

**Science and Mathematics Education Centre**

**A Comparative Study of Lower Secondary Mathematics Textbooks  
from the Asia Pacific Region**

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**This thesis is presented for the degree of  
Doctor of Mathematics Education  
of  
Curtin University of Technology**

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## **Declaration**

This thesis contains no material that has been accepted for the award of any other degree or diploma in any university.

To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgement has been made.

Signature:.....

Date: XX May 2006

## **Abstract**

The rationale behind this study concerns the issues school administrators and teachers of expatriate students face over the progress and placement of the growing number of these students in mathematics classrooms in various countries brought about by the demographical changes occurring in this globalization era. This study aimed to present a method of examining lower secondary school mathematics textbooks with the purpose of evaluating students' expected past learning and comparing students' expected mathematics learning across the different curricula. It is anticipated that such an investigation will be of value to those responsible for the correct level of placement of these students.

Six sets of textbooks from four countries on the Asia-Pacific rim, namely Australia, Brunei, China and Singapore, were selected for this study. The textbook content of each country was analyzed in terms of strand weighting and content details, and then coupled with information gained from interviews with teachers. This led to the findings which addressed the various issues raised.

The findings facilitated a comparison of the learning paths offered by the various textbooks, fleshed out the differences and similarities of the various curricula and made available detailed comparisons of the textbooks' content in terms of topics covered. The analytical procedure of the examination of text content as presented in this study is itself a diagnostic technique for assessment of the students' past learning, which addressed the main objective of the study.

The findings will be of interest to all who are interested in the mathematics taught in the countries involved. Outcomes will be particularly useful to curriculum planners and textbook writers as well as the administrators and teachers of International Schools and other schools enrolling expatriate students from these countries. The study offers a "simplistic" way of evaluating textbooks to assess students' learning progress, and highlights the traits of the countries' curricula to provide a general idea of the mathematics ability expected from the expatriate students residing in these countries.

## **Acknowledgements**

Twenty-eight years ago I was awarded a scholarship by the University of Wales to pursue a PhD in Engineering, which I declined due to several reasons, among which was the picture I saw of a lone researcher engaged in solitary study which, I decided, was not the role I wanted to play in postgraduate study. Twenty-eight years later, I realized I had painted an incorrect picture then. I was and certainly am not in solitude doing this postgraduate course at Curtin University. In fact I have had the support of many people who have helped me to accomplish a feat that I was reluctant to take on before.

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# Chapter 1

## Study Overview

### 1.1 Background

During my undergraduate life as an Engineering student in the United Kingdom, I had ample opportunity to get to know many international students from a varied cultural and educational background. Applied mathematics is an essential tool in engineering; I recalled being astounded at some of the problem solving approaches applied by my peers during tutorials. It was during this undergraduate period that, on top of having thoroughly enjoyed and completed the engineering course with flying colours, I also developed a keen interest in how mathematics was taught in a different education curriculum. The interest sustained over the nine years of my career as an engineer had in fact culminated to such a degree that I decided to become a mathematics teacher and undertook the PGCE course for Secondary Mathematics Education. The decision on a career change was never regretted; in fact it was quite the reverse as it opened my mind to multiple aspects of teaching and learning mathematics while I worked my way through the education arena as a teacher, a mathematics department head, a senior mistress and a deputy principal in both private and government schools in Brunei.

Brunei has a relatively large expatriate population; every so often expatriate children arrive in the classrooms. The country also employs a large number of expatriate teachers, especially in the English Language, Mathematics and Science Departments. Both the expatriate students and teachers have to be inducted into the Brunei educational curriculum and climate. Most adults make the transition very smoothly, but some of the children do take longer to adapt to the new environment. Being a mathematics teacher, I am aware that many expatriate students lag behind the class as the consequence of their transition into a different curriculum, and some suffer a loss of confidence, especially in mathematics. The severity of such a consequence, which should not be taken lightly, is aptly described by R. James Milgram (2003) of Stanford University as follows:

“To begin, one must understand that mathematics is almost unique among the subjects in the school curriculum in that what is done in each grade depends crucially on students having mastered key material in previous grades. Without this background, students simply cannot develop the understanding of the current year’s material to a sufficient depth to support future learning. Once this failure happens, students typically start falling behind and do not recover” (p. 76).

From the school administration perspective, to ensure a smooth induction of the expatriate students into the local curriculum is a concern that was almost non-existent a couple of decades ago. A mismatch may result in an unfortunate scenario as described by Milgram above, which could have far-reaching consequences with students. They could eventually lose interest in their study and create associated problems in school discipline, affect public examination results and detract from the school’s standing in the national school-ranking list.

## **1.2 Rationale for the study**

Most schools have similar policies on expatriate student’s class placement, which is based on the student’s age and past school reports. Drawing on my past experience as a deputy principal of a private school in Brunei, which enrolled students from Nepal, Germany, India, Pakistan, The Philippines, Malaysia, Singapore and Australia, the decision for student placement is not always straight forward. For students who have insufficient documentation to support their past learning, and from an educational system that is unfamiliar to the school administrator, their placement is not a clear-cut decision. In such cases, short tests on the core subjects (English, Mathematics and Science), which normally last an hour per subject, are administered to assess the expatriate student’s past learning. The test results are used as a guide for student placement although this is an unfair practice as the test may assess an area of content that may not concur with the student’s previous learning. It is a diagnostic measure that is both inaccurate and unfair for appraisal of past learning, and this may lead to placing the student in an inappropriate class.

The dilemma facing school administrators, parents, teachers and students concerning the ‘transfer from another educational system’ issue gives rise to many questions:

- From the school administrator, “At what level and class should I admit the expatriate student so that he/she fit into the system comfortably?”
- From the teachers, “How do I assess the student’s past learning? How do I help to ease the strain of his or her transfer into a different curriculum?”
- From the student/parents, “What has been taught in this school that I/my child have not learned before? What is entailed in the new curriculum?”

The answers to these questions lie in linking up expatriate students’ past learning to the new curriculum, which brings to prominence the needs for all concerned parties to be more informed of the education system of other countries. Knowledge of students’ past curricula would not only aid in a more accurate assessment of students’ past learning, it would also enable the teachers to identify probable areas where more assistance could be rendered to the expatriate students to smooth their transition into the new curriculum.

Knowledge of the student’s previous curriculum is vital to address the above concern, for there is a close link between curriculum content and the textbooks used. Past research on the influence of textbooks on teachers’ teaching practice established the importance of textbooks relating to understanding of curriculum (e.g. Fan, 1999; Graybeal, 1988; Krammer, 1985; Sosnial & Stodolsky, 1993). Textbooks are important constituents of an intended curriculum – they influence what and how teachers teach (Fan & Kaeley, 2000; Robitaille & Travers, 1992). An analysis of textbooks can make important contributions to an understanding of a curriculum in a particular country (Howson, 1995). It would serve to provide a window into the educational system, which might lead to an indication of student’s past learning (or intended learning). It is a more accurate diagnostic measure to assess the student’s probable mathematical skill from the ‘old’ curriculum, and it also provides more insight into the ‘new’ curriculum which may assist in a smoother transition from one curriculum to another. The quotation by Robitaille (1995) below further stressed the importance of textbook analysis from the mathematics education perspective.

“Mathematics textbooks exert a considerable influence on the teaching and learning of mathematics, so understanding of how textbooks vary in their content and approach across countries is an important area of investigation. ... An analysis of textbooks makes an important contribution to understanding curricula in a particular country....” (p. 5 & 6)

### **1.3 Purpose of the Study**

This study aimed to examine Lower Secondary Mathematics curricula in the Asia-Pacific region, and to formulate a comparison of the curricula across nations based on the textbook content.

The specific aims were to:

1. provide an overview of the lower secondary mathematics curricula based on the textbooks used.
2. compare the progress or expected student achievement based on the age-group timeline, across nations.
3. facilitate easy extraction of information for evaluating a topic or strand across these different curricula.
4. determine the characteristics of the curriculum as represented by the textbook content.
5. explore teachers' opinions on the textbooks.
6. make recommendations for teachers and administrators.

One of the many characteristics of globalization is the high mobility of people, which accounts for the emergence of many international schools across the globe as well as the generation of a growing group of students who relocate, along with their parents, and who encounter a number of different educational curricula in their schooling. What began as a school administrator concern for me was transformed into a study which hopefully will furnish interested parties curious about the mathematics curricula in these countries with useful information. With the results of cross-national mathematical performance studies drawing avid attention from educators, researchers and the general public at this time, this study sought to contribute to a

research area which, until two decades ago, was somewhat ignored. The study endeavored to realize its aims by analyzing a number of textbooks from different aspects, starting as a whole-book investigation, followed by individual strand analysis, topic content evaluation and finally topic sequence comparisons.

#### *Intended outcomes*

This study, with its main focus on textbook content, aimed to identify the different accent and emphasis of different curricula, thereby to produce some explanations of the disparity in student performances in many of the international comparative studies such as The Third International Mathematics and Science Study (TIMSS) and International Mathematics Olympiads (IMO), as well as to highlight the expected mathematical skills acquired in a particular curriculum. The intention was to offer the stakeholders – such as the school administrators, curriculum planners, textbook writers, parents and students – an insight into the different curricula through the textbooks used, so as to achieve an improvement, if necessary, to the teaching and learning of mathematics in the particular education system.

### **1.4 Specific research areas**

This study aimed to gain an insight into the curricula of different nations by comparing their school textbooks used. The criteria for the selection of textbooks were based on the selected textbooks being written in a language comprehensible by me, and that the textbooks were used in counties with a relatively high expatriate student population. The outcome of such selection parameters narrowed the choice of textbooks to those from four countries, namely Australia, Brunei, Singapore and China.

In conducting this analysis there were six areas that acted as foci for the research questions, data collection and analysis processes. The areas are listed below with a brief outline of the data analysis and descriptions of the uses made of the data in each area, followed by a set of research questions designed to provide a more defined focus for the study's aims. Attention focused on gaining:

*An overview of the lower secondary mathematics curricula based on the textbooks used.*

The aim here was to identify the emphasis of individual textbook and programme, and to produce a comparison across nations. Such comparison would give a clear picture of the different preference of a particular curriculum on a particular strand or topic.

*A comparison of the progress or expected student achievement based on the age-group timeline.*

This facilitated an insight of the students' expected progress and because the information was charted on the same time-line, it was used to facilitate a comparison across the nations and to be used for determining students' standing in a different curriculum.

*Easy extraction of information for evaluating a topic or strand across these curricula.*

The first two research questions also played an important role in delivering the answer to this research area. The data collected provided a wealth of information for a particular topic or strand across the curricula along the same time base.

*Curriculum characteristics as represented by the textbook content.*

This was to flesh out the individual traits of the curriculum, as well as any cultural influences portrayed in the books and used to draw more distinction on the differences across the curricula.

*Teachers' opinions on the textbooks used.*

The outcome was used as an input from the key stake-holders to enhance the study. However, not all teachers who were invited to participate took part in this exercise. The number of response was not large enough to draw a conclusion, but it did give an indication of teachers' view on the textbooks.

*Information for teachers and administrators.*

This information would highlight the important differences and similarities in the various curricula so that the teachers and administrators would be better prepared in

inducting and assisting the expatriate students and teachers into their education system.

The following research questions were devised to provide a more defined focus for the research to achieve these aims.

1. What is the strand weighting for each level and for the whole lower secondary mathematics programme in the different countries?
2. What are the differences and the similarities of the students' expected mathematics knowledge in these countries based on their yearly progress?
3. How do individual topic and strand feature in the textbooks through the various levels and at what depth and width?
4. What are the strengths, weaknesses and exemplary characteristics of textbooks?
5. What is the outcome of conducting a questionnaire interview on teachers' opinions about the textbooks used?
6. What useful information can be passed onto teachers and administrators of expatriate students as a result of this study?

## **1.5 Theoretical framework and methodology**

This study builds its stance on two important research findings: Firstly, the significant link between textbooks and curriculum in that analysis of textbooks contribute to understanding a curriculum in a particular country, as established in past research (Howson, 1995). Secondly, textbooks exert considerable influence on teaching and learning (Robitaille, 1995). These findings are supported by a number of other researchers, for example, Millett and Johnson (1996) who argued that mathematics has long been regarded by many as a subject for which the textbook is the main resource, a statement that concurs with the findings of the IEA Second International Mathematics Study (Robitaille and Garden, 1989). Findings from the Third International Mathematics and Science Study (TIMSS) further indicated that this is a world-wide phenomenon (Schmidt et al, 1996).

The study focuses mainly on an analysis of textbooks to gain an insight into the curriculum as well as a projection of the mathematical expectation at a particular level. It seeks to expand on past research findings from a different perspective, specifically in that it scrutinized the textbook content for three consecutive years at the Lower Secondary level. A teachers' interview questionnaire supplied the qualitative aspect of the study, while the textbook content provided the quantitative measure needed to complete the analysis. This methodology of using a combination of both qualitative and quantitative measures for data collection ensured a richer and more balance analysis and conforms to the research paradigm suggested by Guba & Lincoln (1989).

## **1.6 Significance**

The study has a practical aspect which is significant to a number of groups who should find the study's findings useful. First, it offers information to stakeholders (parents, teachers, students, mathematics educators, curriculum planners and textbook writers) who are curious about the mathematics taught in Australia, Brunei, China and Singapore. The study provides an investigation of the approaches and strategies outlined in the textbooks, the weighting and timing of the topics, and the expected achievement progress at the end of each lower secondary school year for the various curricula.

Second, it serves as a diagnostic tool for school administrators and teachers to gauge the mathematics knowledge of students transferred from a different education system as the study analyses and compare the intended progress in mathematics learning as detailed in the textbooks from these countries. It examines the expected mathematical skills and concepts acquired at the end of each school year to provide an overview of the mathematics progress of the different curricula for comparison purpose. Additional information aims to provide the administrators and teachers with a more accurate assessment of the students so that appropriate assistance may be rendered to the students to facilitate the learning process.

Third, it is useful for educators, curriculum planners and textbook writers to gain an insight into the existing textbooks where exemplary features representing the various curricula are highlighted. Hopefully this will afford them a broader base to work on with a view for improving the existing curriculum with possible adjustment to, or adaptation of, future projects they may have in mind.

Fourth, it is hoped to provide supplementary information to various international comparative studies. For example, Brunei did not participate in the large scale international comparative studies such as the TIMSS. The present study should make a contribution to this lack of information. The study also includes an investigation of more than one set of textbooks in Australia to reflect on the diversity and similarity of the different textbooks used across that country. The outcomes of this study may also be used as a check on past comparative studies.

Finally, many of the comparative studies of school textbooks tackle the analysis by selecting a particular aspect in the text content, or a single topic, or a specific level for textbooks used in two or three countries in their discussion. Howson (1995) analysed mathematics textbooks from six European countries, USA and Japan for grade 8 textbooks and published the study as a monograph to the TIMSS report, however there is a paucity of research tracking a complete lower secondary mathematics programme for its three consecutive years. There is also limited literature which analyses and compares textbooks from the Asia-Pacific rim, and none of the existing literature placed strong emphasis on the Australian textbook scene. Bearing in mind the circumstance which kindled the initial interest on the chosen research area, the study bears the distinction of possibly shedding a different light on an increasingly important research area in mathematics education.

## **1.7 Thesis structure and overview**

This thesis consists of six chapters, references and a series of appendices, figures and tables. Chapter 1 presented the purpose of the study, explained the researcher's interest, outlined the theoretical framework and methodology, and discussed the significance of the study.

Chapter 2 consists of a review of literature relating to the role of mathematics textbooks in the teaching and learning of mathematics, as well as the research on comparative studies of mathematics curricula and textbooks. It also reports the outcomes of international comparative studies and consequent research. Throughout there is a particular focus on the area of comparison of curricula as reflected by the textbooks' content.

Chapter 3 details the methodology of this study, maps the research questions and outlines the textbook selection criteria. It also describes the teacher interviews questionnaire and also describes the participants as well as the data collection and analysis procedures.

Chapter 4 presents the discussion and analysis of the textbook content, with the analyses presented as graphical representations and in tabulated forms. In this chapter the first four research questions are also addressed.

Chapter 5 describes, discusses and analyses the teachers' interviews about the mathematics textbooks used. This set of qualitative data is included to flesh out the voices among teachers and to inject an element of key users' opinions in the use of textbooks. The chapter concludes by pooling together the findings from both textbook content and teachers' interviews and examines the findings in terms of the research questions.

Chapter 6 reports on the major findings and discusses them in relation to the research questions. It highlights the significance of the study as well as its wider implications and also includes a discussion on the study's limitation, further research avenues and conclusions. This chapter also includes a brief personal reflection on the study which is followed by the Reference section. Appendices A – G incorporate the data collected from textbooks, basic statistical analysis of textbook data, a set of Teachers' Interview Questionnaires and the interview transcripts, as well as several items relevant to the study.

## **Chapter 2**

### **Literature Review**

#### **2.1 Introduction**

The study sought to address some issues arising from increasingly multi-racial and multi-cultural classrooms which pose as areas of concern for the teachers and school administrators of expatriate students. It aimed to furnish information and insight into a few mathematics curricula for interested groups of people, to formulate a diagnostic strategy, and to address these concerns with a view to identifying expatriate students' past mathematics learning and to ease their strain of transition from one curriculum to another. To achieve its intended objectives, a preliminary investigation suggested that analysis of textbooks was the best starting point to commence this study. Consequently the next course of action was to amass and review past relevant research articles.

It was found that there was a paucity of research related to this area until relatively recently. The effects of globalization have brought about a change in the school learning environment and culminated in numerous comparative studies of mathematics curricula, prompting many mathematics educators and researchers to focus on what has been a neglected area of mathematics education. The outcomes of the concerted efforts of researchers and mathematics educators include several large scales international comparative studies as well as those of a smaller scale, all of which involved analysis of textbooks' content from different perspectives.

This literature review is divided into sections, presenting an overview of past research significant to the study and linking the findings and theory from other studies to this research. The key aspects of relevant past research are highlighted to give a more extensive and connected picture of the findings which serve as a literary backdrop for this study. The relevant research papers are from three main sources: (1) comparative studies of textbook content between countries, (2) large scale international comparative studies, and (3) international mathematics competitions. Results of testing from large scale international comparative studies and international

mathematics competitions were incorporated in this study to complete part of the mathematics education tapestry with textbook analysis as the main focus.

## **2.2 The role of mathematics textbooks**

The past two decades witnessed the commencement of many large scale comparative studies measuring students' mathematical achievements, the findings of which functioned as important benchmarks for comparing students' mathematics performance across nations. These studies stimulated much research interest in mathematics education with attention focused on the mathematics textbook, considered to be a tangible reflector of the national curriculum. The use of textbook in these studies effectively reduced the disparity in interpreting curriculum statements that were often characterised by adopting broad, unspecific guidelines as their working document.

Many researchers believe the textbook is an important factor in students' mathematics achievement. The ideas that a textbook reflects national curricular goals, and reflects and legitimises national cultural traditions are well documented in the literature (Haggarty & Pepin, 2002). Apple (1992) maintains that "texts are not simply 'delivery systems' of 'facts'. They are the simultaneous results of political, economic, and cultural activities, battles, and compromises" (p. 4). He also quotes A. Graham Down of the Council for Basic Education in the same article:

"Textbooks, for better or worse, dominate what students learn. They set the curriculum, and often the facts learnt, in most subjects. For many students, textbooks are their first and sometimes only early exposure to books and to reading. The public regards textbooks as authoritative, accurate, and necessary. And teachers rely on them to organise lessons and structure subject matter." (p. 6)

Robitaille, in the foreword to the Third International Mathematics and Science Study (TIMSS) Monograph No. 3 by Howson (1995), mentioned that in the conceptual framework for TIMSS, differentiation were made among the intended curriculum,

the implemented curriculum and the attained curriculum; and questions were raised about the role and function of mathematics textbooks. He surmised that

“In most places, the textbook is almost certainly not the embodiment of the intended curriculum. More likely, and as Professor Howson’s analysis indicates, the textbook is either a subset or a superset of the intended curriculum. Similarly, the textbook is not identical to the implemented curriculum, as teachers make their own decisions about which topics to include or not to include in their course, and about which approach or approaches to take in the teaching of particular topics. An analysis of textbooks makes an important contribution to understanding curricula in a particular country, but this is a necessary, not a sufficient, condition for that understanding to be possible” (p. 6)

Based on my working experience as a high school mathematics teacher and the mathematics department head in Brunei, I observed that Robitaille’s remark about the autonomy of teachers in the selection of topics to be taught in the classroom is not entirely valid. In Brunei the teachers’ choice of topics and teaching materials is very often closely dictated by the examination syllabus that serves as the platform upon which students’ mathematics achievement is examined. The teaching approaches of the team of teachers teaching the same year group may vary according to individual preference, but teachers have to plan and follow the same annual scheme-of-work so that similar progress in teaching is made to ensure that students are taught the same topics within a set time frame to prepare them for the internal and external examinations, and have to check students’ understanding of the topics and formulate students’ standing in their year group. Taking into considerations the accountability factor in education, it is indeed very rare for responsible teachers to omit or select certain topics without prior consensus from their colleagues and heads. In places where the “school-gate culture” is strong, any deviation from the norm may have grave consequences when the school administration has to handle parental actions or complaints which can be tricky. For these reasons, in Brunei the textbook is indeed a superset of the intended curriculum, and that it reflects the implemented curriculum more than what was implied in the statement by Robitaille.

The attained /achieved curriculum mentioned by Robitaille is represented by students' performance, which varies differently from intended curriculum (described in curriculum document and may be portrayed in the textbooks) and implemented curriculum (which is reflected in textbooks). While textbook is a reflection of the intended curriculum and consequently an indicator, in varying degrees, of the expected student knowledge, the actual student achievement differs depending on individual. Good teaching, strong mathematical background and good command of the language of instruction are some of the many factors influencing students' achievement. Students using the same textbooks may or may not perform well. To illustrate this point, reference is made to an extract of the 1999 November 'O' Level Mathematics 'D' results published by the Brunei Ministry of Education.

Table 2.1: *Extract from the 1999 & 2000 November 'O' Level Mathematics 'D' result analysis*

School Name	Total no of Candidates	Pass Grades achieved by the Candidates					Total credits A - C	%age Credits	Gov't Schools Ranking
		A	B	C	D	E			
<b>Year 1999 'O' Level Mathematics 'D' Result Analysis</b>									
MSPSBS	156	65	59	20	4	1	144	92.31	2 / 30
SMPDSM	139	11	15	21	18	26	47	33.81	9 / 30
SMB	278	2	10	37	40	49	49	17.63	29/30
*Chung Hwa	114	23	31	20	12	12	74	64.91	N / A
*St. Margeret	59	18	9	24	4	2	51	86.44	N / A
<b>Year 2000 'O' Level Mathematics 'D' Result Analysis</b>									
MSPSBS	217	91	77	31	8	7	199	91.71	3 / 30
SMPDSM	131	5	18	31	18	27	54	41.22	9 / 30
SMB	235	1	21	28	25	43	50	21.28	25/30
*Chung Hwa	87	25	21	18	9	7	64	73.56	N / A
*St. Margeret	37	13	13	6	2	0	32	86.49	N / A
* Private schools which were not included in the government school ranking list Source: The data was extracted the result analysis compiled by the Brunei Ministry of Education and was available by request from the Examination Department. Web-site: <a href="http://www.moe.gov.bn.htm">www.moe.gov.bn.htm</a>									

As can be deduced from the result analysis in the above extract, the achievement outcomes of students certainly do varied even though the same set of textbooks are

used. Lim and Clements (2002) published an interesting paper on the mathematics skills of Brunei students in a large secondary school. The research found that a large number (88%) of the sample (111 Form 4 students) had difficulty comprehending algebraic word problems and translating the meaning into appropriate algebraic symbols. This research data was collected from the government school SMB which is one of the “academically poorer” schools from the ranking list. If it were conducted in one of the better schools, the outcome may well be different. Nevertheless, even though the data sample was too small to be representative of the national average, it does support the point that language is an important factor in the teaching and learning of mathematics. Robitaille’s (1995) differentiation among the intended curriculum, the implemented curriculum and the attained curriculum is well illustrated by the Brunei example.

The role of textbooks in both teachers’ teaching and student learning of mathematics has received increasing attention from researchers over the last two decades (Ball & Cohen, 1996). Many studies revealed that the accessibility of textbooks was positively linked to student achievement, especially in developing countries (Fuller & Clarke, 1994; Heyneman, Farrell, & Sepulveda-Stuardo, 1978; Schiefelbein & Simmons, 1981). Keitel et al (1980) claimed that “amongst the tools for teaching and learning, the textbook is one of the oldest and also the most controversial, and is one of the most important orientations for the teacher and the influencing factor of the teacher’s work in its entity” (p. 15, free translation as quoted in Haggarty & Pepin, 2002).

Researchers around the world have consistently reported on the extensive use of textbooks in classrooms. In Europe, for examples, teachers in Germany and Switzerland used one main mathematics textbook per year in their teaching and generally followed the book fairly closely (Bierhoff, 1996). In England, Her Majesty’s Inspectorate (HMI) estimated that two-thirds of middle and secondary schools used a commercial mathematics scheme for year 7 and Year 8 students (HMI, 1992).

Apple (1986) asserted that the wide spread usage of a textbook in classrooms had the potential to exert a powerful influence on pupils: “Whether we like it or not, the

curriculum in most American schools is not defined by courses of study or suggested programs, but by one specific artifact, the standardized, grade-level-specific text in mathematics.” (p. 85). The researchers in the US found that 75 to 90 percent of instructional time was structured around textbooks (Tyson & Woodward, 1989; Woodward & Elliott, 1990).

