions of mathematical relationships.

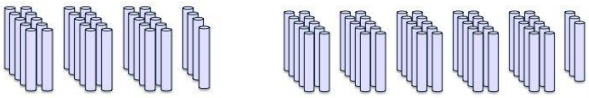
Year 3 Interview Assessment Tasks

Activity 1 **Which of these boxes are the positions for 626 and 630? What strategy did you use? Is there a different way of finding the answer?**

623										633

Activity 1 assessed students' K&S and WM abilities and strategies to identify positions of given numbers that are less than 999.

Activity 2



What number sentence describes the total number of sticks in each of the pictures? What is the total number of sticks in the two pictures?

Activity 2 assessed students' K&S and WM abilities in reasoning and thinking strategically while counting objects in pictures and representing the results as number statements sentences.

Activity 3 **Pattern starts at 397 and jumps forward by 5 numbers. What are the next 3 numbers after 397? How did you get the 3 numbers? Use the empty number line to illustrate your strategy.**

Activity 4 **Pattern starts at 836 and jumps backwards by 7 numbers, what are the next 3 numbers after 486? How did you get the 3 numbers? Draw a diagram using the empty number line (below) to show how you got your 3 numbers.**

Activities 3 and 4 assessed students' K&S and WM abilities in reasoning and thinking strategically while generating increasing and decreasing number patterns given start numbers and jump numbers.

Activity 5

How many more big paper bags are there in the picture than small paper bags?
What strategy did you use?
Create a story and pose a question based on the picture.

Activity 5 assessed students' K&S and WM abilities in reasoning and thinking strategically in counting objects to determine 'how many more' one set of object has compared to another set and communicate mathematically.

Activity 6 0, 20, __, 60, 80, 100 **What is the missing number? What strategy did you use?**
If the pattern is extended after 100, what are the next two numbers?

Activity 6 assessed students' K&S and WM abilities in reasoning and thinking strategically in identifying missing numbers, extending an increasing pattern and communicating mathematically.

Activity 7 **What is the meaning of 137 + 8? Use the spaces in the rectangle to explain four different examples to illustrate your understanding of what 137 + 8 means.**

Activity 7 assessed students' K&S and WM abilities in reasoning and thinking strategically in interpreting and illustrating their understanding of the given number statement.

Activity 8 **The first classroom is 3 metres long. The second classroom is twice as long. What is the length of the second classroom?**

Draw a diagram to show the length of the two rooms.

The third classroom is four times the length of the second classroom. What is the length of the third room?

Activity 8 assessed students' K&S and WM abilities in reasoning and thinking strategically while interpreting quantitative descriptions and relationships.

Activity 9 **What is the meaning of 125 ÷ 5? Use the spaces in the rectangle to explain four different examples to illustrate your understanding of what 125 ÷ 5 means.**

Activity 9 assessed students' K&S and WM abilities in reasoning and thinking strategically in interpreting and illustrating their understanding of the given number expression.

Activity 10

If the numbers are arranged from smallest to biggest, what is the order of the numbers?

What number is in third position?

If you add 172 to the given numbers, what position will 172 be at? What strategy did you use?

Activity 10 assessed students' K&S and WM abilities in reasoning and thinking strategically in sequencing and ordering numbers, identifying positions of numbers, extending number patterns, and communicating mathematically.

Activity 11 **What numbers are equivalent to these number descriptions: two less than 16; three more than eleven; and 10-digit in the number 354?**

Activity 11 assessed students' K&S and WM abilities and strategies in interpreting and computing number descriptions to determine equivalent numbers.

Activity 12 **What is the meaning of 226 – 8? Use the spaces in the rectangle to explain four different examples to illustrate your understanding of what 226 – 8 means.**

Activity 12 assessed students' K&S and WM abilities in reasoning and thinking strategically to interpret and illustrate their understanding of the given number expression.

Activity 13 **What is the meaning of $\frac{3}{8}$? Use the spaces in the rectangle to explain four different examples to illustrate your understanding of what $\frac{3}{8}$ means.**

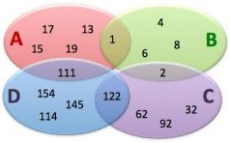
Activity 13 assessed students' K&S and WM abilities in reasoning and thinking strategically to interpret and illustrate their understanding of fractions.

Activity 14 **How many cubes in the picture?**

Write an addition number sentence to describe the total number of cubes in the picture below. What multiplication sentence is the same as your addition statement?

Activity 14 assessed students' K&S and WM abilities and strategies in counting building blocks of three-dimensional objects and in recognising situations where repeated addition or multiplication is applicable.

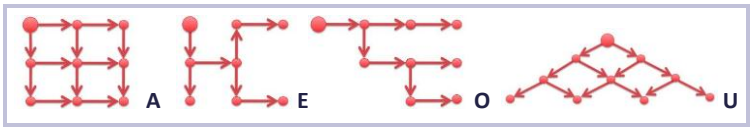
Activity 15



Which set has the most elements?
What element is found in both set A and set C?
Pose a question using the given picture.

Activity 15 assessed students' K&S and WM abilities and strategies in counting elements in a set, identifying common elements in two sets and posing questions.

Activity 16



How many arrows in picture A? What is the total number of arrows in picture O?
What is the order of pictures A, E, I and O if the total number of arrows in each picture are arranged from smallest to biggest?

Activity 16 assessed students' K&S and WM abilities and strategies in counting, ordering, and sequencing numbers

Activity 17

Four starfishes in the picture have 20 arms.
How many starfishes if there are 45 arms? Draw a diagram to illustrate your answer.

Activity 17 assessed students' K&S and WM abilities and strategies in counting and organising objects into equal groups, reasoning multiplicatively and communicating mathematically.

Activity 18 **Simolo's Youth Club collected 343 coconuts. How many groups of 6 coconuts can you get from 343 coconuts? Draw a diagram to illustrate/explain your strategy.**

If Makisi Company buys 6 coconuts for a $1. How much money can the Youth Club get if they sell their coconuts to Makisi?

Activity 18 assessed students' K&S and WM abilities and strategies in reasoning and thinking strategically in interpreting and illustrating their understanding of word descriptions of mathematical relationships, recognising situations where repeated subtraction is applicable, determining equal groups, implementing money transactions, and communicating mathematically.

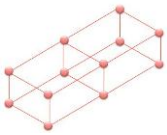
Activity 19 2, 4, 8, 16, 32, ____, 128, ____, ____, 512

What are the missing numbers in the given pattern? What is the pattern of the number sequence? What is the pattern with the units of the last pattern?

What numbers are missing from this number sequence: 3, 6, 12, 24, ___, 96, ___, ____, 768

Activity 19 assessed students' K&S and WM abilities and strategies in reasoning and thinking strategically in interpreting and illustrating their understanding of number sequences and in recognising and describing number patterns.

Activity 20



How many line segments are shown in the picture?
How many balls have 4 line segments connected to it?
Draw a circle around the balls with 4 connecting line segments.

Activity 20 assessed students' K&S and WM abilities and strategies in recognising, identifying and counting line segments on three-dimensional figures in pictures.

Activity 21

The tower in the picture has three layers of cubes stuck together without gaps. What is the volume of the tower?

What strategy did you use?

The tower in the picture has four layers of cubes stuck together without gaps. What is the volume of the tower?

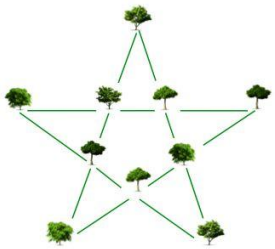
Activity 21 assessed students' K&S and WM abilities and strategies in estimating the volume of 3-D objects using informal strategies by counting building blocks in a 3-D shape.

Activity 22

How many trees are standing on the line between two other trees?

How many are standing on lines and angles in the picture?

Explain your strategy used.



Activity 22 assessed students' K&S and WM abilities and strategies in recognising and identifying objects in a picture that satisfy given conditions and communicating mathematically.

Activity 23

$1	$2
$4	$8
$15	$30
$60	$120
$250	$500

What is the total amount of money that is in the envelopes in the picture? What strategy did they use?

How many tens and units in your answer?

Activity 23 assessed students' K&S and WM abilities and strategies in adding up quantitative information in a picture, recognising place values, and communicating mathematically.

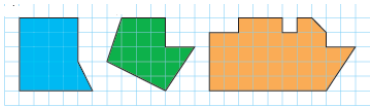
Activity 24

Draw in the lines of symmetry of each shape.

How many lines of symmetry of this shape (star)?

Activity 24 assessed students' K&S and WM abilities and strategies in identifying and counting lines of symmetries.

Activity 25



I **II** **III**

What are the areas of each of the shapes in the picture?

Activity 25 assessed students' K&S and WM abilities in strategically thinking and reasoning when estimating area of shapes on grid paper using informal strategies by counting unit squares.

Provided in Table 107 is a summary of Year 3 students' performance in terms of the 5 difficulty levels. The summary results demonstrate that Year 3 students have difficulties solving assessment tasks that involve interpreting and illustrating in multiple ways their knowledge and understanding of simple fractions and number sentences with one operation (eg $\frac{3}{8}$, 125 ÷ 5, 226 – 8, 137 + 8); generating increasing and decreasing number patterns given start and jump numbers; identifying and counting objects in pictures that satisfy given conditions and communicating mathematically; determining 'how many more' one set has when directly compared to another set, posing a question and communicating mathematically; recognising and counting arrows and line segments of 2D shapes in pictures; interpreting number descriptions and computing equivalent numbers; estimating volume of 3D figures informally by counting building blocks and communicating mathematically; inserting a 3-digit number into an ordered 3-digit number sequence; and identifying a missing number, extending an increasing number pattern and communicating mathematically.

Table 107: Summary of Year 3 Students' Assessment Tasks Performance By Difficulty Level

1	2	3	4	5
Well done	Above Average	Average	Below Average	Poorly Done
80 – 100%	60 – 79%	40 – 59%	20 – 39%	0 – 19%
Activity 2(i) Counting objects in pictures and representing the results as number statements sentences. **Activity 10(i)** Sequencing and ordering numbers. **Activity 22** Recognising and identifying objects in a picture that satisfy given conditions	**Activity 1** Identifying positions of two numbers given two end numbers (<999) **Activity 5(i)** Counting objects to determine how many more one set has compared to the other **Activity 16** Counting objects in different pictures and ordering and sequencing the results **Activity 6(i)** Interpreting mathematical relationships and identifying missing numbers **Activity 8** Interpreting quantitative descriptions and relationships to compute lengths **Activity 2(ii)** Counting objects in pictures **Activity 10(ii)** Identifying positions of numbers. **Activity 22(i)** Recognising and identifying objects in a picture that satisfy given conditions	**Activity 15** Counting elements in a set and identifying common elements in two sets and posing questions . **Activity 2(iii)** Counting objects in pictures and representing the answer as a sum **Activity 5** Counting objects to determine how many more one set has compare to the other	**Activities 3** Generating increasing number patterns given start numbers and jump numbers **Activity 16** Recognising, identifying and counting line segments on 2D figures **Activity 14** Counting building blocks in 3-D shape and estimating the volume of shapes using informal strategies **Activity 5(ii)** Counting objects in pictures to determine how many more one set has compared to the other, posing a question and communicate mathematically **Activity 6(ii)(iii)** Identifying a missing number, extending an increasing number pattern and communicating mathematically **Activity 10(iii)** Inserting a number into an ordered number sequence and communicating mathematically **Activity 21(i)** Estimating the volume of 3-D objects using informal strategies by counting building blocks **Activity 22(ii)** Recognising and identifying objects in a picture that satisfy given conditions and communicating mathematically	**Activity 7** Interpreting and illustrating their understanding of the number statement: 137 + 8, creating a story and posing a question **Activity 9** Interpreting and showing their understanding of the given number expression 125 ÷ 5. **Activity 11** Interpreting number descriptions and computing equivalent numbers. **Activity 12** Illustrating their understanding of 226 − 8 **Activity 13** Reasoning and thinking strategically to interpret and illustrate their understanding of fraction $\frac{3}{8}$. **Activities 4** Generating decreasing number patterns given start numbers and jump numbers **Activity 21(ii) (iii)** Estimating the volume of 3-D objects using informal strategies by counting blocks and communicating mathematically. **Activity 22(iii)** Recognising and identifying objects in a picture that satisfy given conditions, explaining the reasons behind the strategy used **Activity 20** Recognising, identifying and counting line segments on 3D figures **Activity 17** Counting and organising objects into equal groups, reasoning multiplicatively and communicating mathematically. **Activity 23** Adding up quantitative information in a picture, that satisfy given conditions. **Activity 25** Estimating area of shapes on grid paper using informal strategies by counting unit squares. **Activity 18** Interpreting and showing their understanding of word descriptions of mathematical relationships, recognising where repeated subtraction is applicable, determining equal groups and implementing money transaction **Activity 19** Interpreting and showing their understanding of number sequences and describing number patterns. **Activity 20** Recognising, identifying and counting line segments on 3-D figures in pictures. **Activity 24** Identifying and counting lines of symmetries of shapes.

Year 4 Interview Assessment Tasks

Activity 1 **Which of these boxes are the positions for 1626 and 1630? What strategy did you use to find the positions for the two numbers? Is there a different strategy to find the positions? Pose a question that uses the given empty number line and given numbers.**

1623									1633

Activity 1 assessed students' K&S and WM abilities to strategically think and reason in positioning numbers that are less than 9999, posing questions and communicating mathematically.

Activity 2

What number sentence describes the total number of sticks in each of the pictures?

What number sentence describes the total in each picture and the total altogether of sticks from the pictures?

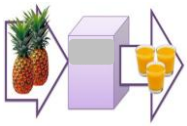
Activity 2 assessed students' K&S and WM abilities to strategically think and reason in counting objects in pictures and representing the results as number sentences.

Activity 3 **Pattern starts at 1897 and jumps forward by 100 numbers. What are the next 3 numbers after 1897? How did you get the 3 numbers? Use the empty number line to illustrate your strategy.**

Activity 4 **Pattern starts at 9836 and jumps backwards by 1000 numbers, what are the next 3 numbers after 9836? How did you get the 3 numbers? Draw a diagram using the empty number line (below) to show how you got your 3 numbers.**

Activities 3 and 4 assessed students' K&S and WM abilities to strategically think and reason while generating increasing and decreasing number patterns given start numbers and jump numbers.

Activity 5



How many pineapples are needed to produce 12 cups of juice?
What strategy did you use?
Pose a question using the given picture.

Activity 5 assessed students' K&S and WM abilities in strategically thinking and reasoning in interpreting quantitative information displayed in pictures and diagrams and communicating mathematically.

Activity 6

The TV and the bed cost $1116. If the cost of the bed is $800 more than that of the TV, how much is the TV? What strategy did you use? Use the empty number line to show a different way of finding your answer.

Activity 6 assessed students' K&S and WM abilities in strategically thinking and reasoning in interpreting and representing word descriptions of mathematical relationships and communicating mathematically.

Activity 7 How much bigger is 1312 than 1278? What strategy did you use? Use the empty number line to show a different way of finding your answer.

Activity 7 assessed students' K&S and WM abilities in strategically thinking and reasoning in interpreting word descriptions of a mathematical relationship: 'how much bigger' one 4-digit number is compared to another and communicating mathematically.

Activity 8 What three numbers when added together gives 3760? Show how you got your answer using a number sentence. Use the empty number line to show a different way of finding your answer.

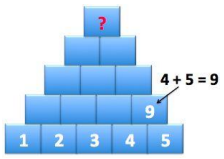
Activity 8 assessed students' K&S and WM abilities in strategically thinking and reasoning in interpreting and computing answers to number sentences involving operations with 4-digit numbers and communicating mathematically.

Activity 9 What are the following equal to?

2119 + 2119; 1299 – 1266; and 3197 – 3154

Activity 9 assessed students' K&S and WM abilities in strategically thinking and reasoning in interpreting number statements and computing with 4-digit numbers.

Activity 10



Write the sum of two numbers above as shown in the picture. Complete all the blocks in the picture.

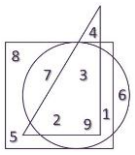
What number goes in the space marked with '?'?

Activity 10 assessed students' K&S and WM abilities in strategically thinking and reasoning in continuing a pattern and finding missing numbers.

Activity 11 **What is the middle number between 77 and 177? Show your strategy using the empty number line. Pose a question using the numbers.**

Activity 11 assessed students' K&S and WM abilities in reasoning and thinking strategically to interpret and illustrate their understanding of a number statement, identify the middle number of a sequence, compute with whole numbers and communicate mathematically.

Activity 12



What numbers are in the square and circle but outside the triangle at the same time? What is the product of all the numbers in the triangle? What strategy did you use? Explain.

Activity 12 assessed students' K&S and WM abilities in reasoning and thinking strategically while interpreting descriptions of conditions for number selection, computing with whole numbers and communicating mathematically.

Activity 13

What fraction of these animals are dogs?

What fraction is painted in the darker colour in the picture?

What fraction is equivalent to the fraction that is painted a darker

colour?

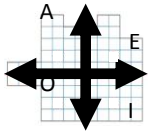
Activity 13 assessed students' K&S and WM abilities in reasoning and thinking strategically in identifying fractions of a set of objects and shaded areas and determining equivalent fractions.

Activity 14

Tagata Pasifika had 72 boxes of food to be distributed to 9 villages of Moanaloa District. How many boxes should each village get? What strategy did you use? Pose a question based on the given picture. What is the answer to your question?

Activity 14 assessed students' K&S and WM abilities in reasoning and thinking strategically to interpret and illustrate their understanding of word descriptions of mathematical relationships, recognise problem situations where grouping or repeated subtraction is applicable, and communicate mathematically.

Activity 15



Tomasi subdivided his land into four parts as shown by the two arrows in the diagram. Which piece of land is the biggest? What is the basis of your answer? What is the total area of the land?

Activity 15 assessed students' K&S and WM abilities in reasoning and thinking strategically to interpret and extract quantitative information from diagrams, estimate area using information strategies and communicate mathematically.

Activity 16

What is the weight shown by the scale balance in whole kilograms? How many grams in your answer? What strategy did you use?

Activity 16 assessed students' K&S and WM abilities in reasoning and thinking strategically when reading measuring devices, converting between units of mass and communicate mathematically.

Activity 17

Bag	Colour	Weight (grams)	Cost (talā)
A	Black	1050	$10
E	Green	550	$6
I	Grey	400	$5

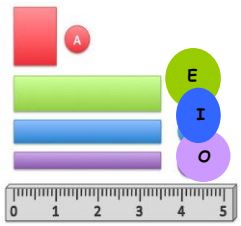
Seve bought 3 bags of marbles. Use the table to answer the following questions:

What is the total weight of the three bags of marbles? What strategy did you use?

If one marble weighs 50 grams, what is the total number of marbles in bag A?

Activity 17 assessed students' K&S and WM abilities in reasoning and thinking strategically to interpret and operate with quantitative information displayed in a table and described in words, recognise when grouping or repeated subtraction is applicable, and communicate mathematically.