Fujii (2001) indicated that the majority of teachers in Japan taught the contents in textbooks in a straightforward way which he called “a very honest manner” as they usually stayed within the textbook content and neither went beyond the materials nor offered less than what was included in the books. Beaton et al (1996) surmised that, world-wide, most mathematics teachers used textbooks as their main resources for teaching approaches. Schmidt et al (1996) reported that as part of the TIMSS study they observed lessons in Norway, Spain and the USA in which there was heavy reliance on the textbook: “In all these cases, the mathematics presented in the class appears as an authoritative body of knowledge to which students and teachers must hold”.

Many research findings support the fact that textbooks affect, to a varying degree, not only what teachers teach, but also how teachers teach (Fan & Kesley, 2000; Robitaille & Travers, 1992). However Gilbert (1989) argued that though textbook studies portrayed the intended curriculum of a country, they did not claim to depict the classroom outcomes in practice, as quoted below:

“The analysis of text can point to potential, even likely, outcomes in classroom use of texts, but it can never conclude with confidence that the ideological import of a text as interpreted by the researcher will be similarly realized in the discourse of the classroom” (p. 68).

Nevertheless it is obvious that the intended curriculum had a great influence on the implemented curriculum, and textbooks reflect the national goals set in intended curricula. And because they are widely used in mathematics classrooms all over the world, they also exert considerable influence on the implemented curriculum, for example, by often defining the contents discussed during the mathematics lessons (Haggarty & Pepin, 2002; Schmidt, Mcknight, Valverte, et al, 1997). In particular, a

TIMSS report (Beaton, Mullis, Martin, Gonzalez, Kelly, & Smith, 1996) indicated that the textbooks were the major written source mathematics teachers used in deciding how to present a topic to their classes in almost all the participating countries.

In summary, the textbook plays a prominent role in mathematics education. Not only does it constitute one of the most influential factors in teaching and learning, it provides an insight into the mathematics curriculum and consequently is indicative of students' expected learning. However, it does not yield much information on students' actual learning as students using the same textbooks may achieve different outcome.

### **2.3 Research on comparative studies of mathematics curricula**

There has been a long history of international comparative studies in education (Alexander, 2000). Comparing is one of the most basic intellectual activities which enables one to check one's standing in the area concerned. Over the last twenty years, mathematics educators and researchers have paid considerable attention to cross-national comparative studies on students' mathematical achievement (Beaton, Mullis, Martin, Gonzalez, Kelly, & Smith, 1996; Robitaille & Garden, 1989). Such cross-national studies in the teaching and learning of mathematics provide unique opportunities to understand the current state of students' learning and to explore how students' learning can be improved (Cai, 2001; Stigler & Hiebert, 1999). This result drew much attention from the general public and aroused curiosity and interest from researchers and educators who were prompted to search for possible explanations for such an outcome. The fact that textbooks are extensively used in schools has conveniently provided a tool in many comparative studies of mathematics education and national curricula where analysis of textbook content links directly to reflect the curricular content and forms the database to establish research findings.

There have also been a number of studies reporting on different curricula and education systems. Studies on certain aspects of the European curricula have been covered by Bierhoff (1996) who reported on a study of primary school textbooks. Haggarty & Pepin (2002) investigated textbooks and mathematics learning

opportunities in English, French and German classrooms by focusing on the topic “measuring angle” in Year 7 text. Harries & Sutherland (1998) studied primary textbooks with the particular focus on the treatment of Number in five countries, namely, England, France, Hungary, Singapore and USA. Bao (2002b) compared the composite difficulty of Chinese and British school mathematics curriculum.

A considerable number of research articles have compared mathematics education between the United States and other countries and have addressed various aspects or issues in the discipline. For example, some researchers analysed the representation of problem types in the textbooks (Fan & Zhu, 2004); Mayer, Sims & Tajika (1995) compared how textbooks teach mathematical problem solving in Japan and the US; Li (1998) compared problems that follow selected content presentations in US and Chinese mathematics textbooks; Cai, Lo & Watanabe (2002) investigated intended treatment of arithmetic average in US and Asian school mathematics textbooks; and there are others who worked on an assortment of topics (for examples, Hess & Azuma, 1991; Carter, Li, & Ferrucci, 1997; Zhu, 2003; Cai, 2004). It is clear that all these analyses have identified important differences between selected US textbooks and textbooks that might provide explanations of student performance disparities in international comparative studies such as TIMSS and TIMSS-R.

Several research studies have deviated from the format of examining a selected few or a single aspect of mathematics textbook content across nations. In connection with TIMSS, Howson’s (1995) comparative study entailed analysing many facets of the Year 8 textbooks from eight nations, namely England, France, Japan, The Netherlands, Norway, Spain, Switzerland and USA. It spanned three continents and provided valuable materials that served to supplement the ambitious TIMSS project. The wealth of information in this monograph, ranging from research on textbooks to pedagogy and philosophy of mathematics on top of the textbook content analysis, provides an excellent example of textbook evaluation processes from the rudimentary to the most advanced.

A recurring problem confronting comparative studies in education is that changes are always taking place in educational systems and in national curricula (Howson, 1995). Small-scale comparative studies frequently have yielded insights unlikely with large-

scale studies (Theisen & Adam, 1990; Kaiser, 1999), and they have the advantage of being able to furnish their findings in a relatively shorter time since they do not work from a huge database. Although they might be prone to problems of unacknowledged cultural influences (Theisen & Adam, 1990), they have sought to account for the influence of context (Schmidt & McKnight, 1995). By comparison, large-scale comparative studies across nations normally have spanned a much longer time duration before any findings have been published, and during such time-spans there might have been changes in the education systems that have rendered the research outcomes invalid, with the recommendations arriving too late to be incorporated into the change. Despite this, Medrich and Griffith (1992) pointed out that these studies have been the most completely executed large-scale international surveys in the education domain.

The large-scale comparative study was first suggested in late 1950s (Husen, 1996) and the International Association for Evaluation of Educational Achievement (IEA) was the first organization to conduct such a survey (Robitaille & Travers, 1992). Since then the organization has conducted over 20 large scale comparative studies amongst which five were carried out in mathematics. The First International Mathematics Study (FIMS) was conducted from 1961 to 1967 with 12 participating countries; the Second International Mathematics Study (SIMS) was carried out in 1976 with 20 participating countries (Robitaille & Garden, 1989a), and the Third International Mathematics and Science Study (TIMSS) was the largest and most ambitious study undertaken by the IEA. It commenced in 1991 with over forty participating countries and investigated many aspects of mathematics education, including surveying schools and teachers about teaching practices, training and school policies. It also examined textbooks which entailed scrutinizing and analyzing key content topics; as well as conducting testing in 1995 for three age-groups: fourth, eighth and twelfth graders. The subsequent follow-up studies were conducted at four-year intervals during 1999 and 2003 and were termed TIMSS-R (TIMSS-Repeat) with more testing performed at the eighth grade level. The results are discussed in a later section.

Another organization that claims to be the largest private educational testing and measurement organization, the *Educational Testing Service* (ETS), undertook two

large-scale studies across nations, named the International Assessment of Educational Progress (IAEP 1 and IAEP 2) prior to 1992. The studies investigated numerous aspects of mathematics education including content areas, student ability and attitude, educational and cultural factors associated with achievement as well as conduct performance testing. Data was gathered from two groups of students, age 9 and 13, on mathematics content covering the five main strand areas: number, measurement, geometry, data and statistics, and algebra. Mead (1995) and Lapointe, Mead & Askew (1992) report that the result showed that the highest scorers were from Asian countries such as China, Korea, and Taiwan.

One more global organization which started in the early 1990s, the *Organisation for Economic Cooperation and Development* (OECD) also conducted a large scale international comparative study called the *Programme for International Student Assessment* (PISA) which spanned over 2000-2002. It was a three-yearly survey of the knowledge and skills of 15 year-olds in reading, mathematics, and scientific literacy (Fan & Zhu, 2004). PISA defined mathematical literacy broadly as the capacity to identify, understand and engage in mathematics as well as to make well-founded judgement about the role of mathematics played in an individual's current and future private, occupational, social life with peers, relatives, and life as a constructive, concerned and reflective citizen (OECD, 2003). Three broad dimensions were identified for assessment by PISA: mathematical content, mathematical processes, mathematical situations and context. In this study, Hong Kong students were the overall best performers among some 40 participating countries, followed by Japan and Korea (Fan & Zhu, 2004).

These large scale comparative studies have received much attention from researchers (Postlethwaite 1999). The good standing of Asian students portrayed in the outcome of these international studies and testing has led to much research work centered on the mathematics curricula of these countries looking for answers to explain this excellence. Many researchers have examined the factors that affect students' mathematics learning, such as the curriculum, textbooks, mother tongue, societal expectation, parental involvement, social beliefs, cultural values, the learners' time spent on studying, and their learning attitudes (Cai, Lo & Watanabe, 2002; Zhu, 2003).

While the usefulness of international comparative studies have been accepted by many education administrators and educators (Baker, 1997; Beatty, 1997), some researchers questioned the reliability and validity of the results obtained from these comparative studies because the test problems were rather routine and traditional, and were somewhat unsuitable for investigation of higher order thinking skills. There were doubts as well about the small-scale studies because the conclusions were rather dubious due to the small data base. (Bracey, 1993, 1996, 2000; Jaeger, 1992; Rotberg, 1990; Wong, 1996, 2001).

A number of educators hold reservations about these large scale comparative studies and were vigorously critical of them (Atkins & Black, 1997; Bracey, 1998). Keitel and Kilpatrick (1999) observed that people involved in these large comparative studies often ignored challenges to the rationality of these studies by claiming that they were well designed by leading educators and scientists. They also concluded that while Schmidt et al. (1997) employed very complicated methodology in the Curriculum Analysis Study under TIMSS, there are no real outcomes of their study. Ellerton and Clements (2000) also queried and challenged the fundamental assumptions by the designers of TIMSS that the translation of an English-language mathematics test to other languages produces equivalent tests.

There were certainly a good mixture of contrasting views by educators regarding the usefulness and validity of these international comparative studies such as TIMSS. Nevertheless TIMSS had established a common ground for comparison across nations, and is a starting point for large scale education comparison in this globalization era.

## **2.4 A review of some research outcomes after TIMSS testing**

The outcomes of cross-rational comparative studies generally conclude that the Asian students put up a better performance than their western peers. This conclusion has been further endorsed in other large scale international studies such as TIMSS where the Singaporean students ranked top in both mathematics and science performance (Keys, Harris & Fernandes, 1996 & 1997).

The results extracted from TIMSS mathematics testing are tabulated in Table 2.2 to illustrate the ranking of a few countries involved in my research area as well as that of USA. The countries listed in the table, Australia and Singapore, were the key countries in my study, and the USA, a superpower in many fields, was included in the table as a benchmark for relative standing of the countries in the testing. The other countries in my study, Brunei and China, did not participate in TIMSS, which accounts for their omission from the table. Other participants such as Hong Kong and Taiwan have similar backgrounds to China and were among the top scorers in the study, however their data was not incorporated in the table as I did not see the relevance of their inclusion.

Table 2.2 *Extract from the results of TIMSS and TIMSS-R testing on overall performance in Mathematics Achievement for eighth graders*

Country	1995		1999		2003	
	Score	Ranking	Score	Ranking	Score	Ranking
Australia	530	16 <sup>th</sup>	525	17 <sup>th</sup>	505	12 <sup>th</sup>
Singapore	643	1 <sup>st</sup>	604	1 <sup>st</sup>	605	1 <sup>st</sup>
USA	500	28 <sup>th</sup>	502	18 <sup>th</sup>	504	14 <sup>th</sup>

Source: The data was abstracted from the Third International Mathematics & Science Study–Repeat TIMSS-R 2003 report published at the web-site [www.aip.org/statistics/trends/reports/timss.htm](http://www.aip.org/statistics/trends/reports/timss.htm)

It is worth noting that countries in the Asia-Pacific rim included in my research, barring Brunei which did not participate, performed consistently better than their American peers. This observation is highlighted to bring to attention the rather substantial number of comparative studies between US and other countries, whose findings may be extended to correlate with the curricula in my study based on their standings in large scale comparative studies. Similarly, information and outcomes of comparative studies may be connected and extended to cover the participating countries based on their standing in TIMSS or other large scale studies against that of well-researched countries such as the USA.

The success of Singapore students attracted much attention from researchers worldwide who looked for viable explanations for the Singapore students' continuing success in TIMSS. Many have turned to the Singapore mathematics curriculum and textbooks for answers. An article in the Singapore newspaper The Straits Times claimed that mathematics textbooks used in Singapore provided students with a firm

grasp of the subject (Quek, 2000). In the United States, a number of educators had been promoting the use of Singaporean textbooks in the schools in many states, such as Colorado, Illinois, Maryland and New Jersey (Fan & Zhu, 2000). The feedback from schools adapting these Singapore textbooks was: “both teachers and students seem to like the textbooks, especially the problems and the explanation for the solutions presented in the texts” (Viadero, 2000). An article from [www.channelnewsasia.com](http://www.channelnewsasia.com) highlighted the achievement of Singapore students in TIMSS, as well as mentioning a Stanford University study which reported that students in US schools where the Singapore mathematics textbooks were in use, were obtaining better grades (Channelnewsasia.com, 2004).

One example of international interest in the Singapore mathematics curriculum kindled by Singapore students’ performance in TIMSS was in the form of a report by Adams et al (2001) on a project undertaken by a group of professors, lecturers and Ph.D. students from the Department of Applied Mathematics in University of Washington. The Adams Report began its introduction with the following statement highlighting the impact of TIMSS testing outcome;

“In the mid-nineties, the mathematical community in the United States was severely shaken by the results of TIMSS – the test performance of our students dropped from mediocre at the elementary level through lack lustre at middle school and down to truly distressing at the high school level.”(p. 1)

The aftermath of the TIMSS report led to the obvious key question in the Adams Report: “How do Singapore’s texts compare with the books which have been designed since the early nineties in the United States, books that represent the direction of the current thrust in American mathematical education?” (p. 1). The team undertook an investigation of the Singapore curriculum and textbooks, and compared them with two US curricula, namely the Connected Mathematic Program (CMP) and Mathematics in Context (MIC). The key question was “to what extent is the Singapore curriculum aligned with the National Council of Teachers of Mathematics (NCTM) standards and principles?”

It is worth reiterating that the study based its analysis and comparison of the three curricula on the yardstick as set in the standards and principles defined by the NTCM. The findings from the Adam's Report covered a wide range of issues and discussed the strengths and weaknesses of the three curricula. There were obviously many strong points about the Singapore curriculum, and some, not all, of the key traits that were found wanting in the Singapore curriculum are summarised below. The mention of just the "perceived shortcomings" was by no means trying to project a biased picture of Singapore curriculum, as in the way of taking things out of a context, but to outline a perspective of the curriculum from a group of researchers who considered these qualities, or the lack of them, worth repeated highlighting in their scrutinisation of the Singapore curriculum.

- While the mathematics in Singapore's curriculum may be considered rigorous, we notice that it does not often engage students in higher-order thinking skills.
- When we examine the types of tasks that the Singapore curriculum ask students to do, we see that Singapore's students are rarely, if ever, asked to analyze, reflect, critique, develop, synthesize, or explain.
- The vast majority of student tasks in the Singapore curriculum are based on computation, which primarily reinforced only the recall of facts and procedures.
- This bias towards certain modes of thinking may be appropriate for an environment in which students' careers depend on the results of a standardized test, but we feel it discourages students from becoming independent learners.
- Furthermore, we believe that Singapore's curriculum does not adequately recognize that students have a wide range of learning styles.

- For example, Singapore's curriculum does not recognize that some students learn better through guided discovery than a direct presentation of concepts and procedures.

The Adams Report offered a different perspective from those researchers who considered the Singapore textbooks were good enough to be transported into the American classrooms. Its findings cautioned against adopting the Singapore textbooks into the American schools, as expressed in the statement: “Simply adopting the middle grades Singapore curriculum is not likely to help American students move to the top ...” It also included in its conclusion the following statement about the testing conducted by TIMSS;

“On the other hand, we doubt very much that any test, no matter how well designed, can accurately test creativity and independent thinking, qualities which the new America curricula such as CMP and MIC strive to foster.” (p. 51)

The above discussion portrayed the diversity in education – what drives the Singapore curriculum might not be what the Americans are looking for. To adopt the saying: “one man’s meat is another man’s poison” was perhaps not quite fitting in describing the scenario, but the gist of the meaning was clearly rather appropriate.

## **2.5 Checking the originality of my study**

After reviewing the various papers on research centered on comparative studies of mathematics curricula and textbooks, an area which was largely neglected until recent years, the literature review brought to light the various textbook evaluation approaches and the intended outcomes; it also shed light on the gaps in this area of study on which new research could focus. It was found that much of the past research work had been focusing in countries outside the Asia-Pacific rim, except perhaps China and Singapore. Hence my research on comparative studies of textbooks in the Asia-Pacific rim was not replicating other research, and the study outcomes might offer some refreshing views on an area in education research which had grown in significance and importance to many groups of people.

It was a well known fact that: “what student learns depends heavily on the teacher. Different styles of teaching bring out different kinds of learning and produce different possibilities for non-learning” (Adams, et al, 2001). Yet it was also well established in past research findings that the textbook plays a very prominent role in the teaching and learning of mathematics, and it influences what and how a teacher teaches a topic in class. Another conclusion established in past studies is the significant role the textbook plays as an effective expression to the implemented mathematics curriculum, which constitutes a critical component of the student’s education. Consequently, many comparative studies on the mathematics curriculum based their analyses on the textbooks used, which is what this study focused upon.

The participating countries for TIMSS had to nominate a text that best represented their nation when they had more than one set of textbooks in use in the country, usually that choice was the most widely used textbook. In Australia, where instead of a national curriculum the country has, in its place, a curriculum statement and a profile providing guidance to the mathematics standard and principles, and different textbooks are used in different states and schools. The chosen text was definitely not considered to be the representative textbook of the nation. For this reason, the TIMSS report would not have information on some textbooks not selected to take part in TIMSS, though they were in use. Brunei did not join in TIMSS, therefore any information on the Brunei mathematics or science curriculum or textbooks in use was not available. To this end, the study hoped at least to partially fill this gap. The content of this section will be discussed further in Chapter 3.

TIMSS collected a wealth of data for its enormous comparative curriculum analysis project by scrutinizing textbooks for the fourth, eighth and twelfth grade in over forty countries. Other large scale international studies such as FIMS, SIMS, IAEP1 and IAEP2 also took similar approaches to build up their database. The present study differed from these and other comparative studies by tracking the complete three year Lower Secondary programmes. The findings would offer greater detail especially in charting the comparison of the learning progression of the topic content across the curricula.

Going back to the origin and aim of my study, it would be pertinent to conclude that the objectives which this study set out to achieve were attainable through the research path designed for this study, and the findings would be of value to the researchers and educators interested in this aspect of comparative studies in mathematics education.

## **2.6 Summary**

The research on mathematics curriculum and textbooks was somewhat neglected until two decades ago, when globalisation moved people outside their home country and brought different nationalities closer with the consequence that one no longer expects the classroom to cater for just one single nationality. There has arisen a need to know about other curricula, and the healthy competitions organised to test the mathematics and science knowledge among nations stimulated many comparative studies, looking at different curricula and textbooks. These comparative studies offer an insight to the different curricula and provide an idea of the mathematics education of other countries. This relatively new research area brought forth an aspect of mathematics education that draws the interest of not only the people in the education field, but one that also attracts the notice of the general public, as portrayed by the much publicised international competition such as TIMSS, which was considered newsworthy.

The review in previous sections has indelibly established the bridges connecting the intended mathematics curriculum, implemented curriculum and textbook, in that most textbooks reflect the intended curriculum, and standards and principles influence the implemented curriculum in classrooms. This study aimed to make a contribution to fill in a little of the unexplored component of this research area. The next chapter presents the methodology employed in this study and provides details on the research design, two-way approach in data collection and analysis, and ethical considerations.

## **Chapter 3**

### **Methodology**

#### **3.1 Introduction**

This chapter describes the research questions and the methodology used in this study. It includes a description of the administration of the teachers' interview questionnaire, the process related to data collection and analysis, and specific ethical considerations.

The study centers on the analysis of the lower secondary mathematics curricula of four countries on the Asia-Pacific rim with particular attention paid to the textbooks used. The research focuses on the extent to which these curricula differ in their textbook content over three consecutive years and identifies the characteristics of the mathematics programs, with a view to answer some of the issues arising from an increasingly multi-cultural mathematics classroom. The research questions are structured as foci to these issues and are discussed more fully in the later sections.

The methodology adopted a two-way data collection approach to provide an extensive database, which includes a detailed analysis of the textbook content as well as the teachers' interview information. The textbook content is the main bulk of data collection and is complemented by the teachers' interview data that represents the view of key stakeholders of the mathematics curriculum, and underpins the user group's perception of the subscribed textbook.

#### **3.2 Research Questions**

This study is comparable to past comparative studies that investigate a single, or multiple issue(s). Hantrais and Mangen (1996) claim that the choice of a comparative enquiry is important, in the sense that cross-national comparisons are perceived to help to sharpen the focus of analysis by suggesting new perspectives. The focus of this research was to structure a comparative study across nations aimed at gaining an insight into the various mathematics curricula based in the school

textbooks used, and seeking an outcome to address issues arising from a multicultural learning environment.

With the increasingly popular trend of students studying abroad and consequently creating classrooms that have become progressively more multicultural, there are certain issues arising leading to a need to know the curricular background of the expatriate students. This study will hopefully be beneficial to different groups of stakeholders ranging from those in the school environment, such as the students, parents, teachers and administrators, and others such as curriculum planners, textbook writers, educators and researchers.

A list of six research questions was formulated to help shape this comparative study. Following each research question, the main source of the data base in this study is cited with a brief description on how the findings relate to the discussion and analysis of the textbook content.

**1. For each country, what is the strand weighting for each level and for the whole lower secondary mathematics programme?**

The topics in the textbooks' contents were differentiated into five strands: Number, Measurement, Space, Chance and Data and Algebra. The National Council of Teachers of Mathematics (NCTM) Curriculum Standards (1989) also listed other strands as well that include mathematics as problem solving, communicating, reasoning, connections and structure. In the Australian Curriculum Statement (1994), there is an additional strand "Thinking Mathematically" which consists of problem solving approaches and strategies on topics source from the five basic strands. Taking into considerations that most of the textbooks reviewed divided the contents into the just five strands and incorporated problem solving, simulation etc under the basic umbrellas, similarly the "Thinking Mathematically" strand content found in some of the Australian textbooks was re-grouped under the five strands for equal comparison across the nations. The process aspect of the study of mathematics is incorporated under the content of the five basic strands.

This content break-down was recorded on an Excel spreadsheet and sorted according to level to provide an overview of the lower secondary mathematics curricula based on the textbooks used (See Appendix A). The information was used to calculate the strand weighting for every level and for the three year lower secondary programme. The strand weighting was calculated by dividing the number of pages devoted to a particular strand by the total textbook content pages. The objective was to identify the emphasis of individual textbook and curricular programme and enable a cross comparison for the curricula to be made in terms of identifying the emphasis of the content and the strand.

## **2. What are the differences and the similarities of the students' expected mathematics knowledge in these countries based on their yearly progress?**

The main objective of this research question was to provide an insight into the students' expected progress. To achieve the objective, the path of a particular topic in a strand was tracked and its progress charted on a timeline through the three years for each curriculum. This information was used to determine how the textbook content is organised in terms of the timing of a particular topic in the curricula, which can be used to determine students' expected knowledge at the particular level and facilitates comparisons across curricula. The data is tabulated for easy comparisons of their similarities and differences across curricula (See Appendix B). The analysis and discussion of these raw data is reported in Chapter 4.

## **3. How do individual topics and strands featured in the textbooks vary through the various levels and at what depth and width?**

This question sought to examine and evaluate a topic or strand in detail in terms of its depth and width throughout the programme. It is an extension of the first two research questions, and plays an important role in further exploring a particular topic in the curriculum. A set of data developed from Appendix B, but including more individual topic details, was compiled and tabulated for each individual strand. The data collected provides a wealth of information for a particular topic or strand and by charting them on the same timeline, highlights the variations across the curricula and

facilitated convenient extraction of information. The data was sorted according to the strand and recorded accordingly (Appendix C); its analysis is documented in Chapter 4.

#### **4. What are the strengths and weaknesses, as well as the exemplary characteristics, of the textbooks?**

This question aimed to highlight the curriculum characteristics and to underline the outstanding features of the textbooks. The main source of data was the textbooks as a complete package. They were scrutinized to flesh out any individual traits of the curriculum as well as any cultural influences portrayed in the books. The discussion is reported in Chapter 4.

#### **5. What are teachers' opinions on the textbooks used?**

A set of questionnaire items (Appendix D) was designed to solicit teachers' opinion on the textbooks used. The interviews aimed to provide an alternative perspective to an otherwise purely textbook-content based study in that the views of the teachers, who were the key user of textbooks, would be incorporated into the study to complement the data from the textbooks (Guba & Lincoln, 1989). The teachers' responses are discussed in Chapter 5; and the transcripts of the responses appear in Appendix D.

#### **6. What useful information can be passed onto teachers and administrators of expatriate students as a result of this study?**

This information sought to highlight the important differences in the various curricula so that the teachers and administrators are better prepared in dealing with the expatriate students. The outcome of this study should benefit the teachers and administrators of expatriate students in two ways: firstly in providing detailed information on the other curricula so that they are better informed; secondly the sentiments expressed by the teachers as recorded in the teachers' interview should also shed some light on the views of teachers from a different country, which provide a useful insight from outsiders of different backgrounds. Overall, the bulk of

information in this study should be helpful to both the teachers and administrators of expatriate students.