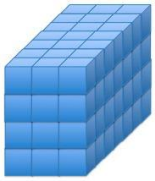
Activity 18



Which shape has the biggest perimeter? What is the perimeter? What strategy did you use?
Which shape has the biggest area?

Activity 18 assessed students' K&S and WM abilities in reasoning and thinking strategically to read measurements on a ruler and interpret quantitative information displayed in a picture, use informal strategies to estimate and order lengths, areas and perimeters of rectangular shapes, and communicate mathematically.

Activity 19



What is the volume of this shape? What is the basis of your answer?

What is the area of the shape's top surface?

Activity 19 assessed students' K&S and WM abilities in reasoning and thinking strategically when estimating volume of 3-D objects by counting building blocks, using informal strategies to estimate area, and communicating mathematically.

Activity 20

What is the size of the angle that is marked on the clock face? What is the basis of your answer?

How many minutes does the hour hand of the clock rotate through between four o'clock and five thirty?

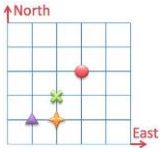
Activity 20 assessed students' K&S and WM abilities in reasoning and thinking strategically when estimating angle size, estimating number of minutes of rotation between two given times and communicating mathematically.

Activity 21

How many vertices for each of the shapes in the picture? Complete the table.

Activity 21 assessed students' K&S and WM abilities in reasoning and thinking strategically when counting vertices of a three-dimensional figure and communicating mathematically.

Activity 22



Start walking from the circle. Walk one block north, next walk two blocks east, then walk three blocks south, then walk four blocks west.
What shape have you arrived at? Draw on the grid where you walked.

Activity 22 assessed students' K&S and WM abilities in reasoning and thinking strategically when interpreting and following directions and communicating mathematically.

Activity 23

What is the total amount of money shown in the first picture?
What strategy did you use?

What is the total amount altogether in the three pictures?

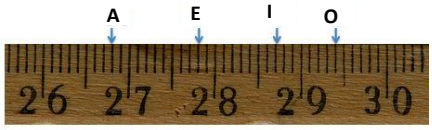
Activity 23 assessed students' K&S and WM abilities in reasoning and thinking strategically when interpreting quantitative information in pictures, determining total amounts and communicating mathematically.

Activity 24

Which number would be located where the X is marked on the number line: 767, 775, 777 or 783?
What is the basis of your answer?
What number is located at point A?

Activity 24 assessed students' K&S and WM abilities in reasoning and thinking strategically when reading and locating numbers on a number line and communicating mathematically.

Activity 25



Which position on the ruler shows 287 millimetres?
Which position shows 278 millimetres?
Pose your own question using the given picture.

Activity 25 assessed students' K&S and WM abilities in reasoning and thinking strategically when reading and locating numbers on a ruler and communicating mathematically.

Provided in Table 108 is a summary of Year 4 students' performance in terms of the 5 difficulty levels. The summary results demonstrate that Year 4 students have difficulties solving assessment tasks that involve determining 'how much bigger' one 4-digit number is compared to another; interpreting quantitative information on mathematical relationships displayed in pictures and diagrams; interpreting and extracting quantitative information from diagrams of 2D shapes on grid paper, estimating informally their areas and communicating mathematically; interpreting and representing word descriptions of additive mathematical relationships; interpreting and illustrating their understanding of descriptions of quantitative relationships and recognising situations where equal groupings, repeated subtraction or division is applicable; generating increasing and decreasing number patterns given start and jump numbers; counting the vertices of 3D shapes; counting objects in different pictures and representing the result as a sum; reading measurement on a scale balance and converting between kilograms and grams; reading and locating numbers on a ruler and posing questions; positioning two 4-digit numbers between 2 given 4-digit numbers; identifying the middle number between a 2-digit number and a 3-digit number, communicating mathematically the strategy used and posing a question using the given picture; interpreting conditions for number selection, computing with whole numbers and communicating mathematically; identifying fractions of a collection of objects and shaded areas and determining equivalent fractions; and identifying 3 numbers that add up to a 4-digit number, representing result as a number sentence and using an empty number line to illustrate the strategy used.

Table 108: Summary of Year 4 Students' Assessment Task Performance by Difficulty Level

1	2	3	4	5
Well done	Above Average	Average	Below Average	Poorly Done
80 – 100%	60 – 79%	40 – 59%	20 – 39%	0 – 19%
Activity 2(i) Counting objects in different pictures and representing the results as number sentences. **Activity 10** Continuing a pattern and finding missing numbers **Activity 12(i)** Interpreting descriptions of conditions for number selection, computing with whole numbers **Activity 13(i)** Identifying fractions of a collection of objects and shaded areas **Activity 22** Interpreting and following directions and communicating mathematically.	**Activity 1(i)** Positioning two numbers between two given numbers (< 9999) **Activity 6** Interpreting and representing word descriptions of mathematical relationships. **Activity 18(i)** Reading measurement on a ruler, interpreting quantitative information displayed in a picture, and using informal strategies to estimate lengths, perimeters and areas of rectangular shapes. **Activity 23(i)** Interpreting quantitative information in pictures and determining total amount and communicating mathematically.	**Activity 17** Reasoning and thinking strategically to interpret and operate with quantitative information displayed in table and described in words, recognise when grouping or repeated subtraction is applicable **Activity 18(ii)** Estimating perimeters of the given shapes and communicating the reason for the given answer. **Activity 19(i)** Estimating volume of a 3-D object by counting building blocks and communicating mathematically. **Activity 20** Estimating angle measure between the two hands of analogue clock (at quarter hour) and between two different times **Activity 23(iii)** Reasoning and thinking strategically in determining total amount of money,	**Activity 15** Interpreting and extracting quantitative information from diagrams and estimating area of shapes on grid paper **Activity 16** Reading measurements on measuring devices and converting between two units of mass **Activity 21** Counting vertices of 3-D figures in pictures **Activity 25** Reading and locating numbers on a ruler and posing questions **Activity 6(i)** Interpreting and representing word descriptions of mathematical relationships. **Activity 1(ii) (iii)** Positioning two numbers between two given numbers (< 9999), posing question and communicating mathematically. **Activity 14(i)** Interpreting and illustrating their understanding of word descriptions of mathematical relationships and recognising situations where grouping or repeated subtraction is applicable. **Activity 19(iii)** Using informal strategies to estimate area, and communicating mathematically. **Activity 9** Adding and subtracting 4 digit numbers **Activities 3** Generating an increasing number pattern given start and jump numbers	**Activities 4** Generating a decreasing number pattern given start and jump numbers **Activity 5** Interpreting quantitative information displayed in pictures and diagrams **Activity 11** Identifying the middle number between a 2-digit number and a 3-digit number, posing a question and communicating mathematically **Activity 14(ii)and (iii)** Posing a question and communicating the reasoning behind the method used. **Activity 2(iii)** Counting objects in pictures and representing the results as a sum of all sticks. **Activity 6(ii)** Interpreting and representing word description of mathematical relationships and describing the method used. **Activity 12(iii)** Interpreting descriptions of conditions for number selection, computing with whole numbers, explaining the strategy used and communicating mathematically. **Activity 13(iii)** Identifying fractions of a collection of objects and shaded areas and determining equivalent fractions. **Activity 24** Reading and locating numbers on a number line. **Activity 7** Interpreting word descriptions of a mathematical relationship 'how much bigger' one 4-digit number is compared to another **Activity 8** Identifying 3 numbers when added gives a 4-digit number, representing the result as a number sentence and using an empty number line to illustrate the strategy used.

Teacher Interviews

This section provides a summary of teachers' responses during their one-on-one interviews. A total of 32 teachers were interviewed from the eight schools; four teachers each from four of the schools (SPU, LOT, STP, FLS and VAM), three teachers from two of the schools (SLV and MAN) and six from one school (STM PS). The 8 interview questions sought teachers' perceptions of what they learnt and experienced since participating in the 2012 National Teacher Workshops and their experiences thereafter as they trialled, implemented and began teaching the new mathematics curriculum (NC). Transcripts of interview responses were analysed in terms of main themes followed by a frequency count of the teachers who raised these main points during the interviews. The results are briefly described next.

Teachers reported that all staff from their respective schools attended the 2012 MESC training with about 60% of the teachers stating they trialled the NC immediately afterwards in 2012. All of the teachers interviewed reported they started teaching the NC at the beginning of the 2013 school year. According to 83% of the teachers, the training was helpful. The other 13% said the NC is hard but did not state why until other questions were asked later on in the interview.

As for identifying the main objectives of the NC which are different from the OC, the majority (70%) of the teachers interviewed talked highly of the NC as introducing new ways of teaching mathematics with a lot of activities with "improved topics and resources" for students to use to "increase, upgrade and develop" their (students) understanding, performance and ability in mathematics. From teachers' viewpoint, "students have the majority of work to do rather than teachers … NC focuses mainly on students, to have them perform more than teachers" and "students learn to cooperate in mathematics". Furthermore, the NC suggests excellent resources with follow-up activities to prepare students for the next higher level. The teachers also acknowledged that the NC emphasises the 'communication between teacher and student'. The remaining 30% of the teachers stated that NC is hard but none stated the reasons why.

When asked about any differences in the way they implemented the NC compared to the OC, nine percent (9%) of the teachers interviewed said the NC is difficult to use but 91% said the NC is easier to use than the OC, the NC improves students' cooperation and performances than OC, requires the teachers to prepare more, NC is rich in resources, NC is simple to use and saves time, and NC is better planned with its listed learning outcomes making each substrand easier to teach and also easier to allocate lessons to four terms.

Regarding changes in their preparations for the substrands in the NC, all of them (100%) stated that the NC is challenging and more work, more preparations, and more planning required of the teacher every day. However, they also acknowledged and pointed out that it is all done for the betterment of their students.

Included in the NC's substrands are subsections for Key Ideas, Knowledge & Skills Learning Outcomes and Working Mathematically Outcomes. When asked how they are using all these different provisions for teaching mathematics, all of the teachers reported they use all of them as guidelines for the preparations and design of their lessons to ensure the objectives of each lesson is achieved.

Regarding any problems and issues faced during the implementation of the NC besides the need for a Samoan version, most of them (80%) said it is the need to become more familiar with it as little time was given to train the teachers. In their view therefore, the teachers need more training particularly as some new topics and new mathematics terms are hard for the students and some teachers. They also find the language of the English version challenging and difficult to translate in Samoan. Some pointed to the need for more resources and the need for them at this point to prepare lesson plans for each lesson. A small percentage (about 15%) of them said that they do not have any problem implementing the NC.

When asked for their views on how the implementation and delivery of the NC could be further improved, all of them emphasized the need for more training and workshops for the teachers on learning to how to better teach the new student-centred strategies of the NC and the need for more resources.

Discussion of Results

Discussion of the results is framed by the four main objectives of the study which are logically reorganised as follows; the identification of primary students' initial numeracy and mathematics major learning outcomes in terms of content (knowledge and skills) and working mathematically (WM) outcomes in the early years (*Mathematics Achievement Standards*); identification of primary students' current initial numeracy and mathematical knowledge and skills in relation to their Year Level's major learning and working mathematically outcomes (*Students' Numeracy and Mathematics Achievement*); examination of any whole-school, classroom, home and community wide practices, activities and strategies which could be supporting the development of primary students' initial numeracy and mathematical competence in the early grades (*Students' Outside of School Environment*); and identification of primary teachers' current knowledge of, and skills for, the teaching and development of initial numeracy and mathematical competence in the early years (*Teachers' Mathematical Content and Pedagogical Content Knowledge*). These are briefly discussed next.

Mathematics Achievement Standards

From a desk analysis of the existing primary mathematics syllabus and supporting documentations made available to schools, primary teachers and students, a learning progression scope and sequence continuum was constructed to provide a set of statements representing the Years 1 to 4 Achievement Standards. Organised by strand and subtopic across the early years, these described the relevant knowledge and skills students should achieve by the end of each year level. These subsequently formed the basis from which test items and interview assessment tasks were developed, and representing the content dimension of the Mathematics Achievement Standards Framework. To reflect the importance of also assessing students' ability and competence in working mathematically (as described in the new primary mathematics curriculum) while students engage with and solve mathematical problems/tasks, a second dimension was added, namely, the cognitive dimension. While the content dimension had 5 domains, namely, the five content strands Number & Operations, Pattern & Algebra, Data Analysis, Measurement, and Space & Geometry, the cognitive dimension had 3 domains: Knowing, Applying and Reasoning. Together the two dimensions made up the Years 1 to 4 Mathematics Achievement Standards Framework which determined and guided the development and final selection of items for Years 1 to 4 student tests and interview assessment tasks. The classification and distribution of test items across the content and cognitive dimensions were as summarised in Table 5.

Students' Numeracy and Mathematics Achievement

Four separate diagnostic tests: Tests 1 to 4, one for each Year Level, were finalised based on the results of the pilot study. To enable test equating using the Rasch Model between Tests 1 to 4, common items, were included in the four tests. There were 30 common items between Tests 1 and 2, 9 common items between Tests 2 and 3, and 22 common items between Tests 3 and 4. Additional data from a smaller number of students (up to six) from each Year Level were obtained through one-on-one interviews as students solved assessment tasks based on their Year Level's achievement standards. This section discusses first the results of Test 1 through to Test 4 whilst at the same time linking to those from the interview assessment tasks and responses from the Year Level teachers.

Year 1 Achievement

The Test 1 cohort mean ability estimate indicated that the cohort found the test, on average, significantly and practically difficult. Test 1 items (Table 9 and Table 10) were developed deliberately to assess students' learning and working mathematically outcomes as prescribed by the Year 1 Achievement Standards. Therefore, the significantly different and moderate practical difference between the Test 1 cohort's item difficulty mean and case ability mean estimates suggested that as a cohort, on one hand, did not achieve the Year 1 Achievement Standards (by 0.35 logit) as measured by the Test 1 items. On the other, at an individual level, there were 2 (1%) students who achieved at the Proficient Achievement Level and scored at least 80% correct on the test, performed at least 3.45 standard deviations (z-scores) above the cohort mean, and had at least 1.72 logit estimates with stanine scores of 9 and classified Very High on the Performance Level (see Appendix A Table T1.2). With only 2 (1%) students of the Year 1 cohort achieving the Proficient Achievement Level, the rest of the students were distributed across the At Risk Achievement Levels. For example, 10% of the students were at At Risk Level 1, 44% at At Risk Level 2, 25% at At Risk Level 3 and 20% at At Risk Level 4. With the At Risk Level 1, 10% of the students were classified in this level with at least 0.56 up to 1.52 logit ability estimates and 61.8% up to 79.4% percent correct with stanine scores that are at least 8 up to 9 and performing at at least Above Average up to Very High level compared to the rest of the Year 1 cohort.

In terms of individual performance relative to the rest of the cohort, 4% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 19% and 4% of the students were classified to be at the Below Average and Very Low Levels. Whereas the performance levels are norm-referenced, the achievement levels indicate whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 1.

In terms of the what the students can do in terms of the Year 1 learning standards, the empirically derived benchmark descriptions characterised the performance of students at each of the five Achievement Levels based on their Test 1 performance. It is theorised, in accordance with the Rasch Measurement Model that students at an achievement level has the capacity or have more than an average probability of successfully solving items that are located at lower achievement levels. For example, students at the Proficient Level were characterised by their ability to identify and recognise quarters of an object; identify and extend decreasing number patterns; interpret and order quantitative information displayed in a table; model division by grouping objects into equal groups or repeated subtraction; and identify shapes found in pictures and the environment. At the At Risk Level 2 Achievement Level, students were able to represent addition as the sum of 2 or more numbers; recognize that half is two equal parts; identify, copy and continue repeating geometric patterns; use the term 'is the same as' to express the equality of two groups; predict the outcome when spinning a wheel of colours; interpret simple maps showing object positions; and read quarter-hour time on digital clocks. At the lowest Achievement Level: At Risk Level 4, students were able to recognise and count up to three objects in a picture; describe the position of an object in a line of objects; and estimate and compare lengths informally to determine the longest.

An additional view of what Year 1 students can or cannot do was derived from their performance with the interview assessment tasks and also from an error analysis of their Test 1 responses. Consequently, a comparison of the summaries of students' performance during interviews as they solved the one-on-one Year 1 assessment tasks (Table 105) particularly the two most difficult levels (Below Average and Poorly Done) and the two most common errors of the students' Year 1 test responses (Table 14) suggested that topics Year 1 students found very difficult and showed at least 30% error rates included those from the Number & Operations strand on interpreting and illustrating in multiple ways their knowledge and understanding of a simple fraction (eg ½) and number sentences

with one operation (eg 8 ÷ 2, 4 – 3, 4 + 3); interpreting number descriptions and computing equivalent numbers; ordering quantitative information displayed in a table; identifying the number of equal groups given an amount; applying their knowledge of common animals and reasoning to solve problems on counting total body parts of up to 3 animals; equally distributing objects which result in equal shares that are simple fractions (eg halves); identifying the fraction (quarter) of a shape that is shaded; distinguishing between equal and non-equal parts of a whole; identifying the position (fourth) of an object in a line of objects; and determining the total number in a queue given descriptions of how many are in the front and back of a position. Areas of difficulty from the Patterns strand included generating increasing and decreasing number patterns given start and jump numbers and continuing a decreasing number pattern given a few terms. Difficult topics from the Measurement strand included those on identifying and counting the number of sides and angles of 2D shapes; viewing 3D objects from different perspectives (eg top); and reading the volume of milk in a calibrated bottle. The overall low Year 1 school averages as shown in Figure 41 demonstrated very clearly that students experienced great difficulty in demonstrating the achievement of their working mathematically outcomes, namely, effectively interpreting and/or posing questions, strategically thinking and representing, reasoning and justifying, reflecting and evaluation, and communicating mathematically and including using the empty number line to illustrate operations with whole numbers.

From an analysis of Year 1 teachers' responses on the questionnaire, it appeared that part of the non-achievement of the students' K&S Learning and WM Outcomes could be explained by and directly linked to teachers' perceived "preparedness' to teach the prescribed Year 1 topics and their responses as to whether or not the Test 1 assessed topics were actually taught at all in 2013 as shown in Figure 36. That the majority of the teachers felt 'very well-prepared' to teach only about 48% of the prescribed topics with only 38% of the prescribed topics being taught in 2013 would have an impact on the quality and achievement of students' learning outcomes. That teachers found the teaching of the student-centred strategies and implementation of the NC difficult could be linked to their own numeracy and mathematical competence as measured by their performance in the teachers' diagnostic test. The latter showed that the majority of the teachers lacked the mathematical content knowledge and skills required to effectively teach the NC (more of teacher competence later on). That the Year 1 students were unable to demonstrate the achievement of many of the WM Outcomes as noted in the interviews suggested that teachers need training on how to effectively implement and enable the WM processes and strategies in their classrooms.