### ***Summary***

Research questions one to four aimed to explore the text content and are a significant part of this study relating to the textbooks, while research question five investigates the teachers' opinion on textbooks to provide the users' perspective of this study. Research question six will furnish the teachers and administrators of expatriate students with specific information with regard to foreign curricula, thus assisting in identifying areas of concern in the course of teaching mathematics to the expatriate students. The data collection and analysis procedure described in this study will hopefully also be used by teachers as a process to investigate unfamiliar textbooks with the purpose of identifying the students' mathematics ability.

### **3.3 Research design**

Having decided on the research area (see Chapter 1), the next phase was to design the research framework which outlined the scope of work for data collection and analysis. It was imperative that the data collection scope be correctly defined so that the subsequent analysis based on the data collected would point in the right direction for addressing the research questions.

Recent development in research methodology, where complementary elements are taken from different research paradigms, leads to building an extensive and rich data base (Greene, 2001). Tobin and Fraser (1998) in their discussion on the learning environment, state that the combination of quantitative and qualitative data is seen as a way to "maximise the potential of research". Guba and Lincoln (1989) define a newly developed evaluation technique, named the Fourth Generation Evaluation, as quoted below;

"As an emergent but mature approach to evaluation that moves beyond mere science – just getting the facts – to include the myriad human, political, social, cultural, and contextual elements that are involved.... This form moves beyond previously existing generations, characterizable as

measurement-oriented, description oriented, and judgment-oriented, to a new level whose key dynamic is negotiation.” (p. 8)

As opposed to the more traditional or conventional evaluation paradigm, this approach takes into account the viewpoints and constructions from the stakeholders in their evaluation procedure; where

“Constructions represent the efforts of people to make sense out of their situations, out of the states of affairs in which they find themselves. They are interpretations based primarily on experience – to ‘see it with my own eyes’ or to ‘hear it with my own ears’ is the best evidence that anyone can muster to demonstrate to him or herself the validity of his or her own constructions.” (p. 70)

To apply this recent development in research methodology, it was necessary to recognise the importance of input from the key stakeholders, who in this case were the teachers. Information from data collected through interviewing teachers on their opinion on textbooks was incorporated into this study to complement the data collected on textbook content. In due respect, two steps were identified as being essential in the data collection agenda. The first step was to select the curricula and textbooks which were the main resource for the bulk of the data collection. The second step was to design a questionnaire with which to interview the teachers on their viewpoints about the textbooks they used. The subsequent sections describe the deliberations and decisions made during these two data collection steps.

### **3.4 Criteria for selecting curricula and textbooks**

There were four questions to consider when selecting the curricula and textbooks: (1) On what basis were the countries to be selected for this comparative study? (2) What were the education systems in these countries? (3) What textbook level was to be selected? (4) What features were to be selected in choosing the textbooks in countries without nationally assigned textbooks?

Considerations given to the above factors help to finalise the textbook list which is described in a later section.

### **3.4.1 Selecting the countries**

Due to economic and demographic changes, there is a high degree of person mobility in the world, resulting in increasingly multi-national classrooms, especially in the Asia-Pacific region. To cite an example, the Principal of the Australian International School (Singapore) in his 2005 welcome address published in the AISS newsletter (Appendix E - The Australian International School Singapore newsletter dated 20 January 2005) mentioned the cultural diversity in the school with students from 40 different countries enrolled. The biggest group came from Australia and New Zealand, followed by Asian students such as Singaporeans, Chinese, Koreans, Japanese, Indonesians and Malaysians, then Europeans as well as Africans. This diversity in student nationality is not an exclusive phenomenon in the Australian International School; it applies to other schools in the region as well. The consequence of this diversity is a multi-cultural classroom with students from varied education backgrounds, and where school administrators and teachers are required to perform the unfamiliar task of assessing the expatriate students' past learning and so on, as discussed in Chapter 1. It follows that a comparative study of the curricula used throughout the Asian-Pacific rim will be of value to a relatively large group of people.

The literature review of related research showed that while there are a large number of comparative studies involving the US curriculum; there is relatively little or no literature on the Australian curriculum. This study aims to fill some of the gap in past comparative studies and in areas which have not been investigated. Australia is one of the largest education exporters in the world. Revenue from foreign students represents the country's fourth largest export earner and is worth more than the traditional exports of wool and wheat combined – as reported in an article by [www.channelnewsasia.com](http://www.channelnewsasia.com) on 17 September 2005, (Appendix F - Channelnewsasia.com article titled “Australia wrongly cancels visas of up to 8,000 international students”). Selecting the Australian curriculum for this study was an obvious and sensible choice, as information on the Australian education system is

useful to the many international students it attracts, and people in the system also benefit from learning about other curricula in this multi-racial learning environment.

With the Australian program chosen to be the key curriculum in my study, the main selection criterion for curricula from other countries in the Asia-Pacific region was based on the textbook language. The textbooks for Singapore/Brunei and China are written in English and Chinese respectively, hence analyzing these textbooks presented a minimal language barrier for me as I am proficient in both languages. The fact that these countries have a high student population outside their countries in the Asian Pacific region was an important consideration for including them in the study. Indonesia and Malaysia, as well, have a high student population in the area, but their national mathematics text is in their national language. My proficiency in the Indonesian or Malay language is mediocre; thus it was not advisable to include in this study the textbooks from these countries in case of misinterpretation or misrepresentation.

The consequence of much research on these multicultural classrooms is a heightened awareness within the mathematics education community that mathematics is culture-laden (Bishop, 1994; D'Ambrosio, 1985; Gerdes, 1996). While I had made my home in Brunei, Singapore and Australia in the past and had adopted much of the social and cultural outlook of these countries, I have the least exposure or contact with the social and cultural aspect of China. Consequently, there may be a small disparity between my interpretation of the mathematics textbook content and those of the Chinese teachers and students from a social cultural perspective. However, with the Chinese language being my mother tongue, every conscious effort was made to ensure the discrepancy did not affect or distract from the accuracy of the interpretation of content matter.

Finally, Brunei is a very young country that had gained its independence from the British government in 1982. It has not participated in any of the large-scale international comparative studies such as TIMSS and IAEP. I am a Brunei citizen and an education officer with the Brunei Ministry of Education and feel I should, by way of contributing positively to the education field in Brunei, include Brunei in my study. By means of this comparative study between Brunei, and the other three

countries which are the frequent participants in many international competitions and comparative studies, I aimed to shed some lights on Brunei's standing in the mathematics education field, and the findings of my study may aid in identifying the strength and weakness of the mathematics curriculum for future reference and development.

### **3.4.2 Curricular background**

A brief description of the countries' school systems is an appropriate inclusion to complete the curricular picture of the countries for the reader interested in knowing more about the countries' school system set-up. This section also explains the choice of textbooks in more detail.

#### **The Australian education system**

Australia has no uniform curriculum for the entire country; however the Australian Education Council (AEC, 1994) undertook a national collaborative curriculum development project and produced a series of documents describing the profile and statement of each of eight major learning areas. Information from the product of the project (Curriculum Corporation, 1994) on mathematics is outlined in the statement which is used as a framework for curriculum development by education systems and schools in the various States. The profile is designed to assist in improving teaching and learning and to provide a common language for reporting student achievement.

The curricular statements do not produce a syllabus and are designed to encourage innovation and experimentation so that students have a positive experience of each learning area. Different states follow their own curricula. The variation in the curricular setup is reflected in the rich array of textbooks used within the country. For examples: in Victoria State, secondary schooling starts from Year 7 while in the State of Western Australia Year 7 is within the primary school system. Both states have a Year 12 public examination under different Year 12 Examination Boards prior to university entrance. As in Western Australia, Queensland starts secondary schools from Year 8. However, it does not have a Year 12 public examination prior

to university entrance. Instead, it has a process of school based assessment moderated by a Year 12 Core Skills test.

### **The Brunei curriculum**

The Brunei government is investing heavily in education, aiming to build a task force capable of positive contributions to the nation. Education is free for the Brunei citizens up to the tertiary level, and local university students receive a monthly allowance to subsidise their study expenses. It has a national curriculum with government designated textbooks for most subjects in schools. Mathematics is an important core subject in school and is compulsory for all students up to Fifth Form level. The total secondary education process usually takes seven years, from Form 1 to 6, prior to tertiary education for the better ability students. It entails five years of compulsory education from Form 1 – 5 studies leading to the Cambridge G.C.E. ‘O’ level examination; and two year of Sixth Form studies when students take the Cambridge G.C.E. ‘A’ level examination.

This study focuses on the Form 1 – 3 curriculum which covers the period of study aiming to prepare students for the Lower Secondary Examination (PMB), the results of which are used as the criteria for students’ progression in the school. Depending on their PMB results, students are retained at Form Three level or promoted and streamed into the ‘O’ or ‘N’ Level course of study at Fourth Form level. The ‘O’ Level course prepares the students for the Cambridge G.C.E. ‘O’ level examination, while the ‘N’ Level students sit for the ‘N’ Level public examination under the Brunei Examination Board. The ‘N’ Level candidates who have performed well may then enrol for an additional year of study prior to taking the Cambridge G.C.E. ‘O’ level examination; many opt for vocational study as the end of the ‘N’ Level course.

### **The school system in China**

In China, students undertake six years of Primary education before entry into the “Middle School” for their Secondary education. The “Middle School” consists of three years each for ‘lower middle school’ and ‘upper middle school’, and is

equivalent to the secondary education in most countries prior to tertiary education. The 'lower middle' school years coincides with Year 7, 8 and 9 while the 'upper middle' the Year 10, 11 and 12. Students sit for a public examination at the end of the 'lower middle school' before promotion to 'upper middle school'.

### **The Singapore school system**

As in other countries, students in Singapore undergo six years of Primary education prior to taking an assessment examination to determine their entry point into the Secondary schools. They are streamed into the Special, Express, and Normal streams in Secondary schools based on their examination results, needs and abilities. Statistics provided by the Ministry of Education (1999) stated that about 60% of the students take the express and special course, which covers a total 4 year period preparing the students for the Cambridge G.C.E. 'O' level examination while the remaining 40% are the Normal stream student who will take 5 years to reach the same milestone examination. Secondary education for the express students lasts a total of six years including two years of 'A' Level study.

#### **3.4.3 Decision on choosing the curriculum level**

Past research on human growth has identified different stages of development in the human cognitive mind. Dacey (1989) describes six peak periods of human creativity growth during a person's lifespan and identifies that the first three of such important periods coincides with a students' schooling period and the preschool. The 10- to 14-year-old period in particular is an important growth period when students are seeking to define their self-concepts and are open to new ideas as they intensify their identity search. Some researchers also discovered a marked change in the problem solving strategies during this particular period when the students' strategies become more systematic and logical (Days, Wheatley & Kulm, 1979; Hembree, 1992; Yudin & Kates, 1963). Other researchers also found that the difference in cognitive growth is greater between the teenagers and younger children than between teenagers and older children who have higher memory and cognitive levels (e.g., Moely, 1977; Ornstein & Liberty, 1973). The conclusion of these findings implies that the teenage children are in their prime intelligence state and that the teenage period is the optimal period for learning.

Based on the past research findings, this study focused on the school curriculum for the 10- to 14-year-old. Most countries have a tiered school system and the lower secondary school-years coincide with this particularly important period in the students' lives. Consequently this study focused on examining and analysing the lower secondary curriculum and textbooks of the chosen countries.

By tracking the lower secondary programme for three consecutive years, this study offers a variation to past comparative studies which have taken the approach of selecting a few different (non consecutive) curricular levels for their analysis. For example, TIMSS investigates the fourth, eighth and twelfth grades; other large scale international studies, such as FIMS, SIMS, IAEP1 and IAEP2, adopt similar approaches to TIMSS in their data collection. In the present study, the lower secondary school programme represents the Year 7 - 9 in Australia, Form 1 - 3 in Brunei, Sec 1 - 3 in Singapore and 'Lower Middle class' in China which is Year 7 - 9, and textbooks for these level form the main data base for analysis.

#### **3.4.4 Selection of textbooks**

Both Singapore and Brunei subscribe to a national curriculum and the MOE approved textbooks are in use which made the choice of textbooks in these countries a straightforward decision. For Singapore, the selected school textbooks were chosen for the first three years of the Express course of study because this group of students are the same age group as the year 7, 8 and 9 students from other countries. Brunei Education Ministry adopts a series of mathematics textbooks from the Singapore education curriculum developed by Singapore Ministry of Education for the Singapore normal stream mathematics curriculum. The Singaporean normal stream students take 5 years to complete the course preparing them for the G.C.E. 'O' level examination in Singapore. The series of textbooks consists of ten books with two books per school year catering for Form 1 – 5 in Brunei. Books for Form 1 – 3 were selected for this study.

Similarly, China subscribes to a national curriculum with a few approved textbooks in circulation in the countries. Generally there is not much variation in the textbooks as they follow the syllabus prescribed in the national curriculum set by the

education ministry. For this study the Shanghai Textbook were selected to represent the Chinese curriculum as the colleague who provided the textbooks lived in Shanghai. The selected Chinese textbook series is for the 'lower middle school' in Shanghai. This series consists of two books for each school year giving a total of six books spanning over three years of lower secondary school education.

An important point to note is that some countries without a uniform national curriculum have more than one set of texts in use. For their participation in TIMSS, these countries had to nominate a textbook which best represented their nation, which was usually the most widely used textbook in the country. Australia is one of these countries where different textbooks are used in different states and even within the same state. It is indeed not easy choosing a textbook from such a varied pool of resources and is even more difficult finding one which is suitable as the representative textbook of the nation.

To reflect the diversity of curricula between different states in Australia, textbooks were selected from the State of Victoria and Western Australia. The main reason for this selection was that both states have high expatriate student populations and their curricula are vastly different: WA begins its secondary education at Year 8 level whilst that in Victoria commences at Year 7, though both take the students to Year 12 prior to university entrance.

To further investigate the variation in the Australian education system, a textbook from a private school in Victoria was selected. This move aimed to add details to the tapestry of Australian curricula by providing a comparison between the mathematics curriculum of a state school and a private school, as both sets of books in these schools subscribe to the same set of parameters governed by the locality and examination body.

#### **3.4.5 List of selected textbooks**

Summarising the above discussion, this study undertook an examination of a total of six sets of textbooks, among which were three sets of textbooks from Australia and one set each from Brunei, Singapore and China. The Australian textbooks selected

are currently in use in Rossmoyne High School (in Western Australia), Balwyn High School (in Victoria) and Presbyterian Ladies College (in Victoria) where all these schools and college have a relatively high foreign student population. These textbooks are used in some other schools as well. The textbook list appears in Table 3.1:

Table 3.1 *List of school textbooks selected for this study*

<p><b>The Australian Textbooks</b></p> <p><u>Balwyn High School, Victoria</u></p> <p>Year 7 - Essential Mathematics 7 – The CSF II course By P. Cribb, D. Robertson, G. Sotiriou, V. Sotiriou &amp; E. Waud. Publisher: Cambridge University Press.</p> <p>Year 8- Essential Mathematics 8 – The CSF II course By P. Cribb, D. Robertson, G. Sotiriou, V. Sotiriou &amp; E. Waud. Publisher: Cambridge University Press.</p> <p>Year 9 - Outcomes Mathematics 9 CSF II Edition By David Coffey et al. Publisher: Heinemann</p> <p><u>Presbyterian Ladies College, Victoria</u></p> <p>Year 7 - Maths for Vic 7 By Ian Bull, Bob Howes, Karen Kimber, Caroline Nolan &amp; Kimm Noonan. Publisher: Pearson Longman.</p> <p>Year 8 - Maths 8 for the CSF By B.J. Lynch, R.E. Parr, H.M. Keating, &amp; L.P. Picking. Publisher: Longman.</p> <p>Year 9 - Maths 9 for the CSF By B.J. Lynch, R.E. Parr &amp; H.M. Keating. Publisher: Longman.</p> <p><u>Rossmoyne High School, WA</u></p> <p>Year 7 - This level is under the Primary Education, hence is excluded from the study.</p> <p>Year 8, 9 - Understanding Mathematics – A resource series for West Australian Secondary School by A. J. Sadler Publisher: Sadler Family Trust</p>
<p><b>The Brunei textbooks</b></p> <p><u>Brunei Secondary School</u></p> <p>Form 1, 2, 3 - Secondary Mathematics (2<sup>nd</sup> Edition), Curriculum Planning &amp; Development Division, MOE, Singapore</p>
<p><b>The China textbooks</b></p> <p><u>Shanghai Secondary School</u></p> <p>Year 7, 8, 9 - Math Texts for the 9 Year Education System, Co-Publishers: Shanghai Education Publisher &amp; Century Publisher, China.</p>

**The Singapore textbooks****Secondary Express Stream**Sec 1, 2, 3 - New Syllabus Mathematics (5<sup>th</sup> Edition) By Teh & Looi.

Publishers: Singlee Pte Ltd, Singapore

### **3.5 Teacher interview**

Results from the TIMSS 2002 study indicated that in Australia, 5% of year 8 mathematics teachers did not use a textbook at all, and that about half the year 8 teachers use a textbook as the main lesson resource (Thomson & Fleming, 2004). In other words, 95% of the Year 8 teachers use textbooks and among them 50% of the teachers' main resource is the textbook. Taking into consideration this information as well as that from past research findings discussed in Chapter 2, it can be asserted that teachers are the main user of textbooks; consequently they are the key stakeholders of this comparative study on textbooks. Guba and Lincoln (1989) advocate the need to incorporate the constructions of stakeholders into the evaluation process. In this case the opinion of teachers regarding textbooks was essential to support the study. As a result, a set of questionnaire items (Appendix D) was designed to investigate teachers' opinions. The subsequent sections discuss the questionnaire and the interview procedure.

#### **3.5.1 Questionnaire for teacher interview**

Due to the fact that the textbooks are sourced from different countries, to conduct face-to-face interviews with teachers in these countries would have been an expensive and time-consuming exercise on top of being one that requires much effort in the preparatory groundwork. Facilitating such interviews would involve obtaining permission from the school and the teachers, or even higher authority, arranging meeting venues, scheduling appointments, booking the air flight and accommodation as well as arranging on-location transportation. In view of these factors and the fact that I did not have any local contacts in these countries to assist or advise in the facilitation of these arrangements, it was deemed sensible to conduct the teacher interview through an interviewing questionnaire via the post.

The questionnaire was designed with two main objectives in mind: first to gather some information on teachers' background in terms of their experience, qualifications, present duties and responsibilities as well as their teaching techniques, and second to solicit teachers' opinion on four main areas – the textbook content, textbook as a teaching tool, textbook as a learning tool and international students joining the class. Taking into consideration the busy routine of a teacher's working life, the questionnaire was arranged in an easy-to-answer format which consisted of six printed pages of five sections of short structured questions such that the participating teachers would not find answering the questions too time consuming. However, space on the form was also made available for teachers who wished to express themselves in more detail.

### **3.5.2 Comments on the questionnaire**

Whilst designing the questionnaire, it was felt that teachers' background was vital in this data collection as their comments are strongly substantiated by their past experience which relates to the number of years of service. A senior teacher may have a set of opinions different from that of a young teacher, but both sets of opinions are equally important as they are both portrayals of the textbook users' perceptions, albeit with different background experiences. Therefore the first category of items was devoted to collecting information on the teacher's background.

Categories 2, 3 and 4 were structured to solicit teacher's opinion of the textbook content and its usage as a learning and teaching tool. All three categories have "Any other comments" to cover areas deemed important but not listed in the short questions.

The question in category 3, "Do you have enough curriculum time to complete the text content?" was important as the study based much of its comparisons on the assumption that textbook content was covered.

The question in category 4, "There are reflections / feedback from teachers teaching higher-level mathematics regarding the need to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills /

strands involved.” aims to check on the continuity of mathematics learning. Since mathematics is hierarchical, a practical use of textbook is to prepare pupils to move on to the next stage of learning. From personal experiences, I had come across some ‘A’ Level mathematics students in Brunei who did not take Additional Mathematics at ‘O’ Level needing extra tuition as they lacked the basic introduction to some of the ‘A’ Level topics.

The final category sought teachers’ opinion on the expatriate students as they do have first hand knowledge on teaching these students. It was an open format without guiding short questions to allow free responses from teachers.

In summary, the questionnaire covered many important objectives that a face-to-face teacher interview might achieve for the purposes of this study.

### **3.5.3 Inviting teachers for interviews**

It seemed logical to invite teachers who used the selected textbooks to participate in the interviews. The Australian textbooks are in used in Balwyn High School, Presbyterian Ladies College and Rossmoyne High School, and the Year 7 – 9 teachers in these schools (Year 8 – 9 for Rossmoyne High School) were invited to answer the questionnaire. In Brunei, teachers from a private school and a government school that caters for better ability students were invited; whilst in Singapore, the Raffles Girls School and Raffles Institution for boys were also invited to participate. All teachers invited for interview were from schools with good academic standing in their countries. This was a deliberate choice aimed at reducing the effect of the learning environment on teachers’ opinions, and it effectively eliminated the need to consider another parameter caused by the disparities of the learning environment in this comparative study.

No teachers in China were invited to participate in this questionnaire due to several reasons. First I had reservations about conducting questionnaire interviews with the Chinese teachers using a written language that is not their speaking and teaching language. The data collected might have contained an element of inaccuracy because of misinterpretation of both the questions and the responses. Second, I was not sure

how involved the procedure was for interviewing teachers in China. The bureaucracy in the country may have required multiple levels of approval before permission was granted. Third, I did not think there were many expatriate students in the Chinese classrooms at that level. In conclusion, I believed that omitting the Chinese teachers in these interviews may have represented a gap in my data collection, but it was a better alternative than collecting “doubtful” data.

### **3.6 Data collection**

Data was collected from textbooks and interviews. The textbook data was collected solely from the list of books selected and reorganised into a format that enabled easy extraction of information, while the interviewing data was collected using a set of interview questions through the post. The following sub-sections describe the data collections in detail.

#### **3.6.1 Textbook data collection**

The research questions were used as a beacon to lead the direction of data collection in order to facilitate this comparative study. The raw data collection was performed in four stages. First, it was crucial to have an overview of all the textbooks set up in a format from which it was easy to extract information, and the Excel spreadsheet provided a convenient support for this information. Textbook content was sorted according to the five basic strands and was tabulated accordingly. The total number of pages for the book and for an individual strand was calculated. This overview is a comprehensive break-down of the textbooks according to the level and is the foundation for subsequent data collected (Appendix A).

Second, the individual strand is further categorised into a few subsets. Each subset embraced similar content matter over the secondary mathematics programme. For example: the Number strand is categorised into five subsets, namely: Whole Numbers; Number Patterns; Fractions, Decimals, Percentages, Rates, Ratio & Proportion; Indices & Standard Form, and Surds. The content matter of the appropriate subset was traced through the programme for all six sets of textbooks. This set of data as appears in Appendix B giving an overview of the strand

organisation, Appendix BA provides a summary of all strands and their subsets, Appendix BB, BC, BD, BE and BF giving details of the subsets for the Number, Measure, Space, Chance & Data, and Algebra strands respectively.

The third stage is a detailed extension of stage 2 where more particulars are added to the strand details, including special features of the books, types of activities, outstanding or unusual worked examples or exercises etc. These exceptional features of the books are noted to add more details for comparisons. This set of data appears in Appendix C, with Appendix CA, CB, CC, CD and CE for the five strands respectively.

The fourth stage consists of the calculations and organisation of these raw data so that the outcomes are relevant for the discussion of research questions raised in the earlier chapters. Section 3.7.1 includes the analysis and formulation of information necessary to address the research questions.

A brief description of the textbook raw data collection would state that it was obtained by fine-combing, sorting and reorganising the content into a format for convenient comparison. It was a lengthy procedure.

### **3.6.2 Teachers' interview data collection**

To facilitate the teachers' interviews, a letter to the Mathematics Coordinator of the school briefly explained my study as well as my intent and this was enclosed with 3 sets of questionnaires for the teachers along with a stamped, self addressed envelope for return postage. This package was mailed in February 2005 to all seven schools. Only four of the seven schools responded to the questionnaire, namely both the Brunei schools, Raffle Girls School in Singapore and PLC in Melbourne. In March 2005 I dispatched another letter to the three non-responding schools to attempt to persuade the mathematics coordinators to return the questionnaires, either completed or otherwise. Regrettably, there was no response from these schools.

In conclusion, the interview data collected was only 57% of the pool of schools invited to participate in the interviews, which was a relatively small subject

population. Some of the planned comparative measures – for example, comparing teachers’ opinion between WA and Victoria, or comparing private and a state school in Australia – had to be abandoned due to a lack of information. However, looking from the more positive angle of this data collection, the interviewing data collected is from schools in Australia, Brunei and Singapore, providing data to support this cross national comparative study.

### **3.7 Data analysis**

This section discussed the analysis of both sets of data from the textbooks and the teacher interviews. The basic data are presented in the following subsections, however, further details and analyses are presented in Chapters 4 and 5.

#### **3.7.1 Textbook data analysis**

As discussed in Chapter 2, several of the comparative studies focus on a particular area for their analysis. For example, Harries & Sutherland (1998) studied primary textbooks with the particular focus on the treatment of number ; Li (1998) compared problems that follow selected content presentations; Cai, Lo & Watanabe (2002) investigated intended treatment of arithmetic average; Haggarty & Pepin (2002) focused on the topic “measuring angle” in Year 7 text; Fan & Zhu (2004) analysed the representation of problem types in the textbooks. These are the various approaches that have been used in evaluating and analysing textbook data.