Year 2 Achievement

With 30 common items between Tests 1 and 2, Test 2 cohort's mean ability estimate was higher than the mean difficulty estimate suggesting that, overall, the Test 2 cohort, on average, found Test 2 slightly easier by approximately 0.14 logit. However, statistically, the difference between mean ability and difficulty estimates was insignificant and the practical difference small. Collectively, these results on one hand, suggested that the test items and sample cases were more or less well-matched and that the achievement standards which formed the basis of the Test 2 items were attained, on average, by the cohort. That the Year 2 cohort demonstrated this average achievement implied that, with the appropriate delivery and teaching of prescribed Year Level standards, it is possible that students can achieve their learning standards at the prescribed level. On the other hand, at an individual level, 9% of the Year 2 cohort achieved the Proficient Achievement Level and scored at least 80% up to 97% correct on the test, had at least 1.64 up to 3.66 logit ability estimates and performed at at least 2 up to 4.5 standard deviations (z-scores) above the cohort mean with stanine scores of 8 up to 9 and classified Above Average to Very High on the Performance Levels (see Appendix A Table T2.2). At the At Risk Level 1 were 16% of the students with at least 0.50 up to 1.44 logit ability estimates and 61.8% up to 79.4%

percent correct with stanine scores that were at least 6 up to 8 and performing at at least Average up to Above Average level compared to the rest of the Year 2 cohort. Fifty two percent of the students were at At Risk Level 2 with at least 41.2% up to 58.8% percent correct and ability estimates of at least -0.43 up to 0.38 logits. These students performed at at least -0.6 up to 0.4 standard deviations above the cohort mean with stanine scores of at least 4 up to 6 and classified Average on the Performance Level. At the rest of the At Risk achievement levels were 21% and 2% of the students at At Risk Levels 3 and 4 respectively.

In terms of individual performance relative to the rest of the cohort, 4% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 19% and 4% of the students were classified to be at the Below Average and Very Low Levels. It should be noted that performance levels were norm-referenced whereas the achievement levels indicated whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 2.

In terms of what students can do in terms of the Year 2 learning standards, the empirically derived Year 2 benchmark descriptions characterised the performance of students at each of the five Achievement Levels based on their Test 2 performance. It is theorised, in accordance with the Rasch Measurement Model that students at an achievement level has the capacity or have more than an average probability of successfully solving items that are located at lower achievement levels. For example, students at the Proficient Level were characterised by their ability to identify and recognise quarters of an object; model division by grouping objects into equal groups or repeated subtraction; and identify shapes found in pictures and the environment. At At Risk Level 1, students typically demonstrated their ability to add two-digit numbers by applying a range of mental strategies; identify and describe the element of chance in an event using words such as possible and certain; identify the position of an object in a line of objects; record quantitative relationships involving subtraction number facts; use the term 'is the same as' to express equality of groups; represent division by sharing equally a collection of objects; sharing objects equally into four equal parts; perform simple calculations with money; read the volume of milk in a calibrated bottle; use reference numbers to form numbers within a range; identify, copy and continue geometric repeating patterns; identify the element of chance and describe chance using familiar language; use addition number sentences and apply place value to add up to three-digit numbers; use the term 'is the same as' to express equality of groups; and describe attributes of 3D objects. At the At Risk Level 2 Achievement Level, students characteristically were able to predict the outcome when spinning a wheel; use the term 'is the same as' to express the equality of two groups; represent addition as the sum of 2 or more numbers; recognise that halves is two equal parts and half is represented by ½; recognise, visualise and name 3D objects; identify tools used to measure mass; predict the outcome when spinning a wheel of colours; interpret simple maps showing object positions; and reading quarter-hour time on digital clocks. At the lowest Achievement Level: At Risk Level 4, students were able to recognise and count up to three objects in a picture; describe the position of an object in a line of objects; and estimate and compare lengths informally to determine the longest.

An additional view of what Year 2 students can or cannot do was empirically derived from their performance with the interview assessment tasks and also from an error analysis of their Test 2 responses. Consequently, a comparison of the summaries of students' performance during interviews (Table 106) particularly the two most difficult levels (Below Average and Poorly Done) and the two most common errors of the students' Year 2 test responses (Table 22) suggested that topics Year 2 students found very difficult and showed at least 30% error rates included those from the Number & Operations strand on interpreting and illustrating in multiple ways their knowledge and understanding of a simple fraction (eg ¼) and number sentences with one operation (eg 125 ÷ 5, 24 − 3, 24 + 3); interpreting

number descriptions and computing equivalent numbers; determining 'how many more' one line has when directly compared to another line; determining 'how much more' is needed for a simple money transaction involving whole tala amounts; identifying the position (fourth) of an object in a line of objects; writing a number sentence to illustrate the results of counting objects or sides of 2D shapes in pictures and its sum total; representing quantitative descriptions as number statements and sentences; creating equivalent number sentences given a two-digit number (<20); identifying the correct addition number sentence that equals a given number; recognising situations where 'equal groupings' are applicable; identifying number of equal groups given an amount; identifying the fraction (quarter) of a shape that is shaded; equal distribution of objects that result in simple fraction equal shares (eg half); and computing with quantitative information displayed in a simple table or a picture. Areas of difficulty from the Patterns strand included generating increasing and decreasing number patterns given start and jump numbers. Difficult topics from the Measurement strand included those on viewing 3D objects from different perspectives (eg top); identifying and counting objects in pictures that satisfy given conditions; and counting building blocks of 3D figures or interpreting quantitative descriptions and relationships and recognising situations where repeated addition or multiplication is applicable. The overall low Year 2 school averages as shown in Figure 41 demonstrated very clearly that students experienced great difficulty in demonstrating the achievement of their working mathematically outcomes, namely, effectively interpreting and/or posing questions, strategically thinking and representing, reasoning and justifying, reflecting and evaluation, and communicating mathematically and including using the empty number line to illustrate operations with whole numbers.

From an analysis of Year 2 teachers' responses on the questionnaire, it appeared that part of the non-achievement of the students' K&S Learning and WM Outcomes could be explained by and directly linked to teachers' perceived "preparedness' to teach the prescribed Year 2 topics and their responses as to whether or not the Test 2 assessed topics were actually taught at all in 2013 as shown in Figure 36. That the majority of the teachers felt 'very well-prepared' to teach only about 25% of the prescribed topics with only 16% of the prescribed topics being taught in 2013 would have an impact on the quality and achievement of students' learning outcomes. That teachers found the teaching of the student-centred strategies and implementation of the NC difficult could be linked to their own numeracy and mathematical competence as measured by their performance in the teachers' diagnostic test. The latter showed that the majority of the teachers lacked the mathematical content knowledge and skills required to effectively teach the NC (more of teacher competence later on). That the Year 2 students were unable to demonstrate the achievement of many of the WM Outcomes as noted in the interviews suggested that teachers need training on how to effectively implement and enable the WM processes and strategies in their classrooms.

Year 3 Achievement

With 9 common items between Tests 3 and 2, Test 3 cohort's mean ability estimate was lower than the Test 3 mean difficulty estimate suggesting that, overall, the Test 3 cohort, on average, found Test 3 harder by approximately 0.50 logit. Statistically, this difference was significant with a large practical difference suggesting that the test items and sample cases were not well-matched and that the achievement standards, on one hand, which formed the basis of the Test 3 items were not attained, on average, by the cohort. On the other hand, at an individual level, none of the Year 3 cohort achieved the Proficient Achievement Level but 7% achieved At Risk Level 1 with percent correct from 60.6% up to 78.8% and at least 1.56 up to 2.65 logit ability estimates and performed at at least 1.8 up to 3.7 standard deviations (z-scores) above the cohort mean with stanine scores of 8 up to 9 and classified Above Average to Very High on the Performance Levels (see Appendix A Table T3.2). At the At Risk Level 2 were 45% of the students with at least 0.65 up to 1.41 logit ability estimates and 42.4% up to 57.6% percent

correct with stanine scores that were at least 5 up to 8 and performing at at least Average up to Above Average level compared to the rest of the Year 3 cohort. Forty three percent of the students were at At Risk Level 3 with at least 21.2% up to 39.4% percent correct and ability estimates of at least −0.55 up to −0.49 logits. These students performed at at least −1.9 up to −0.1 standard deviations above the cohort mean with stanine scores of at least 2 up to 5 and classified from Below Average up to Average of the Performance Levels. At the lowest achievement level of At Risk Level 4 was 5% of the Year 3 cohort.

In terms of individual performance relative to the rest of the cohort, 3% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 15% and 4% of the students were classified to be at the Below Average and Very Low Levels respectively. It should be noted that performance levels were norm-referenced whereas the achievement levels indicated whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 3.

In terms of what students can do in relation to the Year 3 learning standards, the empirically derived Year 3 benchmark descriptions characterised the performance of students at each of the five Achievement Levels based on their Test 3 performance. It is theorised, in accordance with the Rasch Measurement Model that students at an achievement level has the capacity or have more than an average probability of successfully solving items that are located at lower achievement levels. For example, students at the Proficient Level were characterised by their ability to record digital time using the correct notation; determine the number of equal groups for a given amount; recognize views of 3D objects from the top, bottom and side; measure, and compare lengths of objects using cm and mm; and find missing numbers in an addition number sentence. At At Risk Level 1, students typically demonstrated their ability to predict and record all possible outcomes in a simple experiment; add and subtract decimals with the same number of decimal places as in money transactions; identify correct number sentences that use two operations; estimate area of 2D shapes drawn on grid paper; and use formal written algorithm to solve subtraction problems involving two digit numbers. At the At Risk Level 2 Achievement Level, students characteristically were able to use mental strategies to divide by a one-digit number multiplication facts up to 100; recognize and identify appropriate measuring devices for length; model, compare and represent fractions with denominators 2, 4, 8 and position them on a number line; identify and describe patterns when counting forward by 4s; identify and describe 2D shapes using their attributes; interpret and compute quantitative information in a display; estimate, measure and compare lengths and distances using centimetres; create designs by folding, flipping and/or cutting; distinguish between certain and uncertain events in a simple experiment; determine equal shares that are fractions; model, compare and represent fractions by modelling halves, quarters, eighths of whole objects; counting forward by 10 from a given 3-digit number; extend an increasing geometric pattern; and compute money transactions involving only dollar amounts. At At Risk Level 3, students typically were able to read the volume of liquids in a calibrated bottle of standard units; interpret information presented in simple tables to compute 'how many more'; use coordinates on simple maps to describe positions; continue an increasing geometric pattern; recognize and describe the element of chance in everyday events; read and record hour and quarter-hour time on analogue clocks; use mental strategies for addition involving three numbers; and continue an increasing number pattern given the first four terms. At the lowest Achievement Level: At Risk Level 4, students were able to count forward to 10 from a given number.