Shield (2005) describes a four-stage project to develop a mathematics textbook evaluation strategy. The approach was influenced by the methods of Project 2061 (Kulm et al., 2000) whose essence is to “examine textbooks in relation to a set of principles derived specifically for the content in which the material are to be used”. The strategy was to evaluate mathematics textbooks against a set of content specific goals developed using mathematics curriculum principles, syllabus content statements and published research related to content. The topics of ratio and proportion from the “Number” strand are used to illustrate the strategy.

As the main objectives of the present study were vastly different from the intentions of these other studies, the textbook analytical approach would certainly be different

from focusing on specific areas of concern. However, I am in total agreement with Shield (2005) when he says “it is generally impractical and unnecessary to examine in detail the development of every mathematical topic presented in a series of textbooks or even one book”. Indeed it is unrealistic to examine the development of every mathematics topic in the books. Teachers will certainly not have the time for such an ambitious endeavour. The present study involved analysing entire textbooks within the boundary set by the research questions listed in Chapter 1 and did not involve evaluating the textbooks against any curricular principles or syllabi. However, some teachers’ comments from the questionnaire interviews did refer to the constraints of examination syllabus on topic sequence in the course of teaching. These comments are discussed in the later chapters.

### **Coding the textbooks used**

Some of the schools do not use the same series of textbooks for all three lower secondary years, for examples, Balwyn High School and Presbyterian Ladies College. In order to emphasise the point that the textbooks being analysed represent the school mathematics curricula, it is sensible to code-name the books using the abbreviation for school name in order for easy identification of the point that “these books are used in this school”. The codes will be used in the graphs and tables in later analysis. Table 3.2 lists the abbreviated codes for the school textbooks.

Table 3.2 *List of code names for the textbooks used*

Code Name	School where the textbook is used
<b>BH</b>	Balwyn High School, Victoria
<b>PLC</b>	Presbyterian Ladies College, Victoria
<b>RH</b>	Rossmoyne High School, WA
<b>BS</b>	Brunei School
<b>SS</b>	Singapore School
<b>CSS</b>	China Shanghai School

Data collected in Appendix A were extracted and graphically represented using the computer Excel programme for the convenience of information analysis. These data are presented in Chapter 4 to highlight the curricular characteristics and emphasis.

### **3.7.2 Interview data analysis**

The information on teachers' interviews is categorized according to their school and level. For example, a year 7 teacher from PLC is denoted by PLC7, a Form 1 teacher from the Brunei private school is denoted by BPS7, a Form 3 teacher from the Brunei government school is denoted by BGS9, a Secondary 2 teacher from Singapore Raffle Girls School is denoted by SRG8. The teachers' background details are tabulated in Table 3.3 while the transcripts of the interview are attached as Appendix DA, DB ... to DO.

#### **Teacher's background information**

In Table 3.3 the teachers are represented by the symbols designated in section 3.7.2 with the last digit representing the level of mathematics undertaken by the teacher. This tabulation summarised relevant background details of the teachers for easy comparison.

#### **Summary of information**

It is noted that the Australian, Singaporean and Brunei private schools have experienced teachers with a substantial years of teaching experience and all teachers at least have a basic degree. By comparison the teachers in Brunei government school who are degree holders are rather young and inexperienced. The two experienced older teachers have Teacher's Certificates implying that they were trained in the Teacher's Training College after obtaining their 'O' or 'A' Level examination.

In contrast to the Brunei private school, the government school is a relatively bigger one as they have more teachers teaching the Form 1 – 3 classes. There could be more teachers teaching Secondary 1 – 3 in Singapore and Year 7 – 9 in Australia as these are relatively 'big' schools. However, the questionnaire package I sent to them

contained 3 sets of questionnaire which accounts for only three responses each from these schools.

Table 3.3 *Background details of participating teachers*

Indicator	Age	Sex	Years teaching	Highest qualification	Present position
PLC7	45	F	20	BA Dip Ed Post Grad. Dip	Chief of Staff, Senior math teacher, Yr 7 maths program leader
PLC8* PLC9*	54	M	22	BSc (Hon), M Sc, Dip Ed, M Ed	Math teacher Technology leader
BGS7	24	F	0.5	BSc (Mathematics) PGCE	Math teacher Class teacher
BGS7	53	F	32	Certificate of Education	Math teacher Co-class teacher
BGS8	24	M	1	BSc (Education)	Math teacher Class teacher
BGS8	24	M	1	BSc (Education)	Math teacher
BGS9	48	F	26	Teachers' Certificate	Math teacher
BGS9	25	F	1 month	BSc (Education in Math/Physics)	Education officer
BPS7; BPS8; BPS9;	57	F	38	BSc (Education) MA in Teaching Math	Math teacher Development coordinator
SRG7	48	F	20	BSc (Dip Ed)	Senior teacher Developmental supervisor
SRG8	42	F	17	BSc	Math teacher Level coordinator
SRG9	38	F	15	BSc	Math teacher Subject head

Note: \* and ; Indicate teachers who undertake more than one level of mathematics. PLC level 8 and 9 are undertaken by the same teacher. The teacher from the Brunei private school undertakes all three levels as the school has only 2 classes per level.

One can read much into the teachers' responses on the interviews at first glance. It is noted that the Singapore and the Brunei Government school teachers responded very often with short answers like "yes", "agree", "no" or "no comments" portraying either "business" of the individuals or something else. At times the Brunei Government school teachers' responses were rather vague or incomprehensible, which could be an indication of their proficiency in the English language, or rather the lack of it. However the Australian and the Brunei private school teachers responded with great details, which could be indicative that they took the questionnaire seriously and expressed their ideas and thoughts very professionally and effectively.

The 15 sets of responses from teachers' interviews were analysed. The analysis on teachers' responses is discussed in Chapter 5.

### **3.8 Ethics**

All research must meet basic ethical standards, and in this study there was no particular occasion on which I was in a position of power to influence input of data or information. The interviewing data collected were via the post and all the teachers (with the exception of the teacher in the Brunei private school) participated in the questionnaire did not know me, nor had they met me. I was the Deputy Principal of the private school in Brunei 14 years before and the teacher was one of the staff. I left the school after 2 years. The teacher retired and later returned to The Philippines.

I did not make any attempt to validate the typed transcripts with the teachers, mainly because it was difficult to identify the teacher as no names were requested in the questionnaire; and secondly because I did not see the necessity of verifying as I had the original hard copy from the teachers' response as a check on the validity of the interviewing data.

### **3.9 Chapter summary**

This chapter has described the research questions and design, the rationale and procedure in the data collection and analysis, and has included a discussion of relevant ethical considerations.

The two-way data collection approach has been described, of which the source of data was from both the school textbooks as well as the teachers' interviews. It focused on a discussion of the criteria of selecting resources and the level of mathematics programme, along with a brief explanation of the various curricula, which led to an eventual choice of textbooks for this comparative study.

The chapter also included a discussion on the rationale of incorporating a set of data on teachers' interview to support the textbook data, an outline of the structure of questionnaire for teachers' interview and the comments, as well as the selection procedure for the participating teachers' interviews.

An outline of the analysis for both sets of data was also detailed as well as a tabulation of background details and a list of textbook code names. The presentation and analysis of the analysed data from textbook is the subject of the next chapter, while that of the interviewing data appears in chapter 5.

## **Chapter 4**

### **Findings from textbook content analysis**

#### **4.1 Introduction**

This chapter reports the findings from the textbook analysis. The data collection was described in Chapter 3 and included a list of school textbooks selected for the analysis as well as an abbreviated name list of the textbooks used. This analysis was based on a rudimentary evaluation of textbooks without consideration of the rationale behind the curricular planning and design. The main objective of this very basic, but in-depth, form of data collection and analysis was to provide a model for teachers and school administrators which, with their very busy working schedules, they would be able to adopt in their enquiries about their expatriate students' expected past learning. The analysis was achievable without a very involved and complex procedure which might be too time-consuming to be practical.

The findings were guided by the research questions 1 – 4 as described in the earlier chapters, and the issues raised were addressed in terms of the four areas of discussion presented in this chapter: (1) physical appearance of textbooks, (2) overview of the mathematics programme and its break-down, (3) topic sequence and details, (4) exemplary characteristics of the textbooks. It could be deduced from these four headings that the findings derived from an analytical process similar to peeling an onion. First the physical and visual appearance of textbooks were described, followed by an overview of the lower secondary programme presented in different formats to flesh out the differences and similarities of the text content, which was then fine-tuned to compare the levels of complexity or simplicity of the topics covered in individual text, along with findings of exemplary characteristics of the textbooks.

This process might appear to be rather laborious for assessing and comparing students' expected past learning, but experienced teachers would be able to adopt the

process to address the area of concerns in their evaluation of expatriate students' expected past learning, which was the initial intent of this study.

## 4.2 Physical description of the textbooks

The selected textbooks vary in their size and paper quality. To give an indication of the variation, a tabulation of the weight in kilograms of the textbooks for the three-year program was presented below (Table 4.1).

Table 4.1 *Physical description of the school textbooks*

Textbooks	BH	PLC	RH	BS	SS	CSS
Number of Books	3	3	2	6	3	6
Total Weight (kg)	3	4.5	2	2	2	1
Number of chapters	40	44	42	36	44	24

Assuming a uniform paper density for these books; the weight was in direct proportion of the volume of the textbooks. PLC was obviously the bulkiest with the “biggest” book weighed almost 1.8 kg. CSS textbooks were approximately identical in shape and size; hence each Chinese textbook weighed less than 200 grams which was the lightest of the lot, as well as being one with the least number of chapters. The RH textbook for year 8 was a compilation of loose pages of worksheets while the year 9 text was a ‘proper’ book. Table 4.2 tabulated the number of pages in each textbook.

Table 4.2 *Textbook page count*

Level of textbooks	Textbooks					
	BH	PLC	RH	BS	SS	CSS
<b>Year 7 Text</b>	421	390	~	351	332	200
<b>Year 8 Text</b>	407	673	450	309	282	172
<b>Year 9 Text</b>	451	628	192	271	296	160
<b>Total no of pages</b>	1279	1691	642	931	910	532

BH and PLC were in full colours with many striking pictures and drawings illustrating the text. RH and CSS had full colours on the covers with the content in

plain black and white with no photographs and very few drawings. BS and SS had full colour covers but used only one additional colour to enliven the text. All books made good use of typography and bold print to differentiate the content. It was interesting to note that CSS included on the back cover page a list of mathematics terminology used in the textbook and their English translation.

In summary, there was a big range of variation in the design and visual appeal of these six sets of textbooks. The Australian eastern state textbooks were certainly the most “attractive” ones on the list. However, the effects of attractiveness of design on students are yet to be investigated by researchers.

### **4.3 Content-break-down of the textbooks**

Appendix G gives an overview of the textbook content break-down, which was an extraction from the raw data in Appendix A, in order to quantify the textbook content for comparison. It was important to remember that Rossmoyne High School did not have a Year 7 textbook and is represented by ~ in the tabulation in Appendix G.

The content was categorised into the five basic strands and the strand weighting was calculated accordingly, based on the number of pages of the particular strand over the total number of textbook pages. The objective of this calculation was to provide an instrument to examine the structure of the textbook content. The tabulation was represented in a bar graph so that individual textbook arrangement was portrayed more clearly. The analytical outcomes were in three phases: one to gain a comparative overview of the textbook content for all five strands, another to gain a comparative overview of individual strand content over the 3-year programme and the third was to provide an overview of the content composition of individual set of textbooks. These analytical outcomes are described in section 4.3.1, 4.3.2 and 4.3.3 respectively.

### 4.3.1 Overview of textbook content

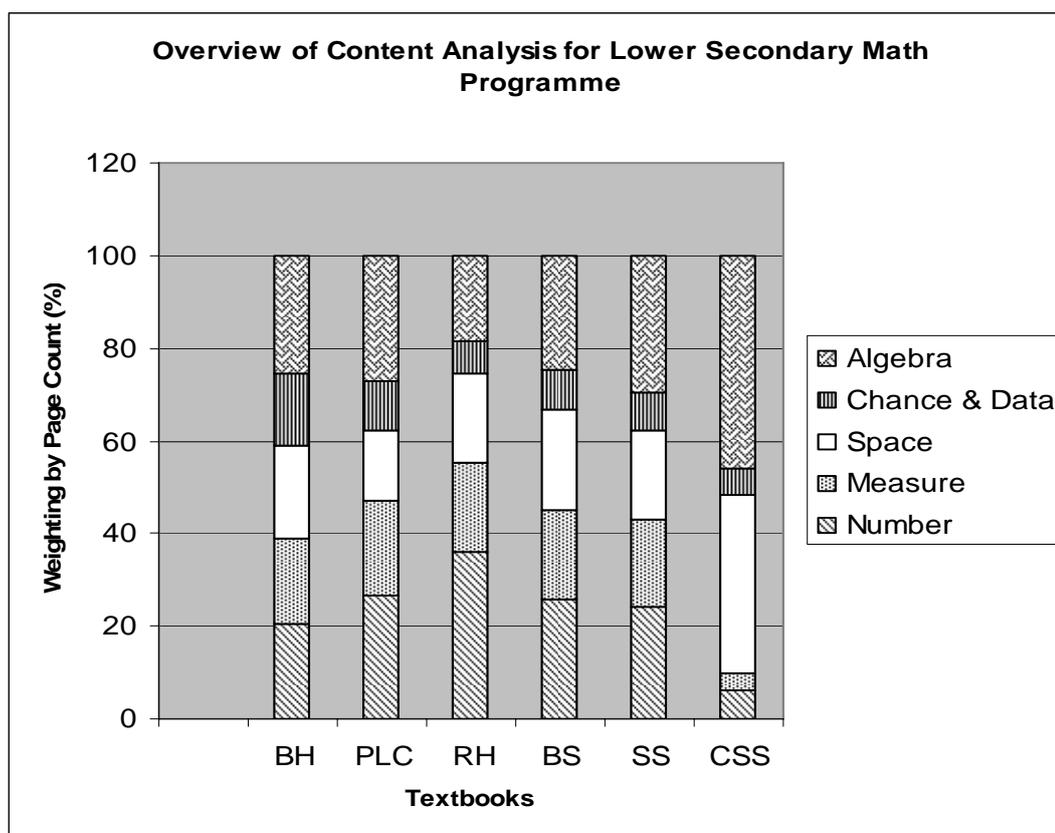


Figure 4.1 *An overview of the lower secondary mathematics textbooks*

Figure 4.1 is the graphical representation of the textbooks for the lower secondary mathematics programme. The textbook content, as represented in the strand weighting, varied according to the direction of individual countries' lower secondary curriculum to reflect the national goals.

At first glance, both BH and PLC which subscribe to the Victorian state curriculum exhibited similar strand weighting profiles, though BH allocated a bigger component of Chance & Data content than PLC, and compensated by having a smaller component of Number content. The Brunei and Singapore textbooks had almost the same strand profiles which were similar to BH and PLC; more so than that of RH which was in used in Western Australia. RH had more than 30% of the content in the Number strand and juggled the programme by reducing the Chance & Data and Algebra strands. The Chinese textbook focused mainly on the Space and Algebra strand with less than 20% of course content allocated for the Number, Measure and

Chance & Data strand. It was important to highlight that for overall strand weighting, a 10% for PLC textbook meant a total of 169 pages as compared to a 10% for the SS textbook which amounted to just 91 pages of the text content, or 53 pages for CSS.

This overview provided a synopsis of the textbook content catering for the Lower secondary mathematics programme in the respective school / countries. There were significant variations among the different programmes, and to gain further insights, overviews of the textbook content per specific level were needed to examine how the textbook content changed over the three year programme. The programme was further fragmented into different levels to facilitate comparison of the variations on each level so that the time factor was included. Figures 4.2, 4.3, and 4.4 following represent the strand weighting analysis for Year 7, 8 and 9 respectively. The legend in the Figure makes use of letters to represent the five strands and numbers to represent the year. For examples: A/7 stands for Year 7 Algebra strand; C/8 stands for Year 8 Chance and Data strand; N/9 for Year 9 Number stand. The bar graphs shows the strand weighting of individual text for each respective year, which represented the strand content for that particular year.

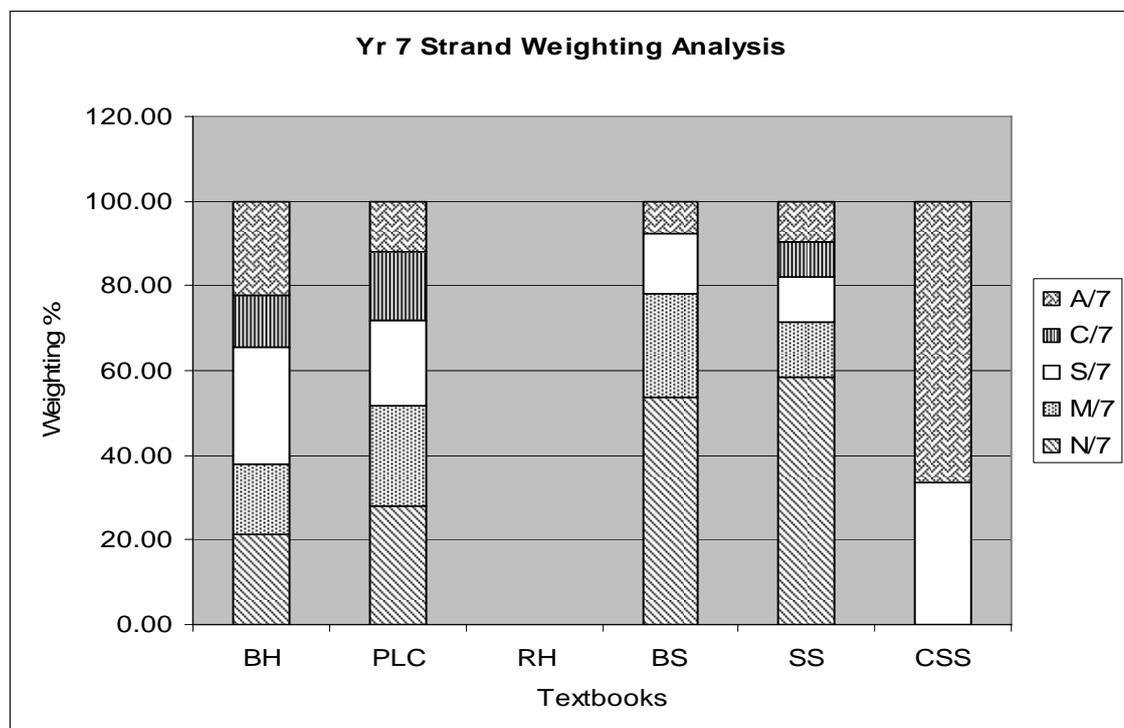


Figure 4.2 An overview of year 7 textbook content

Figure 4.2 represents the Year 7 course content composition. BH, PLC and SS covered all five strands, albeit each with different emphasis on the weighting. There was a distinct difference in the course content composition between BH and PLC, though both subscribed to the same curricular guide in the State of Victoria. There was also a variation in the content composition between SS and BS, which reflected the curricular difference between two different groups of target students with different abilities. The CSS concentrated solely on the Space and Algebra strands, which amount to 35% and 65% respectively of the course content.

Much of the year 7 content focused on reviewing past learning and introducing new mathematics skills. Acquiring and consolidating skills on the Number and Measurement strands usually preceded the learning of Space and Algebra content. The trend of consolidating the Number and Measure knowledge was seen in all school textbooks except CSS with its sole focus on Space and Algebra content during the first year of secondary education. This observation highlighted a question: “Have the Chinese students built sufficient basic Number and Measure strand knowledge as foundation prior to commencing work on space and algebra?”

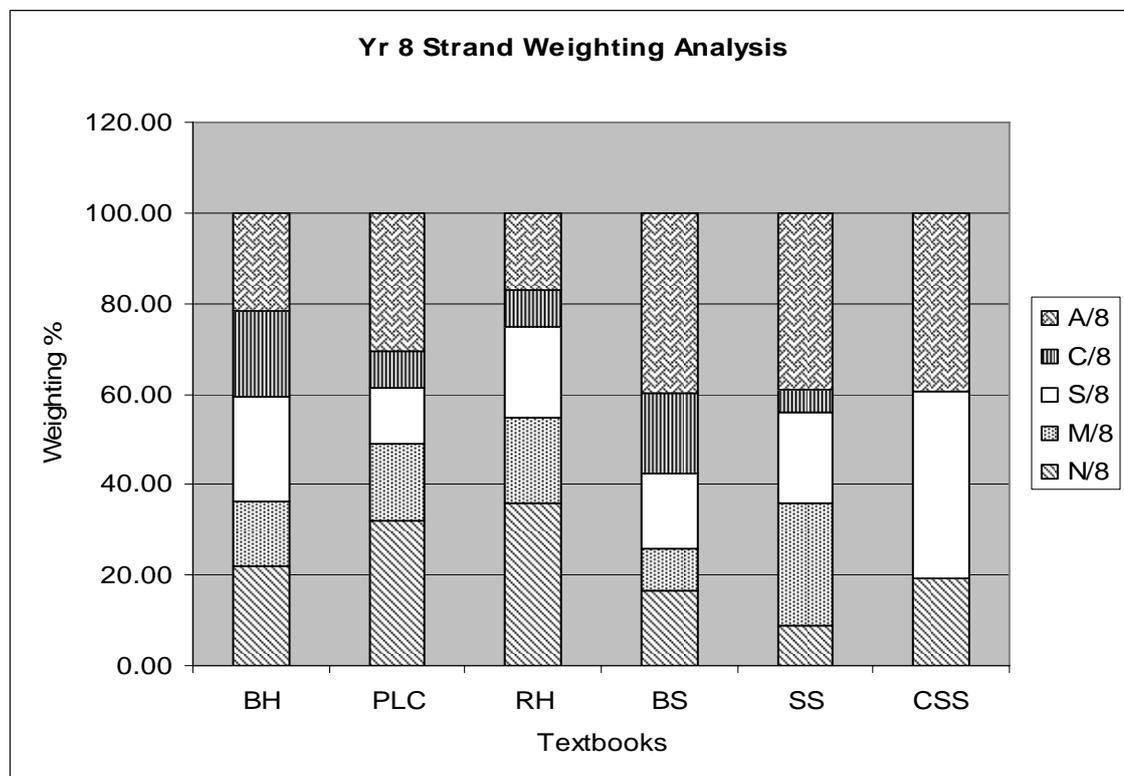


Figure 4.3 An overview of year 8 textbook content

Figure 4.3 provides an overview of the year 8 textbook content composition. Again there was considerable variation amongst the textbooks' content matter. The flexibility offered by the Australian national curricular statement was well illustrated in the variation of strand weighting profiles of the 3 sets of Australian textbooks, which reflected the freedom of interpretation of their curricular guidelines in the textbook presentation and content. Even in the same Australian State, PLC and BH have a varied content composition though both subscribed to the same state curriculum. SS and BS differed substantially which reflected the variance of the curricula for the upper echelon and the average groups of students in Singapore. The heavier Number strand weighting in BS might indicate further consolidation of basic mathematics skill at Year 8 level for the Normal stream of students. CSS covered only three strands in the Year 8 textbooks: Number, Space and Algebra.

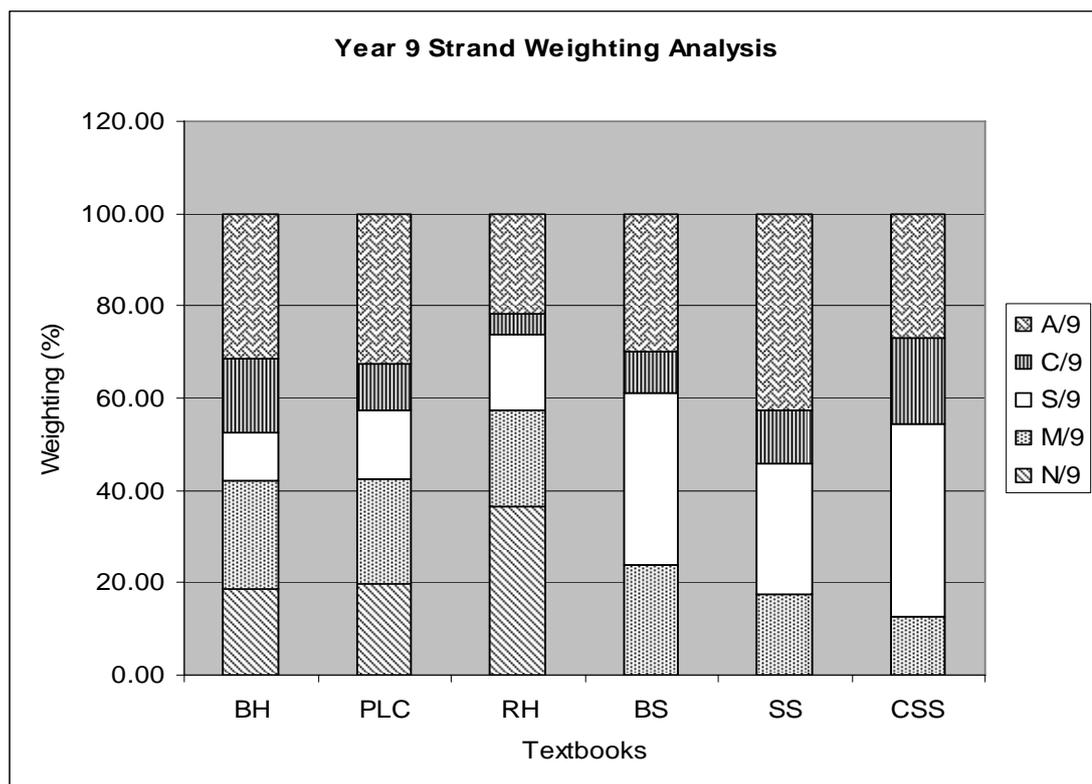


Figure 4.4 An overview of year 9 textbook content

Again the Year 9 content composition varied substantially amongst the textbooks as illustrated in Figure 4.4. The Chance & Data strand was cover in all year 9 textbooks though with a varying weighting emphasis. It was worth noting that at

this level, BS, SS and CSS did not have Number strand materials, which might imply that these textbooks covered the necessary number topics in the year 7 and 8 levels.

### *Summary of section*

The textbooks had different strand content composition and arrangements which were an indication that the curricula content reflected by the textbooks varied considerably. For the Australian textbooks, the content of textbooks reflected the diversity of interpretation of the loosely structured national curricular statements by the state curricular planners and textbook writers. This freedom offered by the curricular statement precipitated a variety of interpretations, leading to the publication of a multitude of textbooks in the country of varying textbook content and presentation. An important outcome of this analysis pointed to the differences between the two sets of Victoria textbooks, which was indicative of how the textbooks varied even though they followed the same set of curricular directives and guidelines in the State.

BS and SS were textbooks published for the Singapore student population. The variation in the weighting profile reflected the content composition of two varied curricula for two groups of target students, which formed a critical platform upon which the education paths of these two groups of students were planned. BS was intended for the Normal stream students which may eventually lead the students to vocational education, while SS was written for the Express stream students for more academically demanding future courses. The Brunei Schools adopted BS, which might disadvantage the more able students as they are placed on par as the Normal stream students in Singapore.

In general, most textbooks covered all 5 strands in their yearly content with the exception of CSS which emphasized the Algebra and Space content more and with nominal coverage on the other three strands. The exception from this observation was that the Chinese students might have acquired the necessary Number and Measure skills during the Primary school years, proceeding onto the Algebra and Space strands at the secondary school level.

It was deemed necessary to investigate the width and depth of the topic in these textbooks. Detail topic comparison would provide an insight of the lower mathematics programme covered prior to students proceeding to the upper secondary level. Any gap in the expected achievement levels would be useful in providing an explanation of students' performance in international comparative studies and competitions.

### 4.3.2 Overview of individual strand

To expand on the textbook content analysis from the previous discussion of an overall strand profile analysis, overviews of how individual strand content, as indicated by the weighting percentage, changed over the three year programme were charted. This comparison threw more light on how textbooks were organized in terms of the content materials within the guidelines from curricular planners and a set time frame. Figures 4.5 to 4.9 illustrated the weighting profiles of all five strands. The observations described the strand content coverage in the textbooks which was reflected by strand weighting.

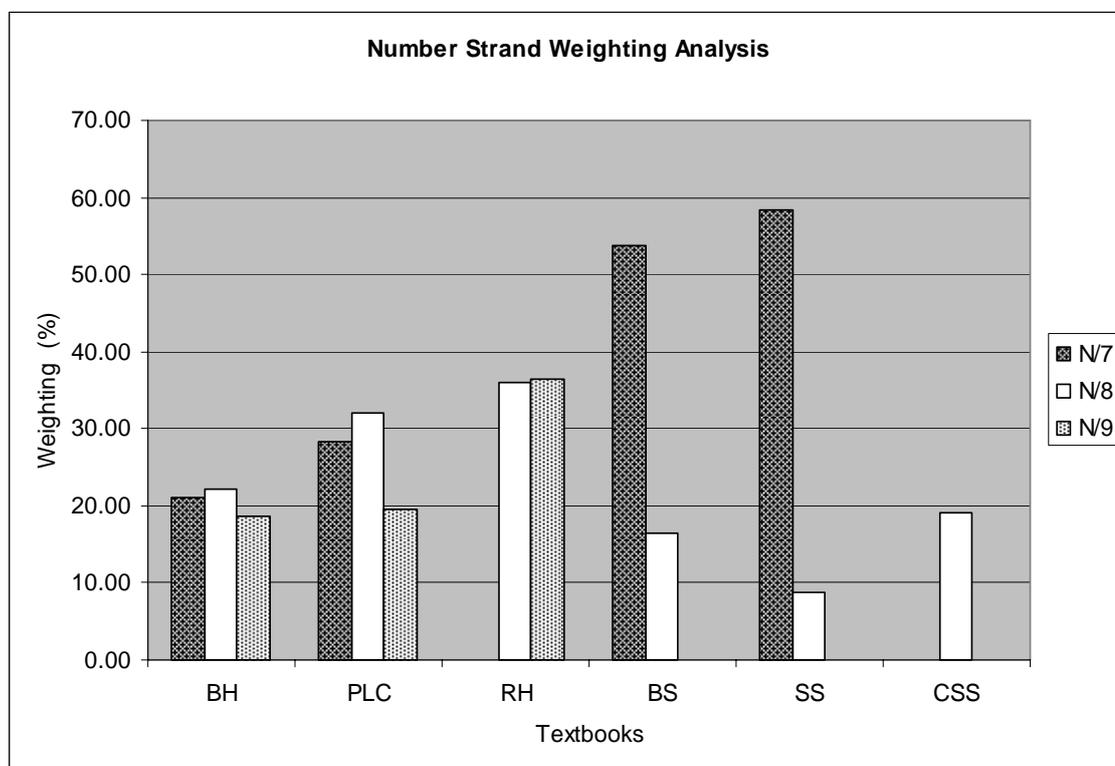


Figure 4.5 An overview of the number strand

Figure 4.5 shows the overview of the Number strand content coverage of the lower secondary mathematics programme. BH, PLC and RH covered Number strand topics at every level in the lower secondary years. BS and SS covered a large component of the Number content during the first year, then the content reduced to less than one-third and one-sixth of the first year quantity respectively during second year, with zero coverage during the third year. CSS did not include any Number strand content in the first and third year but allocated around 19% of year 8 textbook content to Number strand.

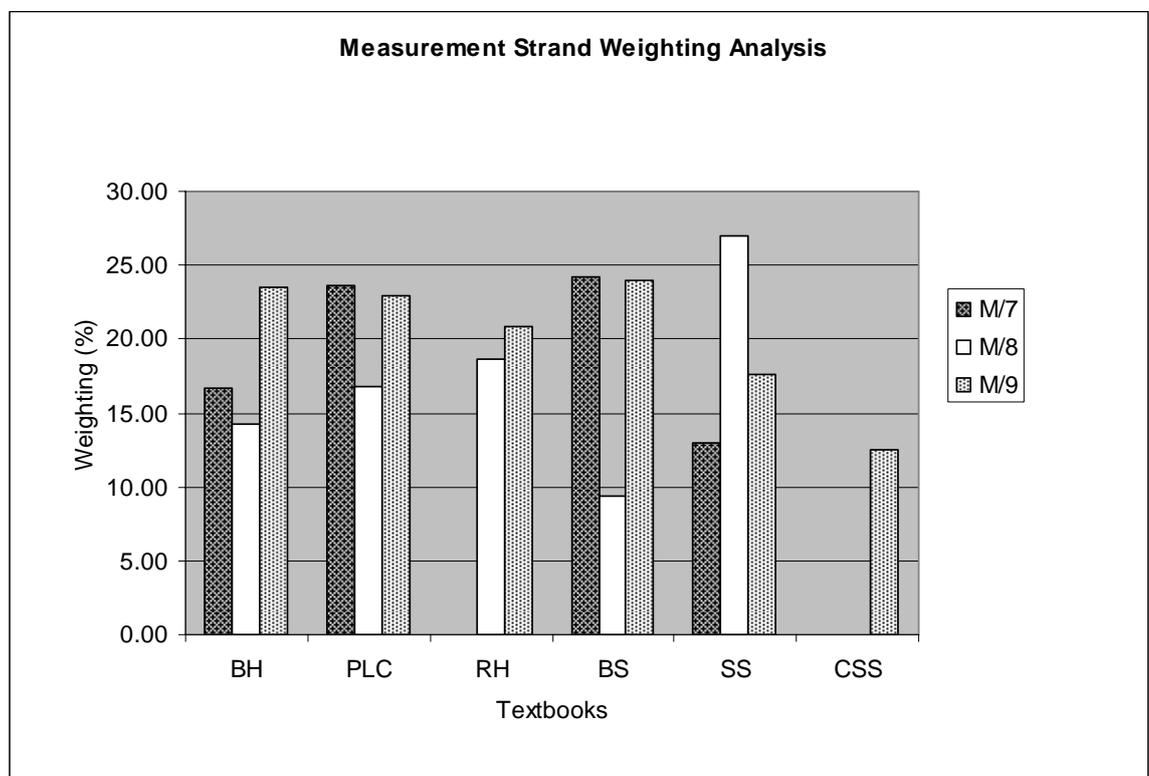


Figure 4.6 An overview of the measurement strand

Figure 4.6 provides an overview of the Measurement strand content coverage. There was no discernable pattern in the Measurement strand content distribution. However all textbooks covered this strand at every level except CSS which covered this strand during Year 9 only.

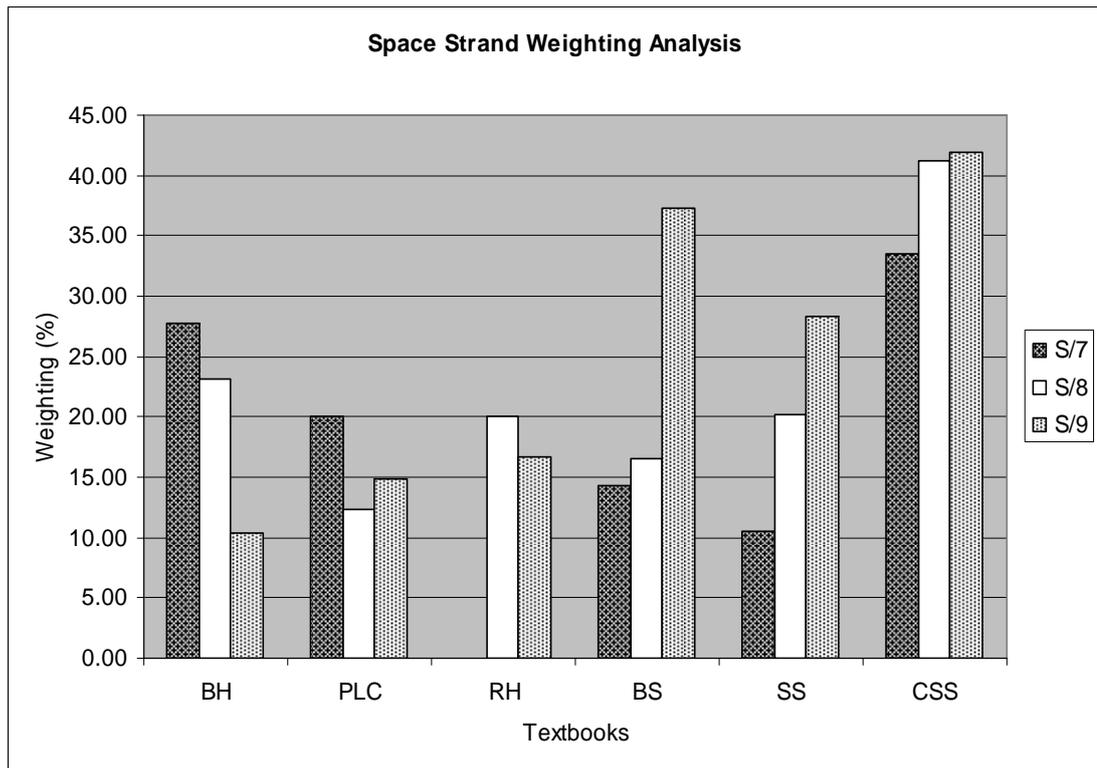


Figure 4.7 *An overview of the space strand*

Figure 4.7 shows an overview of the Space strand. All textbooks covered this strand at every level in their mathematics programme. CSS has the highest coverage content percentage amongst the textbooks. The Australian textbooks exhibited a decreasing pattern of content coverage over the programme duration that was in contrast to the Asian textbooks which showed an increase in the Space content coverage over the three year programme.

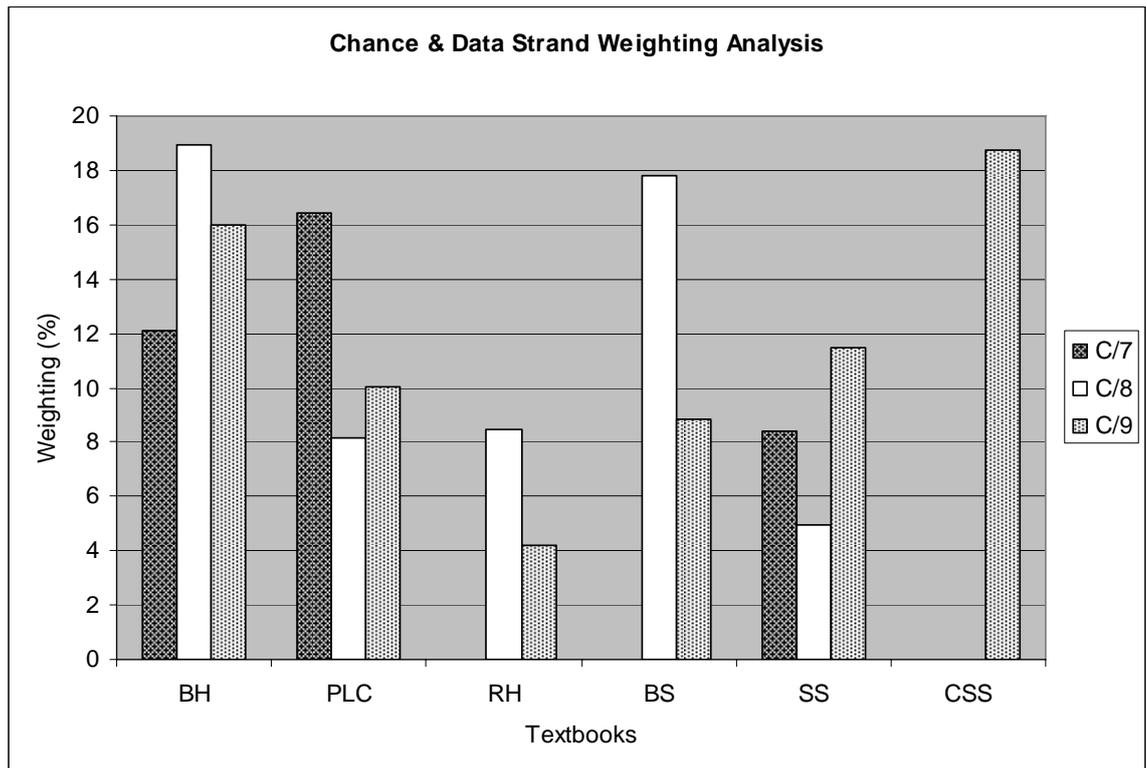


Figure 4.8 *An overview of the chance and data strand*

Figure 4.8 provides an overview of the Chance and Data strand content of the lower secondary programme. There was much variation in the content coverage for this strand in all textbooks. The Australian textbooks and SS covered this strand content yearly, while BS started on Chance & Data in the second year and CSS covered this strand during the final year of the lower secondary programme.

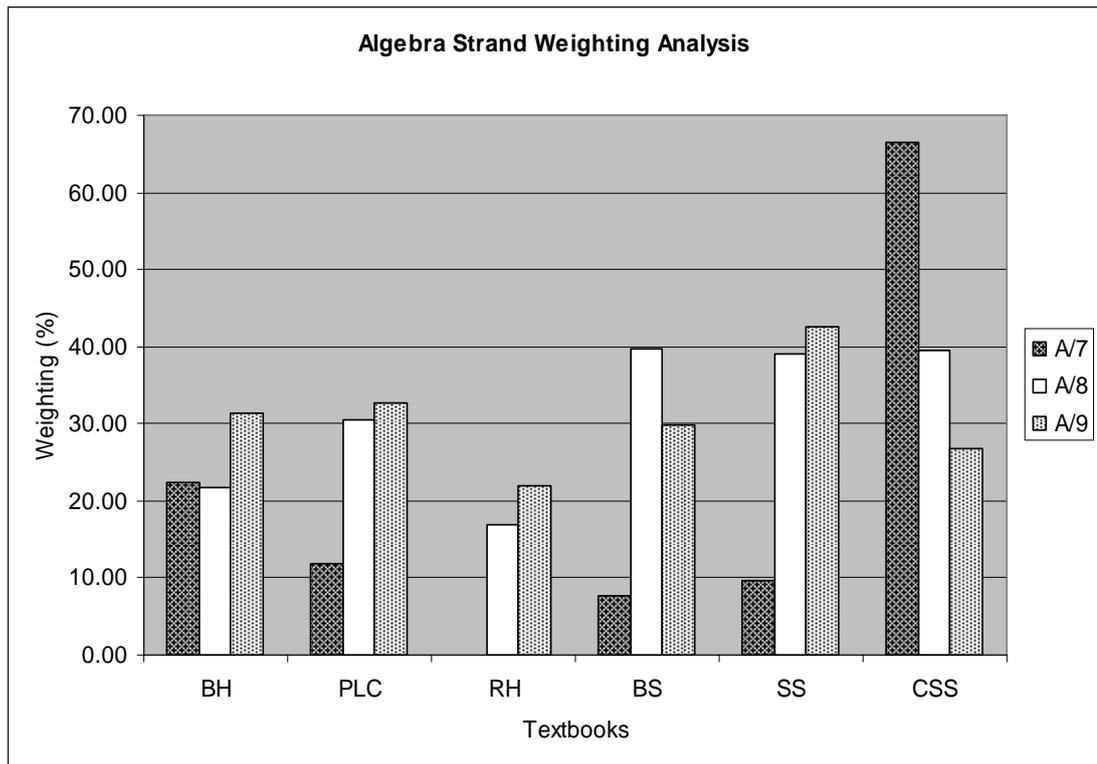


Figure 4.9 *An overview of the algebra strand*

Figure 4.9 provides an overview of the Algebra strand. The importance of Algebra was glimpsed from the fact that all textbooks covered the strand in their yearly content. Except for CSS and BS, the textbooks exhibited an increasing content coverage in the Algebra strand over the three year programme. CSS had the highest Algebra content coverage during the first year which amounted to around 67% of the first year textbook content and decreased to less than 30% in the final year of the mathematics programme.

***Summary of the section***

This section illustrated the distribution of particular strand content weightings over the duration of the mathematics programme. There was no distinct correlation of content composition between the textbooks. The text content was designed to meet the demand of individual curricula. It was observed again that different textbooks organized the content matter differently even for the two sets of Victoria textbooks which subscribed to the same curriculum. It was important to highlight that the strand weighting analysis was based on the percentage of the total number of

textbook pages. With reference to the textbook thickness, a 10% for the PLC year 8 textbook meant 67 pages of the year 8 textbook while a 10% for the CSS textbook amount to just 17 pages of text. Hence it was useful to bear in mind the relative thickness of the textbooks to keep the weighting percentage in appropriate perspective.

### 4.3.3 Overview of individual course content

Figure 4.11 – 4.15 provide a graphical representation of the overview of the content composition of the textbooks throughout the whole lower secondary mathematics programme. The content was classified into five strands and the amount of strand content matter was quantified as the weighting, which measured the percentage of strand content pages over the total textbook content pages.