An additional view of what Year 3 students can or cannot do was empirically derived from their performance with the interview assessment tasks and also from an error analysis of their Test 3 responses. Consequently, a comparison of the summaries of students' performance during interviews (Table 107) particularly the two most difficult levels (Below Average and Poorly Done) and the two most common errors of the students' Year 3 test responses (Table 30) suggested that topics Year 3 students

found very difficult and showed at least 40% error rates included those from the Number & Operations strand on interpreting and illustrating in multiple ways their knowledge and understanding of a simple fraction (eg $\frac{3}{8}$) and number sentences with one operation (eg 125 ÷ 5, 226 – 8, 137+ 8); determining 'how many more' one set has when directly compared to another set, posing a question and communicating mathematically; interpreting number descriptions and computing equivalent numbers; identifying the number of equal groups given an amount; computing the correct number of items to be bought with a given amount of money given a cost that has 2 decimal places; and identifying the fraction (eighths) of a shape that is shaded. Areas of difficulty from the Patterns strand included those on generating increasing and decreasing number patterns given start and jump numbers; inserting a 3-digit number into an ordered 3-digit number sequence; and identifying a missing number, extending an increasing number pattern and communicating mathematically. Difficult topics from the Measurement strand included those on identifying and counting objects in pictures that satisfy given conditions and communicating mathematically; recognising and counting arrows and line segments of 2D shapes in pictures; estimating volume of 3D figures informally by counting building blocks and communicating mathematically; viewing 3D objects from different perspectives (eg top); and representing descriptions of time using digital notation.

The overall low Year 3 school averages as shown in Figure 41 demonstrated very clearly that students experienced great difficulty in demonstrating the achievement of their working mathematically outcomes, namely, effectively interpreting and/or posing questions, strategically thinking and representing, reasoning and justifying, reflecting and evaluation, and communicating mathematically and including using the empty number line to illustrate operations with whole numbers.

From an analysis of Year 3 teachers' responses on the questionnaire, it appeared that part of the non-achievement of the students' K&S Learning and WM Outcomes could be explained by and directly linked to teachers' perceived "preparedness' to teach the prescribed Year 3 topics and their responses as to whether or not the Test 3 assessed topics were actually taught at all in 2013 as shown in Figure 36. That the majority of the teachers felt 'very well-prepared' to teach only about 45% of the prescribed topics with only 42% of the prescribed topics being taught in 2013 would have an impact on the quality and achievement of students' learning outcomes. That teachers found the teaching of the student-centred strategies and implementation of the NC difficult could be linked to their own numeracy and mathematical competence as measured by their performance in the teachers' diagnostic test. The latter showed that the majority of the teachers lacked the mathematical content knowledge and skills required to effectively teach the NC (more of teacher competence later on). That the Year 3 students were unable to demonstrate the achievement of many of the WM Outcomes as noted in the interviews suggested that teachers would need training on how to effectively implement and enable the WM processes and strategies in their classrooms.

Year 4 Achievement

With 22 common items between Tests 4 and 3, Test 4 cohort's mean ability estimate was lower than the Test 3 mean difficulty estimate suggesting that, overall, the Test 3 cohort, on average, found Test 3 harder by approximately 0.50 logit. The Test 4 mean item difficulty estimate was higher than the mean ability estimate suggesting that, overall, the Test 4 cohort, on average, found Test 4 harder by approximately 0.97 logit. The statistically significant and practically very large difference also suggested that the test items and sample cases were not well-matched and that the achievement standards, on one hand, which formed the basis of the Test 4 items were not attained, on average, by the cohort. On the other hand, at an individual level, none of the Year 4 cohort achieved the Proficient Achievement Level and only 1% of the students achieved At Risk Level 1 with percent correct from 60.6% up to 66.7%

and at least 1.79 up to 2.12 logit ability estimates and performed at at least 2.13 up to 2.60 standard deviations above the cohort mean with stanine scores of 9 and classified Very High on the Performance Levels (see Appendix A Table T4.2). At the At Risk Level 2 were 24% of the students with at least 0.88 up to 1.64 logit ability estimates and 42.4% up to 57.6% percent correct with stanine scores that were at least 6 up to 9 and performing at at least Average up to Very High level compared to the rest of the Year 4 cohort. Sixty two percent of the students were at At Risk Level 3 with at least 21.2% up to 39.4% percent correct and ability estimates of at least −0.32 up to 0.72 logits. These students performed at at least −0.89 up to 0.60 standard deviations above the cohort mean with stanine scores of at least 3 up to 6 and classified from Below Average up to Average on the Performance Level. At the lowest achievement level of At Risk Level 4 was 13% of the Year 4 cohort.

In terms of individual performance relative to the rest of the cohort, 4% of the students performed very highly with 19% and 54% at the Above Average and Average Performance Levels respectively. At the other end, 19% and 4% of the students were classified to be at the Below Average and Very Low Levels respectively. It should be noted that performance levels were norm-referenced whereas the achievement levels indicated whether or not the students have achieved or mastered the learning standards of their Year Level as assessed by the criterion-referenced Test 4.

In terms of what students can do in relation to the Year 4 learning standards, the empirically derived Year 4 benchmark descriptions characterised the performance of students at each of the five Achievement Levels based on their Test 4 performance. It is theorised, in accordance with the Rasch Measurement Model that students at an achievement level has the capacity or have more than an average probability of successfully solving items that are located at lower achievement levels. For example, students at the Proficient Level were characterised by their ability to estimate, measure, compare and record lengths using centimetre or millimetres. At At Risk Level 1, students typically demonstrated their ability to continue, create and describe number patterns that increase; identify patterns when counting forward by tens; interpret information presented in graphs and pictures; complete number sentences involving two operations by calculating missing values; and determine factors for given numbers. At the At Risk Level 2 Achievement Level, students characteristically were able to use the symbols <, or > to show relationships between given numbers; multiply and divide decimals with the same number of decimal places (2dp) as in money transactions; model, compare and represent simple fractions with denominators 2,4,8 and locate them on the number line; estimate and measure the perimeter of 2-D shapes; estimate, measure and compare areas of 2D shapes drawn on grid paper; conduct experiment and estimate the likelihood of outcomes and use language of chance in everyday contexts; compute number sentences involving one operation and two 2-digit numbers; use mental strategies to multiply a two digit number by a one digit number and use multiplication facts; sketch views of 3D objects from the top, front and side; and estimate, measure, compare and compute distances using metres. At At Risk Level 3, students typically were able to use mental strategies to divide by one digit number multiplication facts up to 12 × 12 and record answer to division problems to show connection with multiplication; identify the appropriate measuring device for length; identify and describe 2D shapes using multiple attributes; interpret and compute with quantitative information presented in a display; interpret and compute information presented in simple tables; make tessellating designs by reflecting (flipping), translating and rotating a 2D figure; state the place value of digits in numbers with up to 2 decimal places; manipulate, translate and rotate a 2D shape; identify lines of symmetry for a given shape; predict and record all possible combinations of a simple experiment; share objects equally including those resulting in fractional equal shares; model, compare and represent simple fractions including those with denominators 3 and 6; use coordinates on simple maps to describe position; conduct simple experiments to inform discussions about the likelihood of outcomes; and relate analogue notation to digital notation of time. At Risk Level 4, students were able to identify, describe

and continue patterns when counting forward by fours; extend an increasing geometric pattern given the first four terms; and predict and describe the likelihood of outcomes of a simple experiment.

An additional view of what Year 4 students can or cannot do was empirically derived from their performance with the interview assessment tasks and also from an error analysis of their Test 4 responses. Consequently, a comparison of the summaries of students' performance during interviews (Table 108) particularly the two most difficult levels (Below Average and Poorly Done) and the two most common errors of the students' Year 4 test responses (Table 38) suggested that topics Year 4 students found very difficult and showed at least 40% error rates included those from the Number & Operations strand on determining 'how much bigger' one 4-digit number is compared to another; interpreting quantitative information on mathematical relationships displayed in pictures and diagrams; interpreting and representing word descriptions of additive mathematical relationships; interpreting and illustrating their understanding of descriptions of quantitative relationships and recognising situations where equal groupings, repeated subtraction or division is applicable; using mental strategies to divide multiplication facts (up to 12 × 12) by a one digit number; counting objects in different pictures and representing the result as a sum; reading and locating numbers on a ruler and posing questions; positioning two 4-digit numbers between two given 4-digit numbers; identifying the middle number between a 2-digit number and a 3-digit number, communicating mathematically the strategy used and posing a question using the given picture; interpreting conditions for number selection, computing with whole numbers and communicating mathematically; identifying 3 numbers that add up to a 4-digit number, representing result as a number sentence and using an empty number line to illustrate the strategy used; predicting and recording all possible outcomes of a simple experiment; identifying fractions of a collection of objects and shaded areas and determining equivalent fractions; identifying the fraction (eighths) of a shape that is shaded; and computing with information given in simple tables. Areas of difficulty from the Patterns strand included those on generating increasing and decreasing number patterns given start and jump numbers; inserting a 3-digit number into an ordered 3-digit number sequence; continuing an increasing geometric pattern; extending an increasing number pattern and communicating mathematically; and identifying a missing number. Difficult topics from the Measurement strand included those on interpreting and extracting quantitative information from diagrams of 2D shapes on grid paper, estimating informally their areas and communicating mathematically; counting the vertices of 3D shapes; reading measurement on a scale balance and converting between kilograms and grams; grouping 2D shapes using multiple attributes; making tessellating designs by flipping, translating and rotating a 2D shape; and identifying devices for measuring length.