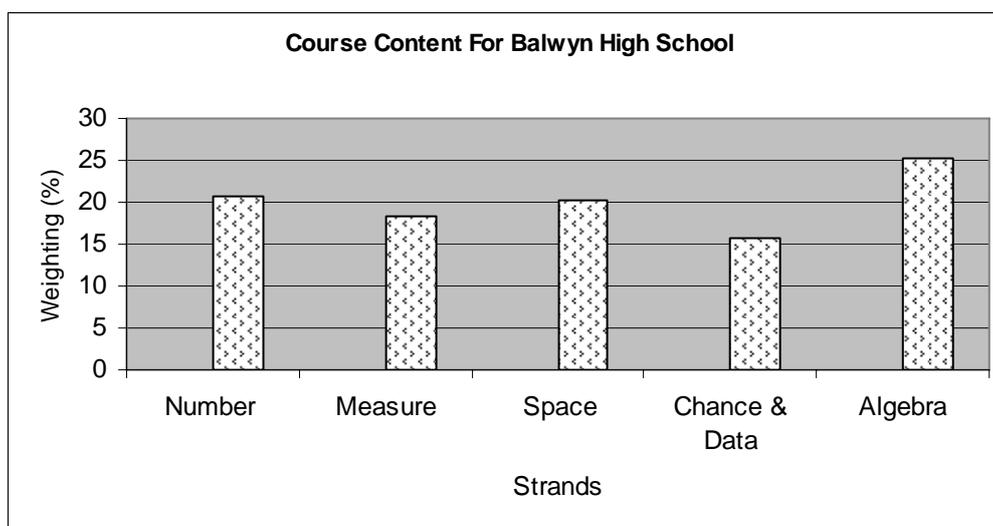


Figure 4.10 An overview of BH mathematics course content

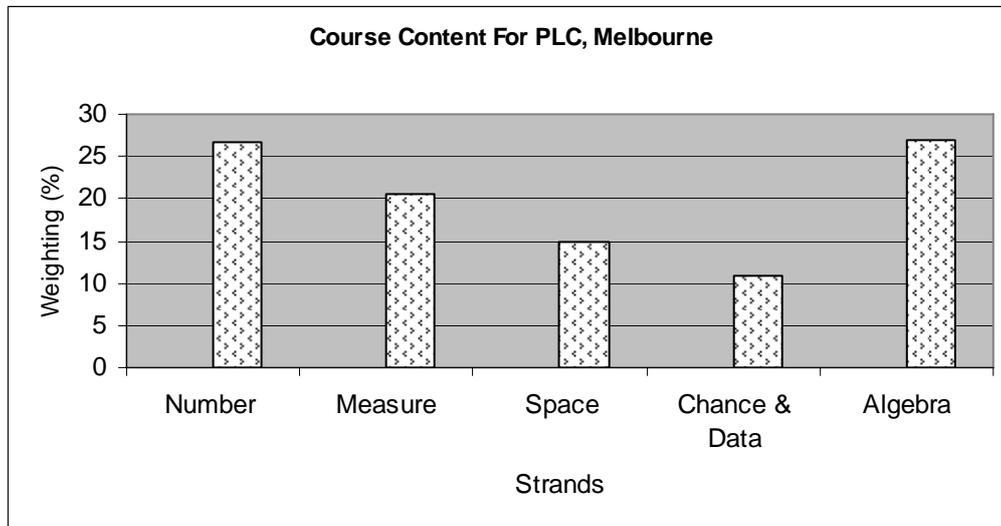


Figure 4.11 *An overview of PLC mathematics course content*

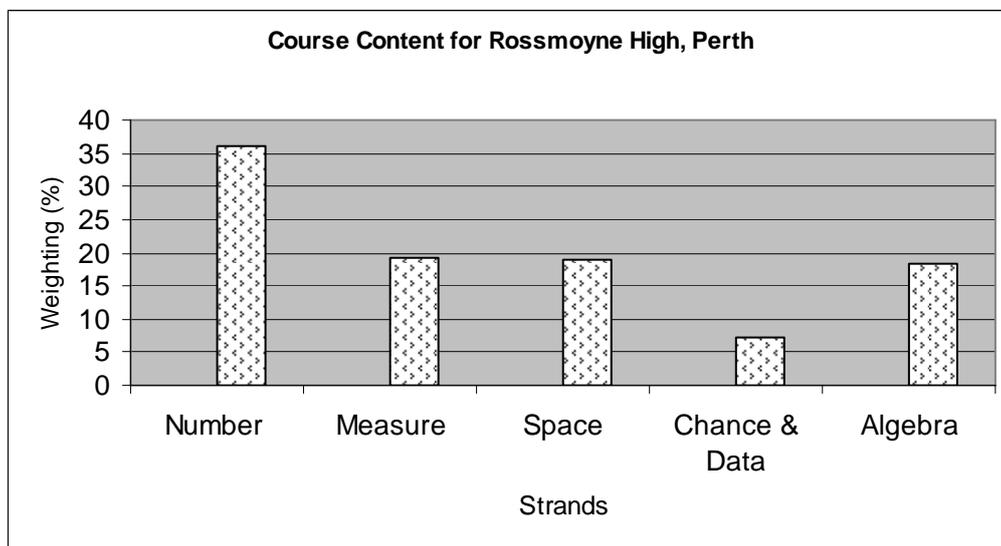


Figure 4.12 *An overview of RH mathematics course content*

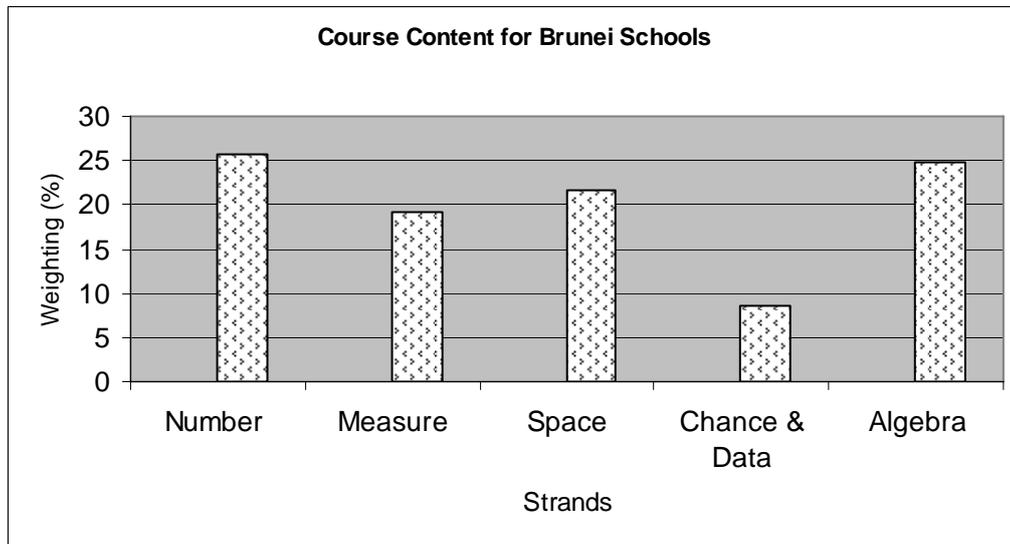


Figure 4.13 *An overview of BS mathematics course content*

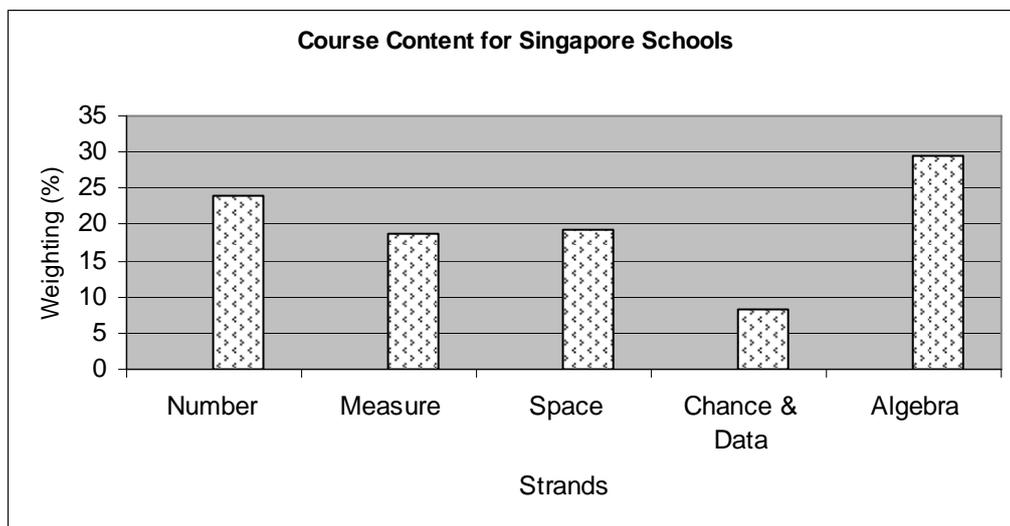


Figure 4.14 *An overview of SS mathematics course content*

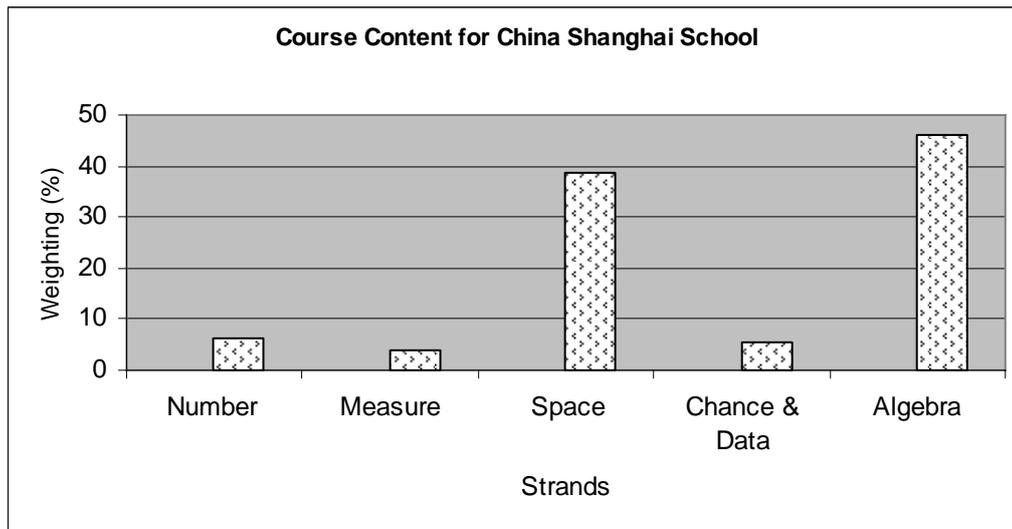


Figure 4.15 *An overview of CSS mathematics course content*

***Summary of the section***

The graphical representations highlight an important common trait of the textbooks in that the Chance and Data strand has the least coverage in all textbooks. The two sets of Australian textbooks from the State of Victoria had the highest Chance and Data strand content amongst all textbooks, which amounted to 10% and 16% for PLC and BH respectively. CSS has the least content matter, which amounted to just 5% of the course content, while the others had around 7% of the course content.

Except for RH which devoted approximately 18% of the course content to Algebra, the other textbooks had at least 25% of the course content in Algebra, with CSS scoring highest with 48% of content in Algebra. All textbooks except CSS had 15% – 22% course content allocated under the Space strand while CSS had 39%.

Number strand also took up a high proportion of course content except for CSS. RH topped the textbook list with 35% of content in Number strand, while CSS scored the least with just 6%. The other textbooks devoted around 20% – 25% of course content to the number strand; similarly for the Measurement strand.

#### **4.3.4 Summary of section**

As in the summary of the subsection, the textbooks had different content emphasis based on the curricula requirement. However, the only textbook exhibiting a big deviation in the strand content trend from the others was the Chinese textbooks which concentrated mainly on the Space and Algebra content, while other textbooks worked on all strands.

All textbooks commenced on the Chance & Data strand during the first year of the secondary school programme except BS and CSS which start on the Chance & Data strand during the second and third year respectively. However, the Victoria state textbooks offered a more substantial Chance & Data content than others.

#### **4.4 Topic sequence and details**

An investigation of the breadth and depth of the topic in these textbooks provided an insight of the textbooks' standards and addressed issues raised in the research questions listed in Chapter 1. The main focus was to identify the level of complexity offered under the same topic in the textbooks in order to facilitate a cross-textbook comparison based on the same timeline. The outcomes of these comparisons formed the platform for assessing students' expected mathematics knowledge based on the textbooks used as well as helping to distinguish the standard of mathematical skills offered at a particular level, which led to more detail differentiation of the mathematics programmes offered by the various textbooks. The raw data for this analysis appear in Appendices B and C.

To facilitate such an investigation, each strand was fragmented into various topics and the level when these topics were taught was charted. Table 4.3 – 4.7 are tabulations of the details of topics against the level taught for the five strands. The year during which the topic was covered is indicated as 7, 8 and 9 representing the level of the secondary school mathematics programme. In addition to the tabulations, problems were selected from the textbook to offer an idea on the degree of difficulties demanded from programme. This last piece of information was included to investigate how the textbooks varied in their coverage of the same topic,

and to gain an insight of the standard offered by the textbook leading to programme differentiation.

#### 4.4.1 The Number strand

Table 4.3 *Number strand topics*

Topics	Level (7 – Year 7; 8 – Year 8; 9 – Year 9)					
	BH	PLC	RH	BS	SS	CSS
Fractions, decimals, percentages	7, 8, 9	7, 8, 9	8, 9	7	7	
Integers: 4 operations	7, 8	7, 8, 9	8, 9	7	7	
Fractions: 4 operations	7, 8	7, 8	8, 9	7	7	
Decimals: 4 operations	7, 8	7, 8	8, 9	7	7	
Prime numbers, factorisations	7, 8	7, 8		7	7	
LCM, HCF	7	7, 8	9	7	7	
Number line	8	8, 9	8	7	7	
BODMAS	7, 8	7, 8, 9	8	7	7	
Number patterns	7	7, 8, 9	9	7	7	
Divisibility test	7	7, 8			7	
Rate, ratio & proportion	7, 8	8, 9	9	7	7	
Interest, profit & loss, hire purchase	7, 8, 9	8, 9		7, 8	7, 8	
Estimation & approximation	7, 9	7, 8	8	7	7	
Standard forms, significant figures	8	8, 9		7	7, 8	
Rational & irrational numbers	8	8		7	7	8
Terminating & recurring decimals	9	9		7	7	
Index notations, indices, index rules	7, 8, 9	7, 8, 9		7, 8	7, 8	
Powers and roots	7, 8, 9	7, 8, 9	8	7, 8	7, 8	8
Surds: 4 operations	9	9				8
Rationalisation of denominators		9				8

The Number strand lays the foundation in mathematics in that much of the necessary basic terminology and skills is introduced in this strand to prepare students for work in other strands as well as the more advanced mathematics. To identify the variation among the textbooks in the same topic, representative problems were listed so as to gain a comparison of the level of difficulties in the problems presented in the textbooks.

#### ***BH Textbooks***

The Year 7 textbook covered number patterns to include triangular numbers, square numbers and rectangular numbers as well as a discussion on Fibonacci numbers.

The divisibility test was clearly presented in the pictorial representation. It also included calculations in percentages for simple interest.

The Year 8 textbook expanded and consolidated certain concepts from Year 7. BODMAS skill was further reinforced through problems such as

Q1  $-7 \times (-6) \div (-2) + 15$  ;

Under the application of percentage, discount and mark-up; profit and loss; budgeting and simple interest were introduced. Index notation was expanded to include index rules and the use of a calculator for powers and roots. Below are questions from the exercises:

Q2 John borrows \$469 at 4.6% p.a. for 3 years, Pauline borrows \$600 at 5.6% for 2 years, and Dargo borrows \$360 at 2.5% for 5 years. Who pays the greatest amount of simple interest and what is the amount?

Q3 Simplify:  $b^3(c^2)^3 \times b^4c^2$

BH devoted an entire chapter in the year 9 text to surds. The topic was introduced from square and cube roots; converting fractions to decimals and vice versa, to eventually mixed surds operations. A typical problem follows:

Q4 Simplify:  $-5\sqrt{2}(2\sqrt{7} - \sqrt{3})$

### ***PLC textbooks***

Year 7 consolidated on BODMAS with exercise problems similar to BH. The divisibility test was clearly presented. The rule for BODMAS was boxed for emphasis. The four operations included some enrichment works such as:

Q1 Find the number represented by \* in the question:  $* \overline{) \frac{62 * 7}{4 * * 36}}$

Pascal's triangle was included under the "Applications and Activities" section where a short anecdote on Pascal was introduced. There was an "Enrichment and Extension" section which provided mind-simulating questions. The squares and square roots of fractions were included at this level. The rounding of decimal numbers was introduced.

A useful feature of the Year 8 textbook was a list of key symbols on the front page. Chapter 1 of this book was devoted to strategies for solving puzzles and problems which was a useful groundwork for mathematics problems. Long division was covered in detail. The worked example demonstrated two approaches to division:  $22 \overline{)946}$  and  $22 \overline{)946}$ . BODMAS was reinforced and index rules were included.

The Year 9 textbook consolidated the skill of using the fraction key of a calculator. Below is an example of the exercise:

Q1 The expression  $\frac{1}{3}x^2 + \frac{4}{5}x - 2$  implies  $\frac{1}{3} \times x^2 + \frac{4}{5} \times x - 2$ . Evaluate this expression when  $x = 15$ .

Regarding percentages, discount, commission, simple and compound interest were covered. Below is a question:

Q2 Paul made an investment on the stock market of \$3200. Shortly after the stockmarket 'crashed' and Paul had to sell out at a loss. If he lost 40% of his original investment, how much did he get back from the investment?

The textbook covered surds using a similar approach as the BH textbook. However, it extended the surds concept to include a section on the rationalisation of denominators which was very well presented. Below are two examples of the questions:

Q3 Expand and simplify where possible:  $-3\sqrt{2}(3\sqrt{2} - 2\sqrt{6})$

Q4 Express as a single fraction with rational denominator:  $\frac{1}{2\sqrt{3}} - \frac{3}{5\sqrt{2}}$

***RH textbooks***

The Year 8 text consisted of 452 pages of unbounded worksheets. Each chapter started with a short explanation prior to a number of exercises with spaces for answers. By comparison to other textbooks, the content covered was rather elementary mainly on mathematics skill acquisition. The usual order of four operations (BODMAS) was introduced in RH year 8 text-worksheets as BIMDAS; which stands for Brackets, Indices, Multiply, Divide, Add and Subtract. However, both abbreviations meant the same. Three of the questions from the worksheet follow:

Q1 In her last three basketball matches Donna has scored 18 points, 9 points and 21 points. Which operation would you use to calculate the total points she has scored in the three games.

Addition      Subtraction      Multiplication      Division

Q2 (a) Work out  $3 + 2 \times 6 - 4 \div 2 =$  \_\_\_\_\_

Now add brackets to each of the following to make the statement true:

(b)  $3 + 2 \times 6 - 4 \div 2 = 5$

(c)  $3 + 2 \times 6 - 4 \div 2 = 28$

(d)  $3 + 2 \times 6 - 4 \div 2 = 7$

(e)  $3 + 2 \times 6 - 4 \div 2 = 5.5$

Q3 Penny scored 60% in an exam that was out of 150 marks. How many marks did Penny get out of 150?

The Year 9 textbook runs along a similar trend with a short introduction on the topic follows by exercises. Chapter 2 covered direct and inverse proportion. Again the content covered was on skill acquisition. There were not many higher order questions.

Year 8 and 9 texts both covered “negative numbers” with the Year 8 text introduced the addition and subtraction of negative numbers using a scale and number-line, while Year 9 text expanded the topic to include the multiplication and division.

Similarly, “fraction” was covered in both Year 8 and 9. However, apart from having more word problems in the Year 9 text, there was no discernible difference between the two levels. Following is a question from the year 9 textbook:

Q4 When  $97\frac{3}{4}$  is divided by a certain number and 3 is added to the result the answer obtained is the same as when  $6\frac{2}{3}$  is trebled. Find the number.

### ***BS textbooks***

Every chapter ends with “do you remember?” and “words you need to know” sections to help summarise the content. Long division by a decimal number was included. Below is a Year 7 textbook question:

Q1 Evaluate  $2\frac{4}{5} \div \left(3\frac{2}{5} + 2\frac{3}{4}\right) \times 2\frac{1}{4}$

Part of the content of Year 7 textbook covered “rate, ratio and proportion”. One question follows:

Q2 If a boy walks at 5 km/h, he will take 15 min to reach school. How long will he take if he walks at 10 km/h?

This topic continued to Year 8 to include discount & commission, profit & loss, foreign exchange, hire purchase, simple interest, taxation, average speed and more complex ratio and proportion problems. The index rules were introduced at Year 8. The use of calculator in the scientific mode was included. Two questions follow:

- Q3 An alloy consists of three metals L, M and N, whose masses are as in the following ratios:  $L : M = 1 : 6$  and  $M : N = 7 : 3$ .
- (a) Find mass of L : mass of N.
- (b) If the mass of L in a block of the alloy is 1.4 kg, find the mass of M.
- Q4 A sum of \$P is deposited in an account at an interest rate of R per annum. If the interest is automatically added to the principal after each year, find, in terms of P and R, the total amount of principal and interest after (a) 1 year, (b) 2 years. Derive a formula to find, in terms of P, R and n, the total amount after n years.

### ***SS textbooks***

The textbooks included various “Notes”, “Just for laughs”, “Library Corner” and “It’s fact” which related mathematical anecdotes and questions on the topics. For example, Babylonians and Egyptians symbols were presented in the “whole numbers” discussion. BODMAS was reinforced. Usually at the end of a chapter, different problem solving strategies were discussed. Below is a question from Year 7 Chapter 1:

- Q1 A fruit seller buys 8 crates of oranges at \$18 per crate and 10 crates of apples at \$20 per crate. There are 72 oranges in each crate of oranges and 100 apples in each crate of apples. If he sells the oranges at 3 for a dollar and apples at 4 for a dollar, find his profit by completing and simplifying the following expression:

$$[] \times ( [] \div 3 - 18 ) + 10 \times ( 100 \div [] - [] )$$

Year 7 text content also included the use of calculator memory storage space and the [RCL], [STO] and [MR] keys. Number patterns included triangular numbers, the Fibonacci sequence, and Pascal’s triangle. Real numbers and absolute values were described. Below are two questions from Chapter 4 of Year 7 textbook:

- Q2 Evaluate:  $0.0\dot{1} + 0.1\dot{2} + 0.2\dot{3} + 0.3\dot{4} + 0.4\dot{5} + 0.5\dot{6}$

At Year 7, the topic “rate, ratio & proportion” was expanded to include reciprocals. Different strategies for problem solving were presented. Below is an example:

Q3 A passenger train travelled at a speed of 72 km/h. A man on the passenger train observed a goods train travelling at a speed of 54 km/h in the opposite direction. If the goods train passed him in 8 seconds, find the length of the goods train (Hint: model the problem and draw a diagram).

At this level, the topics covered were more extensive than BS in that compound interest, hire purchase, money exchange, property tax, income tax, value-added tax and GST were included.

At year 8, the “rate, ratio & proportion” topic was expanded to include “personal and household finances”. Below is an example:

Q4 Mr. Lee bought a second hand car for \$25 480 and made a down payment of \$10000. He arranged to pay the balance at the end of two years with compound interest at 4.75%. How much did he pay at the stipulated time?

### *CSS textbooks*

Only two chapters at Year 8 level out of the entire lower secondary mathematics programme were devoted to the Number strand. Below is a brief description of the chapter content:

Chapter 1 is on “roots of a number” which explains the meaning of square root of a number and the outcome in positive and negative signs. The worked example demonstrates a prior knowledge of indices.

Q1 For example:  $\because 0.0324 = 324 \times 0.0001 = 2^2 \times 3^4 \times 10^{-4} = (2 \times 3^2 \times 10^{-2})^2 = 0.18^2$   
 $\therefore \pm\sqrt{0.0324} = \pm 0.18$

Another example shows the use of algebra in problem solving:

Q2 Find the square root of  $a$  ( $a > 0$ ). The answer given is  $\pm\sqrt{a}$

Find the approximate value of the square root of a number  $\sqrt{2}$ .

Question 2 above shows the use of the iteration method as well as by calculation using a calculator. A worked example on finding the square root of numbers which were the product or quotient of 100, or 10000 of the base number was presented, followed by an exercise on finding the square root of various numbers. Below is an example:

Q3 Given:  $\sqrt{3} \approx 1.732$ ,  $\sqrt{30} \approx 5.477$

Find: (a)  $\sqrt{300}$  (b)  $\sqrt{3000}$  (c)  $\sqrt{0.03}$  (d)  $\sqrt{0.003}$

Similar instructional content applied in finding the cube root and  $n^{\text{th}}$  root of a number. Below is an example of the consolidation exercises:

Q4 (a)  $\sqrt[3]{-\frac{64}{125}}$  (b)  $\sqrt[3]{3\frac{3}{8}}$  (c)  $-\sqrt[5]{12.34}$  (d)  $-\sqrt[4]{8600}$

The instructional content includes an explanation of the meaning of real number and the comparison of negative and positive integers. It introduces fractional indices as a way to replace powers and roots. Below is a given problem:

Q5 Calculate to the nearest 0.001 the value of  $(2^{\frac{1}{2}} + 3^{\frac{1}{2}})^2$

Chapter 2 covered “radical expressions in the square root form”. A worked example was used to explain the absolute value: Using the reasoning  $a = \sqrt{a^2}$  for ( $a \geq 0$ ) leading to solution of  $\sqrt{(-5)^2} = |-5| = 5$  and NOT  $-5$ .

Rules for multiplication and division of radical terms in the square root form were given as below:  $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$  where  $(a \geq 0, b \geq 0)$   $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$  where  $(a \geq 0, b \geq 0)$ .

A consolidation exercise was as follows:

Q6 Simplify:  $\left(4a\sqrt{\frac{a}{b}} + \frac{2}{a}\sqrt{a^3b}\right) - \left(3a\sqrt{\frac{b}{a}} + \sqrt{9ab}\right)$

The content included using the “finding area of a rectangle” concept to introduce the multiplication of radical expressions leading to the 4 operations of radical expressions and rationalization of the denominators. Examples were as follow;

Q7 Evaluate:  $(\sqrt{x} + \sqrt{y})^2 + (\sqrt{x} - \sqrt{y})^2$

Q8 Simplify:  $\frac{3}{\sqrt{7} - 2}$

Q9 Simplify:  $\frac{1}{x + \sqrt{1+x^2}}$

### ***Summary of the Number strand***

It was very obvious that CSS operated at a much higher level of number strand content than the other textbooks. The number strand basic skills were not covered, which might be an indication that such skills were deemed unnecessary due to the fact that the students had already met these topics in previous years. The two chapters devoted to this strand were on “surds” and “roots of a number”, which led to solving numerical and algebraic problems with relatively high degrees of difficulties.

BS and SS portrayed similar topic organization in their textbooks. Test of Divisibility was a topic not covered in BS but was included in SS. SS had an assortment of mathematical anecdotes sprinkled throughout the content which made it a more informative book than the BS textbook. The exercises it included were of a higher order of complexity than those in the BS text, which supported the rationale behind these two sets of textbooks on their targeted groups of students. Most of the

topics on the list were covered in the first year of the lower secondary mathematics programme, which strongly implied that many of the skills were taught in the primary level and were being reviewed and consolidated at this level.

Amongst the three sets of Australian textbooks, PLC and BH had similar topic coverage and organization, which was hardly surprising as they both catered to the same curricular specification in the same state. However, PLC did post more challenging questions and cover the topics to a higher level than BH. It is worth highlighting that the Year 7 book at PLC was a new book that the school had just adopted for use, while Year 8 and 9 textbooks belonged to the same series. There was no noticeable gap, overlapping or discontinuity between the three books under the Number strand. The “divisibility test” was introduced in the new Year 7 textbook and was briefly mentioned in Year 8 text as a reminder.

BH textbooks were similarly structured to the PLC textbooks. However, the Year 9 textbook was from a different publisher to the Year 8 and 9 textbooks; hence the content organization differed rather distinctly from the other two books. The Year 9 textbook commenced every chapter with a skills-check which listed the necessary skills for the content, as well as an outcome list which stated the expected achievement after completing the chapter. It also stressed the Curriculum and Standard Framework (CSF II) in the content set-up. Many of the topics covered in Year 9 were an expansion of the Year 7 and 8 works. It covered “surds” but unlike PLC, it did not apply the concept to include “rationalization of denominators”.

RH differed most distinctly from the other two sets of Australian textbooks in its work-sheets approach to the content. There was limited content coverage due to the shorter lower secondary duration, consequently only some of the listed topics were covered. The exercises it included were mostly a straight forward consolidation of primary work. By comparison, the content of the RH test offered the least coverage of the number strand amongst the textbooks in this study.

Both PLC and CSS covered “rationalization of denominators” which is one of the more advance topics in the content. However, while PLC applied the concept in solving numerical problems, CSS extended it to include solving numerical and algebraic problems.

In conclusions, it can be stated that Chinese students have acquired and mastered most of the skills listed during their primary education, while the Singapore and Brunei students might have acquired the skills in the primary years, which were then consolidated or expanded to a higher level during the first year of the lower secondary education. For the Singaporean Express students it was more likely to be an expanding-on-the-acquired-skill, as the degree of difficulty presented in the exercises required some sound mastery of basic skills. However, some of the skills that were refined and mastered during the first year of the mathematics programme by CSS, SS and BS were covered by the Australian textbooks throughout the entire programme, though PLC did offer some challenging questions as compared with other textbooks. RH however, appeared to be working on a relatively basic skills consolidation which sat right at the other end of the “Degree of difficulties” scale, with CSS sitting at the other extreme end of the scale.

#### 4.4.2 The Measurement strand

Table 4.4 *Measurement strand topics*

Topics	Level (7 – Year 7; 8 – Year 8; 9 – Year 9)					
	BH	PLC	RH	BS	SS	CSS
Mass	7	7, 8	9	7		
Time	7	7, 8, 9	8, 9	7		
Length	7, 8, 9	7, 8	9	7	7	
Money				7		
Perimeter	7, 8, 9	7, 8, 9	8, 9	7	7	
Area	7, 8, 9	7, 8, 9	8, 9	7	7	
Volume	7, 8, 9	7, 8, 9	8	7	7, 8	
Capacity	7, 8, 9	8	8	7	7, 8	
Density				7	7, 8	
Circle	7, 8, 9	8	9	7, 8	7, 8	
Surface area of solids		9		7, 8	7, 8	
Area & volume of similar objects					9	
Estimation and approximation	9	9	9	7		
Coordinate grids			8			
Scales			8		8	
Bearings		9	8	9	9	
Pythagoras’ Theorem	9	9		9	8	
Trigonometry ratio	9	9		9	8, 9	9
Applications of trigonometry	9	9		9	8, 9	9
Sine rule, Cosine rule					9	9
Gradient						9
Three-dimensional problems					9	

### ***BH Textbooks***

The Year 7 text started with a description of the metric system along with a table of units of measurement. Perimeters of regular and irregular shapes and the circumference of circles were included. Areas of irregular shapes, rectangles, triangles; volume of rectangular prisms and capacity were also covered. An example of the year 7 questions follows:

- Q1 A ship has a rectangular storage area 15 m long, 10 m wide and 2.8 m high.
- (a) What is the volume of the storage area?
  - (b) How many boxes of dimensions  $1\text{ m} \times 0.5\text{ m} \times 2.5\text{ m}$  would fit in the storage area?

The Year 8 text expanded on the Year 7 work to include the circumference of circles, areas of parallelograms, trapeziums, circles and combined shapes, the volume of rectangular prisms, triangular prisms, cylinders and capacity. The surface area of a rectangular prism and formulae for these items were included. Below is a question:

- Q2 What is the area of the largest circle that can be cut from a square with sides measuring 28 cm?

Year 9 consolidated on past learning and expanded to include more complex questions like finding the areas of prisms of different cross-sectional areas. It included an investigation on finding the area of an ellipse as well as a section on errors and approximations, which highlighted the practical aspects of measurements. Different proofs of Pythagoras' theorem were presented. Two questions from the exercises are given below:

- Q3 What happens to the area of a circle if you double the radius?  
(Hint: Find the areas of circles with radius 5 cm, 10 cm and 20 cm, and then compare your answers.)
- Q4 A children's slide has a vertical ladder 1.58 m high. Find the angle the slide makes with this ladder if it is 2.35 m long.

### *PLC Textbooks*

The Year 7 book presented the various topics in a colourful and interesting manner with many pictures and sketches of the shapes and figures. Area of rectangles, parallelograms and volume of prisms were included. Below is a question given in the exercises:

- Q1 An organism under investigation is in the form of a cuboid which measures 2 cm tall by 3 cm wide by 4 cm long at noon. It doubles its length, width and height every 2 hours.
- (a) Find the organism's volume at 2-hourly intervals from noon to midnight.
  - (b) Express the volume at each time interval as a percentage of its volume at noon.

Year 8 consolidated and expanded year 7 work. The symbol  $\pi$  was explained in detail. Area of rectangles, squares, triangles, parallelograms, trapezium, circles and composite figures were included. Volume of rectangular prisms, triangular prisms, cylinders and other solids were also included. The 24 hour clocked was discussed. A question from the text follows:

- Q2 At what rate per minute is a phone call charged if a call made at 0920 and finished at 0944 cost \$25.48?

Year 9 content was similar to that in BH. The chapter on "estimation and approximation" was very well presented, which also covered numerical method in Algebra. Unlike BH, nets of three-dimensional figures and bearings were discussed. Below are two questions from the text:

- Q3 Three sticks of equal length,  $x$ , are joined to form an equilateral triangle. If the perpendicular height of the triangle is 12 cm,
- (a) find the value of  $x$ , and
  - (b) hence, find the total length of the three sticks.

- Q4 A ship steams for 150 km on a bearing of  $040^\circ$ .
- (a) How far East does it travel?
  - (b) How far North does it travel?

***RH Textbooks***

The Year 8 text began the Measurement strand content by comparing areas and perimeters of regular and irregular shapes followed by finding areas of rectangles, parallelograms and triangles. Volume and capacity was included. Interpreting scale was introduced at a later chapter which included coordinate grids and bearing. The chapter on time was more elaborate with exercises on TV programmes and train time tables. Below are two questions cited from the text:

- Q1 A football match started at 2.40 pm, went for four quarters each lasting 2 minutes, and there was a five minute break between each quarter. When did the match finish?

The match finished at \_\_\_\_\_ .

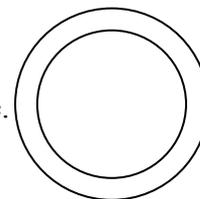
- Q2 In each of the following statements the appropriate unit of capacity or volume is missing. Insert the most appropriate unit in each case.
- (a) A tablespoon can hold 5 \_\_\_\_\_ of liquid.
  - (b) An office waste paper bin has a capacity of 15 \_\_\_\_\_ .
  - (c) An oxo cube has a volume of 8 \_\_\_\_\_ .
  - (d) A large hay bale has a volume of 3 \_\_\_\_\_ .
  - (e) I have a milk jug with a capacity of 1500 \_\_\_\_\_ .

The Year 9 text started with revising the metric system and time. The Year 8 textbook did cover ‘time’ but not ‘metric system’ which presumably was covered during the primary school years. Difference between mass and weight were highlighted for the benefit of students, however it gave a feeling that the ‘cart was put before the donkey’ on the presentation of area and perimeter content before the revision of the metric system. It expanded the area and perimeter skills to include formulae for the areas of rectangles, parallelograms, triangles and trapeziums. Circle

vocabularies, formulae of circumference, area, arc length and sector area were also included. Two problems from the exercises are given below:

Q3 Accurately draw two different trapeziums with each trapezium having parallel sides of length 7 cm and 5 cm and an area of  $24 \text{ cm}^2$ .

Q4 A circular enclosure at a zoo is of radius 10 m. The enclosure is to have a 2 m wide ditch all round the outside of the enclosure. Two fences are to be erected, one along the inside circle of this ditch and another along the outside circle. What total length of fencing will be required, rounded up to the next 10 m?



### ***BS textbooks***

The Year 7 text introduced the SI units and the instruments of measurement and included a section on ‘Limits of accuracy’ with a formula for largest possible error in measurement, length, mass, capacity, time and Singapore money. Perimeter and area of circle, rectangle, square, parallelogram, triangle and trapezium; Volume and surface area of prism and solid with uniform cross-sectional area and the density were covered. One question from the exercises is given below:

Q1 The diameter of a circular table top is measured as 105 cm. Give  
(a) the absolute error of this measurement,  
(b) the shortest possible circumference of the table top.  
Take  $\pi$  as 3.14.

The Year 8 text covered the length of an arc and area of a sector, surface area and volume of a pyramid, cone and sphere, for example:

Q2 Find the slant height of a cone whose base radius is 1.4 m and whose area of curved surface is  $132 \text{ m}^2$ . (Take  $\pi$  to be  $\frac{22}{7}$ ).

The Year 9 text covered Pythagoras' theorem, trigonometry and application. Two questions from the exercises follow:

Q3 A man is standing between two buildings, one 45 m tall and the other 62 m tall. The angles of elevation of the tops of these buildings from the man are  $55.4^\circ$  and  $68^\circ$  respectively. Find the distance between the buildings, giving your answer correct to 1 decimal place.

Q4 A hiker starting from point O walked 4 km on a bearing of  $126^\circ$  to point P. He then changed direction and walked on to point Q, due east of O, where  $\angle OPQ = 90^\circ$ . Calculate

- (a) the distance PQ,
- (b) the distance OQ.

Give your answers correct to 2 significant figures.

### ***SS textbooks***

The Year 7 text started with a brief review of SI units, followed by perimeter and the area of a rectangle, parallelogram, triangle, trapezium and circle, as well as circumference. The volume, surface area of solids, capacity and density were included. The solids included cuboid, prism, cylinder and hollow cylinder. The question below illustrates the complexity of the problems in the exercises:

Q1 A railway tunnel 147 m long is to be bored with a circular cross section of radius 5 m. What volume of soil has to be excavated? If the soil is to be taken away in wagons of capacity  $75 \text{ m}^3$  each, how many wagons are needed?

The Year 8 text devoted a chapter to scales and maps, where linear scale, area scale and representative fractions (R. F.) were covered. It also included Pythagoras' theorem, arc length and area of sectors, volume and surface area of pyramid, right circular cone and sphere. Below are two questions:

- Q2 The plan of a shopping complex is drawn to a scale of 1 : 400.
- (a) Find the length, in metres, of a corridor which is represented by a line 24.5 cm long on the plan.
  - (b) The area of the floor of a fast food restaurant is  $400 \text{ m}^2$ , find its area on the plan.
  - (c) A supermarket on the plan occupies an area of  $0.25 \text{ m}^2$ , calculate its actual area in hectares.
- Q3 Given a triangle ABC where  $(BC)^2 = 370$  units,  $(AC)^2 = 74$  units and  $(AB)^2 = 116$  units, calculate the area of the triangle.  
[Hint:  $370 = 9^2 + 17^2$ ,  $74 = 5^2 + 7^2$  and  $116 = 4^2 + 10^2$ ]

The Year 9 text expanded on the past works to cover finding area and volume of similar figures and solids using ratio. The trigonometrical ratio was extended to include obtuse angles. The Sine and Cosine rule, area of triangle using  $(\frac{1}{2} a b \sin c)$  and more advanced 3-dimensional problems were included. One question from the exercises follows:

- Q4 A man on top of a lighthouse, P, of height 80 m above sea level observed two boats A and B. If the angle of elevation of A is  $35^\circ$  and that of B is  $40^\circ$  and  $\angle APB = 55^\circ$ , calculate the distance between A and B giving your answer correct to the nearest 0.1 metre.

### ***CSS textbooks***

CSS devoted just one chapter to the measurement strand on trigonometric ratios of acute angles and applications. It discussed the derivation of tangent, cotangent, sine and cosine of the acute right-angled triangle, derived the standard angles of  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$  to solve problems based on such angles with the use of a calculator. Problems involved using trigonometry to find: angles, sides and area of different type of triangle; the angle of elevation and depression were used in problems on the cranes in lifting, the flight path of a plane during taking off and landing, the height of a tall

building, the angle of a tunnel, drains, roads etc. The term “gradient” was introduced.

Word problems were set on the practical application of the trigonometry functions. Below are two such questions:

Q1 Solve:  $2 \sin^2 60^\circ - \cos^2 30^\circ + \tan 60^\circ \cdot \text{ctg} 60^\circ$

Q2 On a slope, the trees are planted at a horizontal distance of 5.5 m apart. The angle of elevation of the slope is  $24^\circ$ . What is the distance along the slope between two trees (correct to 0.1 m)?

### ***Summary of the Measurement strand***

CSS stood out as the set of textbooks with the smallest Measurement strand weighting. It devoted only one chapter at Year 9 to “trigonometric ratio” out of the entire three year mathematics programme. The lack of coverage of the other topics such as Area and Volume of Figures and Solids led to two possible conclusions: first, the Chinese students had covered the topics during their primary school years, or second, the Chinese curriculum may not have included these topics in their curricular design. From the content depth of the CSS textbooks, I would infer that it was more likely that the Chinese students had learned at least some of the topics prior to their secondary education.

SS covered the area and volume topics during Year 7 (Sec 1) and expanded the skills to include solving more challenging questions at year 8 and 9. The 3-dimensional problems and “Area and volume of similar figures and solids” were probably the most rigorous and challenging topics in the Measurement strand, and SS was the only textbooks which covered these topics.

BS covered similar topics as SS but with a much “watered down” content. However, most of the area and volume topics were covered during the first year of the secondary mathematics programme. In fact, BS had similar content coverage as PLC

and BH. The vital difference between BS and PLC, BH was that while BS covered content in one year, PLC and BH spread out the same content over the three year duration. It was also worth noting that BH did not include “bearing” and “Nets” in the content.

RH covered the least topics on the list in relation to other textbooks. The questions it included in the worksheet were rather basic and of lower order. There appeared to be an overlapping of topic content at both Year 8 and 9 level.

In conclusion, SS offered a very rigorous and challenging Measurement strand for the lower secondary mathematics programme. The topics were systematically arranged and expanded to encompass lower to higher order questions with much consolidation at every stage.

CSS devoted a single chapter to trigonometric ratio which included the key topics. There were many examples on the use of calculator; with an appendix of the Sine, Cosine and Tangent tables at the back of the book, which could be an indication that some students might not have had the use of a calculator. Though it operated at a high level in terms of topic content, it lacked the diversity of SS textbook on the higher order topics.

BS, PLC and BH all sported similar topics and content, with PLC offering the “richest” Measurement diet among them. BS however completed most topic content during the first year while PLC and BH spread it over the three years.

RH offered the minimalist measurement strand content amongst the textbooks, which could see its students being placed at a disadvantage if they were to compete with students who used other textbooks.

### 4.4.3 The Space strand

Table 4.5 *Space strand topics*

Topics	Level (7 – Year 7; 8 – Year 8; 9 – Year 9)					
	BH	PLC	RH	BS	SS	CSS
Coordinates, maps and bearings	7, 8	7, 9				
Triangle	7	7, 8, 9	8	7	7	7
Quadrilaterals	7	7, 8, 9	8	7	7, 8	7, 8
Polygons and polyhedral	7, 8, 9	7, 8	8, 9	7	7, 8	9
Solids		8			7	
Nets (in Measure strand)	8	8	8			
Angles, parallel & perpendicular lines	8, 9	7, 8, 9	8	7	7	7
Constructions	8, 9	7, 8		7	7	7, 8
Symmetry		8, 9	8, 9	8,	8	7
Perspective drawings	8	8				
Isometric drawings	8	8	8			
Oblique drawings		8	8			
Similar triangles	8, 9	8, 9	9	8	8, 9	9
Congruence triangles	8, 9	8, 9		8	8, 9	7
Circles properties				9	9	7, 9
Circle theorems				9	9	9
Transformation	8, 9	9	8, 9	9	8	
Geometric proofs						9
Coordinate geometry				9	9	

#### ***BH textbooks***

The Year 7 text covered maps and coordinates and included magnification using grids, bearings and contour; angle measurement, triangles and quadrilaterals and finding the angles of these figures; polygons, congruency and symmetry were included. Polyhedral and nets were also covered. It is worth noting that chapter 5 and 15 on “coordinates, maps and networks” and “coordinates and graphs” respectively were categorised under the Space strand in this book. Both topics would fall under the Measurement and Algebra strand in other textbooks.

Following are two questions from the exercises:

- Q1 (a) Plot the points on a graph using a scale of 1 cm for each unit on both axes.

$$A = (2, 1) \quad B = (5, 5) \quad C = (9, 1) \quad D = (12, 5)$$

- (b) Use the graph to answer the following questions:
  - (i) What is the length of AC and BD?
  - (ii) What is the length of AB and CD?
  - (iii) What is the name of the shape ABCD?

Q2 Using a ruler draw each of the following shapes.

- (a) A pentagon that has only one axis of symmetry.
- (b) A quadrilateral that has no axis of symmetry
- (c) A shape that has an order of rotational symmetry of 8 and eight axes of symmetry.
- (d) A hexagon with only two axes of symmetry.

The Year 8 text expanded on the “Maps and coordinates” content from Year 7 to include more consolidation questions on contour and coordinates. It also covered the topics as listed. Isometric dot papers were used for the drawing. Construction techniques on angle, regular polygons, bisecting angles and line segments were included. Below is one question on geometrical construction from the exercises:

Q3 Construct a regular dodecagon using a ruler and a protractor.

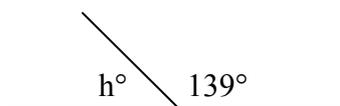
As on the list, Year 9 repeated and expanded some of the year 8 work. Calculation of angles in triangles and quadrilaterals, as well as similarity and congruency of triangles were covered. Below is an example:

Q4 Martin plays tennis at night under floodlights. When he stands 4.5 m from the base of a floodlight, he casts a shadow 1.4 m long. If Martin is 1.7 m tall, how high is the floodlight?

### ***PLC textbooks***

The Year 7 text covered topics as listed including angle properties of triangles, quadrilaterals and polygons. Maps, coordinates and bearing were covered. Exercises were on consolidation of concepts. An example from the exercise follows:

Q1 Find the value of  $h^\circ$ .



The Year 8 text expanded and extended the Year 7 work. It expanded the angles and parallel line theorems, angle properties of triangles and quadrilaterals to those of polygons. The properties of various quadrilaterals and polygons were clearly explained. There were numerous consolidation exercises – below is an example:

Q2 A quadrilateral ABCD is drawn inside a circle. (This is called a cyclic quadrilateral.) If  $AD \parallel BC$  and  $\angle ADC = 75^\circ$ , find:

- (a)  $\angle BCD$
- (b) the angle sum of the quadrilateral.

Year 9 was mainly consolidating on the year 8 work on the topics as listed in Table 4.5, however transformations were covered as an enrichment topic. Two questions from the exercises follow:

Q3 A slide projector enlarges a slide by 20 times so that the ratio of the side length of the picture on the wall to the side length of the slide is 20 : 1. What is the ratio of the area of the picture to the area of the slide?

Q4 Prove that the angle sum of a triangle ABC is  $180^\circ$ .

### ***RH textbooks***

The Year 8 text covered the topics as listed in Table 4.5. The chapter “Designing a Logo” covered transformation where reflection, rotation, translation and dilation for both plane figures and solids using grid and isometric papers.

Year 9 continued and expanded on some of the Year 8 work. Below are four of the tasks:

- Q1 (a) Determine the sum of the interior angles of a regular hexagon.  
 (b) Determine the size of each interior angle of a regular hexagon.  
 (c) Determine the size of each exterior angle of a regular hexagon.
- Q2 In the quadrilateral ABCD,  $\angle DAB = 105^\circ$ ,  $\angle ABD = 25^\circ$ ,  $\angle CBD = 50^\circ$  and  $\angle BCD = 70^\circ$ . Determine the size of  
 (a)  $\angle ABC$   
 (b)  $\angle BDC$   
 (c)  $\angle ADC$
- Q3 A solid cube is enlarged by a scale factor of 2.  
 i.e. lengths in final cube : corresponding lengths in original = 2 : 1  
 What is the ratio?  
 (a) Volume of the final cube : volume of the original cube  
 (b) Surface area of the final cube : surface area of the original cube
- Q4 Find out what you can about “The Golden Ratio” and write a report about the subject.

### ***BS textbooks***

The Year 7 text covered topics as listed in Table 4.5. Construction included copying an angle, bisecting a line and an angle, perpendicular line from a point to a given line and bisecting a line. A question from the exercises follows:

- Q1 Draw a line AB with length 10 cm. Through C, the midpoint of AB, construct a line perpendicular to AB. What do we call this line? Through P, a point on the perpendicular line and 7 cm from AB, construct a line parallel to AB. What is the distance between these two parallel lines?

The Year 8 text covered symmetry, as well as congruency and similarity of plane figures and solids, including order and centre of rotational symmetry. One question follows:

- Q2 Point A and B on the side YZ of a triangle XYZ are drawn such that A is between Y and B. Given that  $XY = YZ$  and  $\angle YXA = \angle BXZ$ , show that  $YA = BZ$ .

The Year 9 text covered circle properties and theorems, translation, reflection, rotation, enlargement and a combination of these transformations. It included Coordinate Geometry in a chapter on “Straight Line Graphs”. Two questions from the exercises are cited below:

- Q3  $R_1$  is an anticlockwise rotation of  $90^\circ$  about the origin O.  $R_2$  is a half turn about O.
- Using a scale of 1 cm to represent 1 unit on each axis, draw the x and y axes for  $0 \leq x \leq 7$  and  $0 \leq y \leq 12$ . Draw and label A.
  - On the same diagram, draw the image of A under
    - transformation  $R_2$ . Label the image B.
    - transformation  $R_2$  followed by transformation  $R_1$ . Label the image C.
  - Describe the single transformation that maps A onto C.
- Q4 The diagram shows a kite with vertices P  $(-2, 4)$ , Q  $(-3, 2)$ , R  $(0, -2)$  and S  $(0, 3)$ .
- Find the perimeter of the kite.
  - Find the distance between the midpoint of SR and Q.
- Give your answers correct to 2 decimal places.

### ***SS textbooks***

The Year 7 text covered some topics as listed in Table 4.5. One question follows:

- Q1 Construct triangle ABC such that  $AB = 12$  cm,  $BC = 11$  cm and  $AC = 9.6$  cm. Construct the perpendicular bisectors of AB and BC. Let the two bisectors meet at K. With K as centre, construct a circle to pass through A, B and C. Find out the name of this circle from your library.

The Year 8 text introduced symmetry, similar and congruent triangles and expanded further work on polygons. It covered reflection, rotation, translation, enlargement and a combination of transformations. Below is one question from the exercises:

- Q2 The transformation P is  $90^\circ$  clockwise rotation about the origin and the transformation Q is a reflection in the x-axis. Describe a single transformation equivalent to
- (a) PQ;
  - (b) QP.

Year 9 expanded further work on similar and congruent triangles; and covered circle properties and theorems as well as Coordinate Geometry.

- Q3 The tangent from T touch a circle at X and Y. A chord YZ, parallel to TX, is drawn. If  $\angle YXT = 60^\circ$ , find  $\angle YXZ$ .
- Q4 The line  $3x + 7y = 13$  is parallel to the line  $kx + 8 = 3y$ . Find the value of k.

### ***CSS textbooks***

The Year 7 text covered the listed topics in greater details than other textbooks, including: for triangles, the terms “median” and “altitude” were introduced; for circles, arc was differentiated into superior and inferior arc.

Year 8 work was devoted to discussion on Euclid’s element with numerous geometric proofs, as well as covering geometrical construction and an introduction to the term “locus”.

Year 9 content covered inscribed circle in triangles and quadrilaterals.

Overall the CSS textbooks devoted much of its content on geometrical proofs. Below are three items:

- Q1 In triangle ABC,  $AB = c$ ,  $BC = a$ ,  $CA = b$ ,  $\angle B \neq 90^\circ$ . Prove:  $a^2 + c^2 \neq b^2$
- Q2 In triangle ABC,  $\angle B = 59.5^\circ$ ,  $\angle A = 60.5^\circ$ , arrange AB, BC, CA in ascending order of their lengths.
- Q3 To prove, for a right angle triangle, the hypotenuse is longer than each of the other two sides.

### *Summary of the Space strand*

For CSS textbooks, the second largest strand by weighting is the Space strand. The strand weighting is almost 40% as compared to less than 20% in the other textbooks. Hence it was rather surprising to note that the topics covered in the CSS textbooks were similar to that for the SS textbooks. However, CSS placed a strong emphasis on Euclidean proofs of the various theorems. The worked examples were presented as a discussion. The content included the least number of problems by comparison with the other textbooks.

SS covered the topics at a greater depth and width than other textbooks, though not on the numerous proofs as included in the CSS content. SS also included in its consolidation exercises many challenging questions. The higher level topic “Coordinate Geometry” was introduced at Year 9 level. Overall it offered a rich question bank for works on the Space strand.

BS covered similar topics as SS but with less width and depth. The consolidation questions were a watered-down version of those offered in the SS textbooks, with fewer challenging questions.

PLC and BH covered similar topics. However, PLC offered more depth and width in its content than BH. Both textbook contents were similar to BS except they were spread over a longer duration than BS. The exercises included were not as challenging as those in BS. RH again covered the least number of topics and with less depth than other textbooks, however, it has a very detailed presentation of isometric drawing in the Year 8 textbooks.

The topic “Surface area of solids” or “Nets” was categorised under the Space strand for the Australian textbooks, however it was categorised under the Measure strand for the three sets of Asian textbooks. It was also worth noting that “Isometric drawing” was missing from the Asian text content, while “Circle properties and theorems” was not covered in the Australian textbooks.

In conclusion, both SS and CSS textbooks covered similar topics with great depth and breadth. However, each placed a different emphasis on the content structure. CSS stressed proofs of concepts and identities, SS aimed at consolidating concepts and skills through its rich question bank. BS appeared to be a watered-down version of SS with similar depth as PLC. PLC offered a more rigorous strand content than BH, while RH covered fewer topics and equipped students with just the basic skills in these topics.

#### 4.4.4 The Chance & Data strand

Table 4.6 *Chance & Data strand topics*

Topics	Level (7 – Year 7; 8 – Year 8; 9 – Year 9)					
	BH	PLC	RH	BS	SS	CSS
Probability: equally likely outcomes	7, 8, 9	7, 9	8			
Probability: long-run proportion	7, 8, 9	7, 9	8			
Selection without replacement	8	8, 9				
Simulation	8, 9	8, 9				
Tree diagrams	8	8, 9				
Tally	7	7, 8, 9	8	8	7, 9	9
Pictograph/ ideographs	7	7, 8, 9	8, 9	8	7	
Column and bar graphs	7	7, 8, 9	8, 9	8	7	
Double/multiple bar graphs	9	7			7	9
Line graphs	7, 8	7, 8, 9	8, 9	8	7	9
Dot & frequency distribution diagram	7	7, 8, 9	9	8, 9	7	9
Circle/pie graph	7	7, 8, 9	9	8	7	9
Scatter plots	9		9		8	
Stem and leaf plot	7, 8, 9	7, 8, 9	8, 9		7	9
Venn diagram		7, 8, 9				
Frequency table	7, 8	7, 8, 9	8		7, 9	9
Histograms & frequency polygons	9	9		8, 9	7, 9	9
Spreadsheet charts	7, 8	9				
Mean, median, mode & range	7, 8, 9	7, 8, 9	8, 9	8, 9	8, 9	9
Inter-quartile range	8, 9	8, 9				
Box and whisker plots	9	8, 9				
Standard deviation, variance						9

***BH textbooks***

The Year 7 text included determining the theoretical probability of events, estimating the probability of events and to simulate situations and drawing inferences from data. It also included data analysis using graphical techniques and technology such as spreadsheets and graphic calculators to provide displays of data. Below appears one item:

Q1 Sally has been practicing shooting netball goals. In 100 attempts, she has scored 70 goals.

- (a) Estimate the probability that Sally will shoot a goal at her next attempt.
- (b) Comment on how reliable this estimate is.

The Year 8 text content included probability and simulation; making predictions on the basis of samples; interpreting and evaluating information contained in tables; visual displays and databases, and reporting on methods of data collection. One item follows:

Q2 The stem plot shows the numbers of butterflies found in different protected areas in Victoria.

- |   | Stem | Leaf      |
|---|------|-----------|
| (a) In how many protected areas was the data recorded?            |      |           |
| (b) What was the smallest number of butterflies found in an area? | 0    | 0 0 1 5   |
| (c) What was the largest number of butterflies found in an area?  | 1    | 1 2 5 8   |
|   | 2    | 0 2 3 3 9 |
| (d) In how many areas were 30 or more butterflies found?          | 3    | 1 2 2 5   |
| (e) What was the total number of butterflies found?               |      |           |

The Year 9 text required descriptions in words of the likelihood of an event happening; calculating the probability of simple events occurring by listing all

possible outcomes, and describing the probability of an event. Below are two items from the exercises:

Q3 The probability of rain on a particular day in June is approximately  $\frac{1}{2}$ . Use a six-sided die to simulate the 30 days of June and find an estimate of how many days it will rain in June.

Q4 These are the numbers of chocolate bars produced in a factory in each hour for 20 hours. For these data, 146, 128, 133, 138, 140, 125, 142, 129, 136, 142, 126, 129, 150, 134, 126, 121, 128, 143:

- (a) Find the interquartile range.
- (b) Draw a box-and whisker plot.