The overall low Year 4 school averages as shown in Figure 41 demonstrated very clearly that students experienced great difficulty in demonstrating the achievement of their working mathematically outcomes, namely, effectively interpreting and/or posing questions, strategically thinking and representing, reasoning and justifying, reflecting and evaluation, and communicating mathematically and including using the empty number line to illustrate operations with whole numbers.

From an analysis of Year 4 teachers' responses on the questionnaire, it appeared that part of the non-achievement of the students' K&S Learning and WM Outcomes could be explained by and directly linked to teachers' perceived "preparedness' to teach the prescribed Year 4 topics and their responses as to whether or not the Test 4 assessed topics were actually taught at all in 2013 as shown in Figure 36. That the majority of the teachers felt 'very well-prepared' to teach only about 37% of the prescribed topics with only 45% of the prescribed topics being taught in 2013 would have an impact on the quality and achievement of students' learning outcomes. That teachers found the teaching of the student-centred strategies and implementation of the NC difficult could be linked to their own numeracy and mathematical competence as measured by their performance in the teachers' diagnostic test. The latter showed that the majority of the teachers lacked the mathematical content knowledge and skills

required to effectively teach the NC (more of teacher competence later on). That the Year 4 students were unable to demonstrate the achievement of many of the WM Outcomes as noted in the interviews suggested that teachers would need training on how to effectively implement and enable the WM processes and strategies in their classrooms.

Summary

In summary, whilst few students achieved at least 2.0 logit ability estimates on the four tests, even fewer achieved Proficient Level. The cohort mean estimates on the four linked tests were as shown in Figure 15 with the misalignments between each test's item difficulty mean estimate and case mean ability estimate revealing existing gaps between student achievement as measured by the test items, and respective achievement standards, as prescribed in the Year Level Mathematics Curricula and as sampled in the four tests. The empirical evidence presented supported the widening vertical gap from Test 1 through to Test 4. This trend clearly indicated that the taught and the learnt curricula were not necessarily the same thing. Furthermore, these taught and learnt curricular topics at this early point in the implementation of the new mathematics curriculum in primary classrooms, represented less than half of what is currently prescribed in the new curriculum.

Students' School and Home Environments

Background information about students' existing classroom and home practices and strategies they perceived were contributing to, and/or supporting, the achievement of their initial numeracy and mathematics learning outcomes were obtained primarily from a student questionnaire. Whilst much information was collected a few constructs were analysed in this report, to provide a view of students' classroom and home environments from their own perspectives.

First, student responses to attitudinal items showed a cohort mean attitudinal estimate that was, on average, positive. Breaking down the student cohort by Year Level showed a trend of Year Level mean attitudinal estimates (Figure 18) that closely mirrored that of mean ability estimates (Figure 15) as graphed together in Figure 42 below.

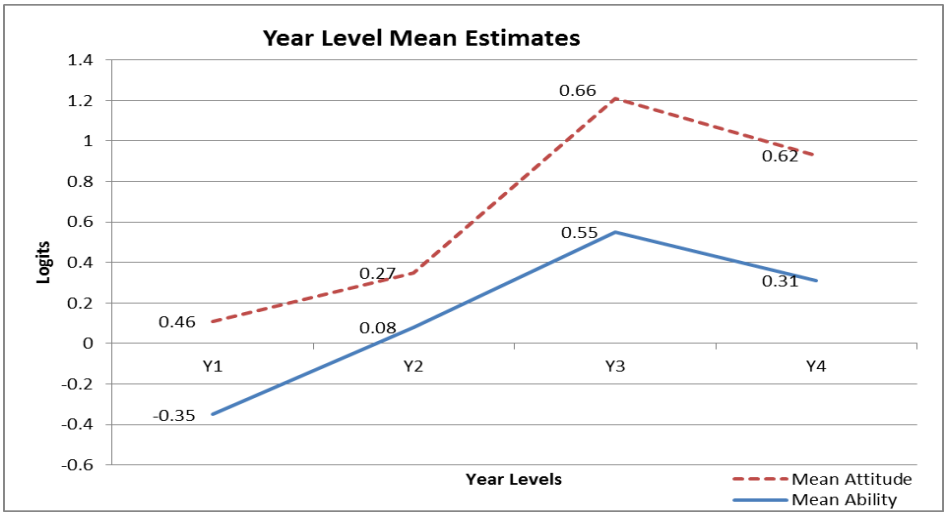


Figure 42: Year Level Mean Ability and Mean Attitudinal Estimates

The graph showed that students' mathematics attitudes continued to increase with Year Level similar to their mathematical abilities and the gap between the two means seemed to progressively

widen as Year Level increases. A more detailed analysis at the construct level of items would provide some insight of the displayed attitudinal trend.

Collapsing response categories showed that over three-quarters of the cohort agreed they liked learning mathematics, learnt things quickly in mathematics, liked working with numbers, and usually found mathematics easy for them. Furthermore, around four-fifths of the cohort agreed they usually did well in mathematics, would like to do more mathematics in school, enjoyed learning mathematics, enjoyed solving word problems, tried to solve problems before asking for help, and liked doing mathematics homework. In addition, 73% disagreed that mathematics was harder for them than for many of their classmates and around 70% disagreed they were not good in mathematics and learning mathematics was hard with 64% disagreeing that mathematics was boring. It appeared then that, in general, students in the early years have, on average, positive attitudes towards mathematics at a much higher level than their mathematics abilities as shown in Figure 42.

Second, an analysis of student responses to the frequency of some classroom practices in mathematics classrooms showed a cohort mean that was, on average, positive towards the more frequent end of the logit scale. Collapsing response categories and organising the lesson practice items into types revealed some interesting statistics which could be linked to those in teachers' questionnaires. For example, the majority of the cohort endorsed that, in most to all lessons, they practised adding, subtracting, multiplying and dividing without using calculators and learnt about shapes such as circles, triangles, rectangles, cubes, prisms, cylinder, cones, and spheres while in some to half the lessons, they worked on fractions and decimals. In most to every lesson, at least forty percent of the cohort endorsed they made tables, charts, or graphs and participated in working mathematically practices such as working with other students in small groups, explaining their answers, measuring things in the classroom and around the school, and solving problems on their own. As for using learning resources, at least a third of the cohort endorsed the use of SRA Mathematics in some to half the lessons compared to 21% that used these in most to every lesson while the rest never used them. With the majority not having any access to computers and calculators in class, about one-fifth endorsed using these in some to half the lessons with a less than a fifth of the cohort using them in most to every lesson. These findings provided feedback from students as to the frequency of lessons that they practised these activities in their classrooms, which would be one of the factors, contributing directly to the achievement of their mathematics learning outcomes.

Third, results from students' home activities suggested that the majority of the students spent some time reading a book they liked (Figure 24Figure 24), participated in informal learning contexts such as extra mathematics classes during the week or Sunday school (Figure 23), and did their homework throughout the week (Figure 22). As for helping out with family chores, the results indicated that more than half the students did this on week days and Saturdays but increasingly so on Sundays (Figure 25).

Fourth, results from students' home practices showed an overwhelming majority (72%) endorsing daily homework from their teachers with 66% spending less than half an hour doing homework at home (Figure 27). While 74% stayed with their parents and go to school, 66% responded their parent or guardian liked mathematics (Figure 28).

In summary, students' existing classroom practices appeared supportive and conducive to the achievement of their learning outcomes with results showing students had positive mathematics attitudes and home practices and environment that were also educationally supportive whilst at the same time leaving sufficient time to help out with family chores.

Teachers' Mathematical and Pedagogical Content Competence

Teachers' mathematical content knowledge was measured by the mathematics diagnostic test to assess their competence with the primary and early secondary mathematics curriculum from Years 1 to 9. Of the 43 teachers who completed the diagnostic test, their ability estimates ranged from 2.96 down to -2.83 logits, percentage correct from 86.8% down to 10.8%, and z-score from 3.00 down to -2.10 with only one teacher achieving Proficient Level. Moreover, the sample kidmaps provided collectively indicated existing gaps in the top and last two cases' content knowledge of the primary mathematics curriculum. Perusing the rest of the individual teachers' kidmaps (40 more) would further confirm these gaps down to the level of topics and subtopics.

Additional data was obtained from a teachers' background questionnaire which collected information about their academic and professional background, years of teaching experience at the current level and other levels, instructional teaching and planning practices, and their current experiences in implementing the new 2013 primary mathematics curriculum. To supplement data from teachers' diagnostic test and questionnaires, individual interviews of teachers in each school were also conducted to further probe teachers' questionnaire responses and/or discuss any other issues related to the teaching of the new primary mathematics curriculum. One of the important areas that needed to be examined was any possible connections between teacher characteristics and student achievement. Four main points are discussed below based on data from the various instruments.

First, it appeared that about 47% of the Years 1 to 4 teachers were in their twenties and thirties and 44% in their forties and fifties with the majority being female teachers. Of the 36 teachers, about two-fifths had less than 5 years of teaching experience with the vast majority having more than 5 up to 30+ years of teaching experience. For years of teaching at the current Year Levels, a vast majority of them (73%) had less than 5 years and only 8% with less than 10 years compared to about twice the percentage with less than 20 years teaching at the current Year Level. Collectively these results imply that the vast majority of the teachers, if not all of them, have been teaching for at least one year a Years 1 to 4 class at the time of implementing the new mathematics curriculum and would/should have been available to participate in the 2012 National Training workshops.

Second, a breakdown of professional development participation by Year Level (Figure 35) indicated a differential distribution of opportunities and/or actual participation across the four years with Year 4 teachers consistently showing the highest rate of participation and Year 1 teachers the lowest. While relatively more workshops and training opportunities had been offered for mathematics content and curriculum followed by those on improving students' critical thinking or problem solving skills and mathematics assessment, there seemed to relatively lesser training opportunities for integrating information technology into mathematics and mathematics pedagogy and instruction in that order.

Third, there seemed to be a decreasing trend between the majority of teachers' perceived level of preparedness and test-assessed topics they indicated were actually taught in the 2013 school year (Figure 36). That the percentage of perceived preparedness was often less than half of the prescribed Year Level topics suggested that teachers would find the teaching of the majority of the prescribed topics throughout 2013 quite challenging; thus the less-than-half-of-the-prescribed topics-being-actually taught-in-2013 result across the four years was to be expected.

Fourth, many of the content areas of difficulty and the non-achievement of working mathematically outcomes (see Student Achievement section) could be linked to the topics that teachers self-assessed they were 'somewhat or not well prepared' to teach or 'not applicable' from the prescribed topics of the relevant Year Level and those that they also indicated were 'mostly taught before this year' or 'not yet taught or just introduced' from the list of topics that were assessed in student tests. Furthermore, the results from the teachers' diagnostic test identified only one teacher achieving the Proficient level with

the rest distributed across the four sublevels of At Risk level as shown in Figure 30. The results clearly showed that 98% of the Years 1 to 4 teachers lacked the depth and breadth of the required mathematics content knowledge to competently and innovatively teach the primary mathematics curriculum.

Of the teachers that were interviewed, the majority expressed positive comments about the new curriculum particularly how its structural organisation and presentation of information down to the substrand level was enabling and facilitating their planning of lessons for the four terms and selection of activities for students. They appeared enthusiastic and willing to work with and teach the new curriculum. However they also acknowledged the fact that they needed/would need some professional, mathematical pedagogical guidance and training in terms of how to effectively deliver/teach the new strategies of the new primary mathematics curriculum. Teachers also realised that the new curriculum was more student focussed and requiring students to do the majority of the work rather than teachers. As a result, the teachers reported that students learnt to cooperate in mathematics and that communication between teacher and student was important. Furthermore, some teachers commented that the new curriculum was hard. With the kind of results displayed in Figure 30, this would be one of the main contributing factors to the teachers' concern and difficulties implementing the new curriculum. It would be helpful for the teachers to have their mathematics competence (or lack thereof) redressed immediately.

Additional information, through a principal's background questionnaire, was also sought from the school principals regarding the school context and the resources available for mathematics instruction. A little over half the principals reported that over half their Years 1 to 4 teachers participated in professional development training. Also all principals evaluated their teachers' practice using student achievement followed by observations by the principal and/or senior staff with a 71% of the principals having their staff being evaluated by an external personnel (Figure 39). The schools' capacity to provide mathematics instruction seemed to be affected by a shortage of budget for stationery supplies, lighting systems and continuous water supply (Figure 40) and shortage of teachers' manuals and student resource books for some principals. Overall, the results from multiple data collected from various instruments support the need to redress immediately Years 1 to 4 teachers' mathematical competence and mathematics pedagogical knowledge of the new mathematics curriculum.

Main Findings

Main findings are organised and presented as answers to the two main research objectives of the study based on the results of the final study presented in this report.

Student Achievement of Numeracy and Mathematics Outcomes

Items in each student test and interview assessment task were directly linked and based on early years' achievement standards. The empirical data showed that, as Year Level increased, gaps between item difficulty mean estimates and case ability mean estimates of the four linked tests increasingly widened, indicating progressive deviations from the Year Levels' achievement standards as measured by the items in the tests. Also data from the interview assessment tasks demonstrated the majority of students experienced difficulties with a number of learning and working mathematically outcomes from across the five content strands and WM process strand. These findings therefore indicated that the achievement of students' numeracy and mathematics learning and working mathematically outcomes as prescribed in the achievement standards is at risk. The gap will continue to widen unless it is addressed immediately.

Teachers' Mathematics and Numeracy Content and Pedagogical Competence

The ability estimates of the school teachers indicated the need to address their mathematical competence or mathematical content knowledge of the primary mathematics curriculum to better enable and equip them to effectively meet the cognitive and pedagogical demands of the new primary mathematics particularly in supporting the development of students' numeracy and mathematical knowledge and skills including students' working mathematically competencies, in the early years. Responses from teacher questionnaires also highlighted the need to ensure that teachers were, and felt, 'very well-prepared' to teach all the prescribed topics of the new mathematics curriculum so that all of the topics are 'mostly taught' for their classes. In addition, teachers' interview responses and students' achievement (or lack thereof) of their learning and working mathematically outcomes in particular, collectively corroborated the need for teachers to also transform their pedagogical practices so that students are achieving their Year Level Learning and Working Mathematically Outcomes. Furthermore, the empirical data from students' interview assessment tasks in particular indicated that all teachers urgently need professional training and support to transform their current teaching styles to enable alignment with a more student-focussed socio-cultural approach to teaching, learning and assessment as promoted in the new mathematics curriculum.

Recommendations

Based on the main findings of the final study, the following are recommended:

1. Primary teachers urgently need mathematics pedagogical content knowledge and skills training workshops and continuous support over the second and third year of classroom implementation of the new primary mathematics curriculum, informed by students' and teachers' common errors and areas of difficulty including findings from teachers' perceived 'lack of preparedness' and topics actually taught, to enable and empower them to transform their current teaching and assessment styles and practices to align more with a socio-cultural and student-focussed approach as envisaged in the new curriculum.
2. Practicing teachers should undertake: (a) the two foundation general mathematics papers (HMA071 and HMA072) offered at NUS to all preservice primary teachers to upgrade their mathematics content knowledge of the new primary mathematics curriculum and the (b) 'teaching primary mathematics' pedagogical course (HTE155) that is compulsory for all primary preservice teachers.
3. Given the vertical widening deviation of actual student achievement from the prescribed achievement standards, NAMDiPS study should be extended to Years 5, 6, 7, and 8 to assess the existing situation at these levels. Whilst this NaMDiPS study has provided baseline mathematics achievements for the early years at this stage of the implementation of the new curriculum against which future impact can be reliably compared to, it is vital that similar baseline achievements are also established for each of the four Years 5 to 8. This is critical given that the current Year 8 examinations are not curriculum-based; instead they are more focussed on the assessment of higher order critical thinking and problem solving skills and the content that is used as the context of mathematics/numeracy items is only a very small fraction of the prescribed Year 8 mathematical curriculum.

4. Primary classrooms should be resourced with the materials required to develop students' informal strategies in measuring length, area and volume (eg building blocks, measuring tape) and creating repeated patterns of objects.
5. An innovative and more empowering strategic approach to professional learning is needed to encourage communities of practitioners within and between schools in clusters and between clusters of schools as they develop, exchange and share resources amongst themselves.
6. The empirical evidence of students' common errors in the achievement tests and their poor performance with the interview assessment tasks demonstrate the need to cultivate and effectively implement a more socio-cultural approach in mathematics learning and assessment as encapsulated by the suite of Working Mathematically Processes in the early years.
7. Following on from Recommendation 6, MESC should consider revising SPELL 1 so that it also includes word problems using the appropriate Year 4 mathematical language to better align with the prescribed Year 4 Achievement Standards.

References

Adams, R. J., & Khoo, S. T. (1996). *QUEST*: *Interactive Item Analysis.* Melbourne: Australian Council for Education and Research.

Andrich, D. (1982). An index of person separation in latent trait theory, the traditional KR-20 index, and the Guttman scale response pattern. *Educational Research and Perspectives, 9*(1), 95-104.

Bond, T. G., and Fox, C. M. (2001). *Applying the Rasch model. Fundamental measurement in the human sciences*. Mahwah, NJ: Lawrence Erlbaum and Associates.

Clarke, D. M., Sullivan, P., Cheeseman, J., & Clarke, B. A. (2000). The early numeracy research project; Developing a framework for describing early numeracy learning. In Bana & Chapman (Eds.), *Mathematics Education beyond 2000* (Proceedings of the 23rd annual conference of the Mathematics Education Research Group of Australasia, pp. 180-187). Fremantle, Western Australia: MERGA.

Great Schools Partnership (2014). The Glossary of Education Reform for Journalists, Parents and Community Members. Retrieved online from http://edglossary.org/.

Linn, R. L., & Gronlund, N. E. (2000). Measurement and assessment in teaching (8th ed.). Upper Saddle River, NJ: Prentice Hall.

Mullis, I. V. S., Martin, M. O., & Foy, P. (with Olson, J. F., Preuschoff, C., Erberber, E., Arora, A., & Galia, J.). (2008). TIMSS 2007 International Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades. Chestnut Hill, MA: TIMSS & PIRLS International Study Centre, Boston College.

Samoan Ministry of Education, Sports & Culture (SMESC). (2010). ESP 2 Project Documentation. SMESC.

Yu, C. H. (2006). A simple guide to the Item Response Theory (IRT). Retrieved from http://www.creative-wisdom.com/computer/sas/IRT.pdf.