### ***PLC textbooks***

The Year 7 text content included using the language of chance in everyday situations, comparing probabilities using language, using language to estimate a probability by using the results of simple experiments, finding the probability of a simple event, and predicting and testing probabilities using spinners. It also included representing and analysing data using different plots and graphs and Venn diagrams. Below appears one question:

Q1 Survey your class to find out who has blond hair and who has blue eyes. Represent the information in a Venn diagram.

There appeared to be an overlapping of some materials between the Year 7 and 8 textbooks which may have been due to the fact that they belong to different series. The year 8 content included explanations on types of data, collecting data (surveys and samples) and interpreting various forms of data and the terms (range, median, mode, mean), ordered data and measures of spread (lower, upper and interquartile range). It also included chance and probability definitions (outcomes, event, and probability) leading to the construction of tree diagrams. One question follows:

- Q2 Two dice are tossed. Use a tree diagram to find the probability of getting no sixes.

The Year 9 text discussed chances, problem solving on probability using the set strategy and formula, analysed compound events using tree diagrams, simulation and investigation of the odds. It included interpretation and comparison of data and statistics as well as simulation:

- Q3 A survey has shown that 20% of the population of a particular country centre does not want a by-pass road around their town.
- (a) Out of every 100 of the town's population, how many would you expect not to want the by-pass road?
  - (b) If one of the townspeople were chosen at random, what is the probability that this person would not want the by-pass road?
- Q4 There are 13 horses running in the race and one of them has to win, or at least draw. Theoretically what should all the probabilities for the individual horses add to? Express each horse's odds as a probability and add them. What is the result? Can you explain this?

***RH textbooks***

The Year 8 text covered statistics including data collection, analysis and interpretation and discussed the various data representations and measures of spread. Below are two questions:

- Q1 Five numbers have a range of 8, a median of 9, a mode of 7 and a mean of 10. Determine the five numbers.
- Q2 Tanya's height at each birthday from age 2 to age 16 are given below, each height being measured to the nearest centimetre. Display the information graphically choosing a graph style that you consider appropriate for this type of data.

<u>Age in years</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
Height (cm)	86	94	103	108	115	121	128

<u>Age in years</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
Height (cm)	133	140	147	154	158	163	165	166

Year 9 expanded on Year 8 work with a revision of various types of graphs and data interpretation. Two questions follow:

Q3 In a particular year it was estimated that 280 000 tonnes of paper products were used in Western Australia. This use could be classified as follows:

Packaging	120 000 tonnes
Newsprint	75 000 tonnes
Office stationery	65 000 tonnes
Tissue paper	20 000 tonnes

- Explain why a pie chart would be a suitable display for this data.
- Display the information as a pie chart.

Q4 For ten cars, the engine size and results of a road test to see how far the car travels on 10 litres of fuel, are given below:

<u>Engine size (L)</u>	<u>3.0</u>	<u>1.9</u>	<u>2.8</u>	<u>6.0</u>	<u>2.0</u>	<u>1.3</u>	<u>5.0</u>	<u>1.6</u>	<u>4.0</u>	<u>2.2</u>
Distance on 10 L (km)	105	114	100	69	132	143	70	131	85	103

- Display this information as a scattergraph with engine size on the horizontal axis and distance travelled on 10 litres on the vertical axis.
- Comment on any general trends suggested by your graph.

### ***BS textbooks***

The Year 7 text did not contain Chance and Data content.

Year 8 introduced statistics and covered graphical representation such as: pictograms, line graphs, bar charts, histograms, pie charts. It also covered “average” included mean, median and mode. Below are three questions:

- Q1 Sometimes, graphs used in advertisements are misleading. An example is the graph given on page 122 where the vertical scale does not start at zero. Here, a first look at the graph gives us the impression that the slimming course is very effective; the girl lost almost half her original mass in five months. However, we know that is not true. Collect other examples of misleading graphs from newspapers and magazines and present them to the class.
- Q2 A pie chart is used to represent the sale of three products A, B and C. The angles of the sectors representing A, B and C are  $90^\circ$ ,  $120^\circ$  and  $150^\circ$  respectively. Given that the total sale is 480 kg, calculate the amount, in kilograms, of each product sold.
- Q3 A survey of 200 children was done to find out the number of hours each child spent in reading story books in a week.

<u>Number of hours</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Number of children	25	40	35	70	20	10

- (a) Represent this information on a histogram.
- (b) How many hours did these children spend in reading story books together?

Year 9 covered grouped data including histogram and frequency polygons. Below is one item:

Q4 The table below shows the burning times of 50 candles of the same length.

Time (in h)	2.0 – 2.4	2.5 – 2.9	3.0 – 3.4	3.5 – 3.9
Frequency (f)	14	24	10	2

- (a) Find the modal class.
- (b) Find the mean burning time.

***SS textbooks***

The Year 7 text covered statistics on collection, classification and tabulation of data; reading and interpreting tables and statistical diagrams; construction of bar graphs, pie charts, pictograms, stem and leaf diagram, line graphs and histograms with equal intervals. Three questions follow:

Q1 During a one-month period, the number of sick leave days of 100 workers in a factory was recorded as shown in the table below:

No. of sick leave days	0	1	2	3	4	5
No. of teams	15	19	8	7	1	0

- (a) How many teams scored more than two goals?
  - (b) Draw a histogram to represent the data.
- Q2 A factory produces three products, A, B and C, in the ratio of  $1 : x : 5$ . What the output is illustrated by a pie chart, the angle of the sector representing the output of C is  $120^\circ$ . Find  $x$ .

The Year 8 text covered measures of central tendency: the mean, median and mode of a set of data.

Q3 A box contained five cards numbered 1, 2, 3, 4 and 5. A card was drawn from the box, its number noted and then replaced. The proof was repeated 100 times and the table below shows the resulting frequency distribution.

<u>Card</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Frequency	21	$x$	$y$	18	17

- Show that  $x + y = 44$
- If the mean of the distribution is 2.9, show that  $2x + 3y = 112$ .
- From (a) and (b), find the value of  $x$  and of  $y$ , and state the mode and the median of the distribution.

The Year 9 text covered frequency distribution including histograms and frequency polygons with calculation on grouped frequency distribution. Below is one question from the exercises:

- Q5 In an examination, each pupil in a group scores either 5, 10 or 15 marks. The number of pupils scoring each mark is shown in the table below:

<u>Mark</u>	<u>5</u>	<u>10</u>	<u>15</u>
Number of pupils	8	12	$x$

- If the mode is 10, write down the range of values of  $x$ .
- If the median mark is 10, write down the largest possible value of  $x$ .
- Using the value of  $x$  found in (b), calculate the mean mark.

### ***CSS textbooks***

Chance and Data content was addressed in one chapter in the Year 9 textbook. The chapter covered basic statistics and explained the meaning of statistics and the terminology: data collection, organization and representation (tabulations, pie and line graphs, bar charts, stem and leaf plots); measure of central tendency of a set of data; histograms and frequency distribution histograms. It covered the spread of data, variance & standard deviation and their application as well as the use of calculators. It also included examples on fieldwork of statistics. Below are three questions:

- Q1 Siow Lim knows his own mathematics test score as well as the highest score, lowest score, mean score and modal score of the class of 51. How does he know if he is above 26<sup>th</sup> place in class.
- Q2 Calculate the standard deviation of the followings;
- (a) 7, 7, 8, 10, 14, 14;
- (b) 107, 107, 108, 110, 114, 114.
- Q3 From among your classmates, collect the height of not less than 20 boys and 20 girls. Construct the histograms of frequency distribution of the height of your classmates.

### *Summary of the Chance and Data strand*

In general, the Chance and Data strand has the lowest strand weighing for all textbooks except CSS, of which the least strand weighting is the Measurement strand. BH has the highest Chance and Data strand weighting of 15.6%, followed by PLC of 10.8%, BS and SS of 8.5%, RH of 7.2% and lastly CSS of just 5.6%. It is important to note that the three sets of Australian textbooks covered both “probability” and “statistics” content while the Asian textbooks focused only on “statistics”.

Both BH and PLC covered similar Chance and Data topics during the lower secondary mathematics programme. PLC might have a smaller strand weighting than BH, however, it being a thicker set of books than BH, PLC managed to cover the topics extensively and adequately with much depth and width. The topics were covered and expanded on at every level with some interesting and challenging exercises for consolidation purpose. It is also the only textbook with coverage on “Venn diagram”. For BH, many of the data representations were covered during Year 7 and were not reviewed at higher level. RH covered less number of topics than BH and PLC. The questions it included were adequate for consolidation of the topics covered though the question type was less varied than PLC and BH.

BS, SS and CSS covered less Chance and Data content material than the BH and PLC with the “probability” content completely omitted. Among the three Asian textbooks, BS covered the least number of topics and did not commence on this strand until the second year of the three year programme, with some consolidation work on “average” and “histogram and frequency distribution” during year 9. By comparison with other textbooks, the presentation of the topics in BS was rather basic without much challenging or interesting examples and questions.

CSS did not commence on Chance and Data until the final year of the lower secondary programme and devoted just one chapter to this strand. It then spread itself very thinly to cover a relatively large number of topics with very few consolidation exercises. However, it is the only textbook which introduced the term “standard deviation and variance” at this level.

SS introduced and consolidated on most of the topics during the year 7 and 8 of the lower secondary mathematics programme, and expanded further on “histogram and frequency distribution” during year 9. The discussion and the exercises offered were relatively more varied and challenging than BS and CSS.

In conclusion, the Asian textbooks offered a thinner diet for Chance and Data than their Australian counter-parts. The most significant omission was the section on “probability” which was very well presented in the Australian textbooks. PLC had an extensive coverage of Chance and Data content providing most topics with yearly revision at every level before expanding to a more complex height. It was important to highlight that “Venn diagrams” which were covered in detail in PLC, were not touched on in BH. Considering the fact that both sets of textbooks subscribed to the same state curriculum, it raised the possibility that “Venn diagrams” might be an optional topic in the curriculum.

## 4.4.5 The Algebra strand

Table 4.7 *Algebra strand topics*

Topics	Level (7 – Year 7; 8 – Year 8; 9 – Year 9)					
	BH	PLC	RH	BS	SS	CSS
Number pattern	7	7	8			
Symbols and rules	7	7, 8	8	7	7	
Linear equations in one variable	7, 8, 9	7, 8, 9	8	7, 8	7, 8, 9	7, 8
Linear equations in two variables					8	7, 8
Inequalities	7, 8, 9	7, 8, 9		8, 9	9	7
Algebraic addition and subtraction	7, 8, 9	7, 8, 9	8, 9	7, 8	7, 8	7
Algebraic multiplication & division	7, 8, 9	7, 8, 9	8, 9	7, 8	7, 8	7, 9
Algebraic distributive law	7, 8, 9	7, 8, 9	8, 9	7, 8	7, 8	7
Algebraic formulae and manipulation	7, 8, 9	7, 8, 9	9	7, 8	7, 8, 9	7, 9
Algebraic fractions, fractional equations	8, 9	8, 9	9	7, 8, 9	7, 8, 9	7, 9
Algebraic expressions: expansion	9	8, 9	8	8	8	7, 9
Algebraic factorisation	7, 8, 9	8, 9	9	8	8	7, 9
Simultaneous equations		8, 9		8	8, 9	7, 8, 9
Sets		8, 8				
Variations (direct & inverse)				9	9	8
Rectangular coordinates & graphs	8	7, 8, 9	8, 9	8, 9	8	7, 8
Linear graphs	8, 9	8, 9		8, 9	8	8
Parabola	9	9		8, 9	8	8, 9
Travel graphs	9	9		8, 9	8, 9	
Graphical solution of equations	9	9	9	8, 9	8, 9	7, 8, 9
Quadratic equations	9	9		8, 9	8, 9	7, 8, 9
Completing the square				9	9	8, 9
Functions		9			8	8, 9
Common logarithms		9				
Golden section		9				9
Equations of higher degrees						9
Systems of equations in 3 variables						7, 9
Graphs of half plane		9				

### ***BH textbooks***

The Year 7 text covered number patterns, symbols and rules; equations and inequations. Below is a question selected to give an idea of the content depth and breadth:

- Q1 The entry fee at the show is twice what Trinh paid three years ago. If the new price is \$15, write an equation and solve it to determine what the entry fee was three years ago.

The Year 8 text covered variables and relations; graphs and linear equations:

Q2 Show each of the following on the number line.

(a)  $x > -2$                       (b)  $-1 \leq x \leq 3$

Q3 A company manufactures soft toys. Its costs, \$C, are given by the rule  $C = 2n + 3500$ , and its revenue, \$R, by the rule  $R = 3n$ , where  $n$  is the number of soft toys produced. Sketch the graphs of  $C$  versus  $n$  and  $R$  versus  $n$  on the same set of axes and determine the break-even point.

The Year 9 text covered expansion and factorization, linear relationships and quadratics. Below are three of the questions:

Q4 Factorise:      (a)  $9c^2 + 66cd + 121d^2$   
                          (b)  $3x^2 - 18x - 48$

Q5 A distance - time graph is represented by the equation  $d = 30t + 20$  where  $d$  is the distance from Geelong in kilometers and  $t$  is the time in hours.

- (a) Write down the gradient of the line.
- (b) What is the speed of travel?
- (c) If the journey has started 90 km from Geelong and a constant speed of 100 km/h was maintained, what equation could now be written to represent the relationship between  $d$  and  $t$ ?

Q6 Find the solution set:  $\left\{ y : \frac{3y + 2}{11} \geq \frac{2y - 5}{3} \right\}$

***PLC textbooks***

The Year 7 text covered algebra symbols, equations and inequations. One problem follows:

- Q1 At the cinema, a group of 10 students was given a total discount of \$20 when they each bought an ice cream. If they paid a total of \$25, find the price of an individual ice cream before any discount was applied.

The Year 8 text covered symbolic expression; sets and problem solving; algebraic factors and fractions; equations and inequations.

- Q2 Draw a Venn diagram to represent each of the following groups of sets

(a)  $A = \{2, 4, 6, 8, 10\}$

$$B = \{1, 2, 3, 6, 12\}$$

$$C = \{3, 6, 10, 15, 18\}$$

(b)  $T = \{a, b, c, d, e, f, g\}$

$$U = \{\text{letters in the word reduce}\}$$

$$V = \{\text{vowels in the alphabet}\}$$

- Q3 The revenue function, \$R\$, for the Technol Company is given by  $R = 200x$ , where  $x$  is the number of items sold by the company normally. Its cost function, \$C\$, is given by  $C = 300\,000 + x$ . Find, algebraically, the break-even point for this company.

Year 9 covered algebraic expansions, simplification and factorization, formulae and their application, linear graphs, simultaneous equations, inequations (including graphs of half plane) and quadratic functions:

Q4 Simplify:  $\frac{a^2 + 3a + 2}{a^2 - 9} \div \frac{a^2 - 4}{a^2 - a - 6}$

- Q5 Find the region bounded by:  $x + y < 6$  and  $x - y < 2$ .

- Q6 Without plotting a graph, state how the parabola defined by

$$y = -\frac{1}{4}(x+1)^2 - 5 \text{ would differ from the basic parabola.}$$

- Q7 A ball is thrown vertically into the air. Its height,  $h$  metres, above ground level after  $t$  seconds is given by the rule  $h = 20t - 5t^2$ . At what times is the ball
- (a) 15 metres above level?
  - (b) 20 metres above level?
  - (c) 30 metres above level?

***RH textbooks***

The Year 8 text started Algebra with the chapter “Every picture tells a story” on the introduction of a graphical representation of information leading to coordinates, simple algebraic manipulations, number patterns and finding missing numbers.

Q1 Solve for  $x$ :  $6(x + 1) + 2(2x + 3) = 102$

- Q2 I think of a number, double it, add 3 and multiply the answer by 3. If I then take away 5 times the number I first thought of I end up with 21.  
What was the number I first thought?

The Year 9 text introduced evaluation of algebraic formulae and linear equations as well as graphs:

Q3 If  $v^2 - u^2 = 2as$ , find  $s$  given that  $v = 7$ ,  $u = 3$  and  $a = 2.5$ .

- Q4 One side of a triangle is twice the length of another side and the third side is 4 cm longer than one of the two sides. The perimeter of the triangle is 44 cm.  
What are the possible side lengths of the triangle?

- Q5 Choose a particular location in your school (for example the school oval, a particular classroom, the school canteen, the corridors etc) and sketch a graph showing how you think the number of people in that location varies over the course of a day.

***BS textbooks***

The Year 7 text covered the topics as listed. Below is a question from the exercises:

- Q1 There are 70 chickens and rabbits in an enclosure. Altogether they have 220 legs. How many chickens are there in the enclosure? (Assume that all chickens have 2 legs each and all the rabbits have 4 legs each).

The Year 8 text covered algebraic manipulation and formulae including expanding and factorizing algebraic expressions; rectangular coordinates and graphs; quadratic equations and simultaneous equations. Three items follow:

- Q2 Without using a calculator, calculate:  $\left(8\frac{3}{5}\right)^2 - \left(1\frac{2}{5}\right)^2$

- Q3 A girl cycled a distance of 20 km in  $1\frac{1}{2}$  hours. She then rested for 30 minutes. She cycled a further 10 km in an hour. Draw a distance-time graph to represent the journey. Find the average speed for the entire journey.

- Q4 An 18-metre length of rope, tied at its ends to make a loop, is laid on the ground in the shape of a rectangle of width  $x$  metres. The area,  $A$  m<sup>2</sup>, of the rectangle is given by  $A = 9x - x^2$ . Draw the graph of  $A$  against  $x$  for  $0 \leq x \leq 9$  with a horizontal scale of 2 cm to 1 unit and with a vertical scale of 2 cm to 1 unit. From the graph, find
- (a) the area of rectangle when  $x = 4.5$  cm,
  - (b) the dimensions of the rectangle when its area is  $19.25$  cm<sup>2</sup>.

The Year 9 text consolidated and expanded on quadratic equations, linear inequalities, fractional equations. It also covered graphs to more details and introduced variations. Two questions follow:

- Q5 An object is thrown into the air. The relationship between the height ( $h$  cm) of the object at any time ( $t$  seconds) is given by  $h = 1400t - 500t^2$ . Draw a graph of  $h$  against  $t$ , using a horizontal scale of 1 cm to 0.2 s and a vertical scale of 1 cm to 100 cm. From your graph, estimate

- (a) the time the object remains in the air,
- (b) the maximum height reached by the object,
- (c) the time when the object is 750 cm high.

- Q6  $m$  varies inversely as  $\sqrt{n}$ . If  $m = 5$  when  $n = 9$ , find
- (a) the value of  $m$  when  $n = 16$ ,
  - (b) the value of  $n$  when  $m = 15$ .

***SS textbooks***

The Year 7 text covered the topics as listed. One question follows:

- Q1 At a fast-food restaurant, for every three people who ordered a cheeseburger, there are five people who ordered an apple pie. The number of people who ordered the cheeseburger is 5 more than the people who ordered the apple pie. If the total number of people who ordered food is 1678, how many people ordered apple pie?

The Year 8 text covered expansion and factorization of algebraic expressions; algebraic manipulation and formulae; linear graphs and their applications; simultaneous linear equations; solving quadratic equations by factorization and graphs of quadratic functions. Below are three questions:

- Q2 Mr. Lin wants to pour 12 litres of water equally into two containers. However, he has only two measuring cans of capacity 9 litres and 5 litres with him. How is he to obtain the two equal amounts of water accurately by using the measuring cans?

- Q3 Solve:
- $$2^x \times 32^y = 2^{13}$$
- $$8^x \times 2^{2y} = 1$$

- Q4 Draw the graphs of  $y = -x^2$  and  $y = 2x - 3$  on the same axes, taking 2 m to represent 1 unit on the x-axis and 1 cm to represent 1 unit on the y-axis, for–

$5 \leq x \leq 3$ . Use your graphs to find  $4.8^2$  and  $\sqrt{6}$ . Write down the values of  $x$  at the points of intersection of the two graphs and find the equation for which these values of  $x$  are the solution.

The Year 9 text covered Indices and algebraic manipulation; variations; graphical solution of equations; further graphs and graphs applied to kinematics; linear inequalities and solutions to quadratic equations. Two questions follow:

Q5 Draw the graphs of the equations  $y = \sin 2x$  and  $y = \cos x$  for  $0^\circ \leq x \leq 90^\circ$ . Hence, find the solution of the equation  $\sin 2x = \cos x$  in this range

Q6 The line  $y = 2x + k$  is a tangent to the curve  $x^2 + y^2 = 5$ . Find the possible values of  $k$  (hint: the tangent meets the curve at a point).

### ***CSS textbooks***

The topics covered in the CSS textbooks were as listed in Table 4.7 with much depth and breadth.

Year 7 included function symbols and long division of polynomials; expressions such as  $f(x) = g(x) \cdot Q(x) + R(x)$ , and the Binomial Theorem was introduced. The area of a rectangle was used to illustrate the multiplication of binomial expressions and a quadratic expression:  $(a + b)(a^2 - ab + b^2) = a^3 + b^3$ ;  $(a - b)(a^2 + ab + b^2) = a^3 - b^3$ . Included in the Year 7 textbook was an anecdote on Pascal's Triangles in which it was claimed to have been discovered by a Chinese mathematician Yong Huey in his book in year 1261, around four hundred years earlier than Pascal.

Below are two Year 7 questions:

Q1 Solve:  $\frac{|x| - 4}{3} = \frac{3|x| - 5}{2}$

Q2 Solve: 
$$\begin{cases} 4 - 2(2x - 1) \geq x - 3(1 - x), \\ \frac{x}{4} - \frac{2x - 1}{3} < \frac{1}{2} - \frac{x}{6}. \end{cases}$$

Three Year 8 questions are shown below:

Q3 Given that  $y = y_1 - y_2$ ,  $y_1$  is inversely proportional to  $x$ ,  $y_2$  is directly proportional to  $x^2$ . When  $x = 2$ ,  $y = -6$  when  $x = 1$ ,  $y = 2$ ; find the analytic expression of the function in terms of  $y$  and  $x$ .

Q4 Let  $x_1, x_2$  be the roots of function  $2x^2 + 4x - 3 = 0$ , find the followings;

(a)  $(x_1 - 2)(x_2 - 2)$ ;      (b)  $\frac{x_2}{x_1} + \frac{x_1}{x_2}$ ;  
 (c)  $x_1^2 + x_1x_2 + x_2^2$ ;      (d)  $(x_1 - x_2)^2$ .

Q5 Sketch the given function: 
$$y = \begin{cases} 2x + 3(x \geq -\frac{3}{2}), \\ -2x - 3(x < -\frac{3}{2}) \end{cases}$$

The Year 9 text covered application of quadratic equations, which included factorisations of quadratic trinomials, fractional equations & irrational equations as well as anecdotes on “Golden Section” and “Fibonacci Number”. Below is one item:

Q6 solve 
$$\begin{cases} 6x^2 - 5xy + y^2 = 0 \\ x^2 + xy + y^2 = 7 \end{cases}$$

***Summary of the Algebra strand***

At first glance all textbooks introduced algebraic symbols and rules during the first year of the lower secondary mathematics programme when they covered and consolidated the basic algebraic skills on addition, subtraction, multiplication,

division; the distributive laws, fraction, expansion and factorization as well as basic graphing skills. A closer scrutiny of the exercises set in the books revealed that different textbooks “attacked” the topics at different levels of complexity, including problems and exercises with different degrees of difficulty.

In terms of topic coverage and the degree of difficulties offered in the exercises, the RH textbook could be regarded as the book with the easiest Algebraic content. It covered the least number of topics and offered relatively straight forward problems in the worksheets. It sought to equip students with the basic algebraic skills during the two year mathematics course.

By comparisons, the CSS text probably sat at the other end of the scale to RH. There was hardly any coverage of Algebraic symbols and rules, which might be an indication that the Chinese students had been introduced to Algebra prior to this stage of education. The questions included were usually of a relatively higher degree of difficulty than those included in the other textbooks. Taking into account the “thinness” of the textbooks, the number of topics covered was significant. There were a number of topics which were not covered by other textbooks. The content was presented in a discussion mode with a small number (around 3 – 5) of problems in the exercises, which was the least amongst the six sets textbooks examined in this study.

BS and SS texts covered similar topics with BS being the water-down version of SS. The questions included and topics covered by SS were rather interesting with a good assortment of word problems, while that used in BS were a simpler version. The three Asian textbooks also covered “Completing the square” and “Variations” which were missing from the Australian textbooks.

BH and PLC texts covered the topics on basic skills at every level for reviewing, consolidating, expanding and extending. This “building block” approach in content presentation was observed in all other strands which did enhance the teaching and learning of content matter. Consequently, the depth of topics achieved might not be the same as CSS or SS. However, PLC being the thickest set of the textbooks, did manage to include topics in its content not covered by others, for examples: “Sets”,

“Common logarithms” and “Graphs of half plane”. It also included an excellent discussion of “Parabola”.

The BH textbook was not as rigorous as PLC and it is worth noting that “simultaneous equations” were missing from its content on top of the three topics mentioned earlier. This fact certainly points to the flexibility in the Australian curricular statement, which allowed plenty of room to differ even for textbooks subscribing to the same state curricular requirement.

In conclusion, the Algebra strand highlighted the varied approaches in content structure amongst the textbooks, in terms of presentation and rigor of the topics and problems, which served to reflect the curricular goals within a given time frame and ability of target students. Taking into consideration that RH textbook was written for a two year lower secondary programme, its content coverage was certainly the least by comparison. It also appeared that the Chinese students might have acquired a substantial quantity of mathematics knowledge during the Primary school years to leap to more advanced topics and skills at the secondary level. The remaining four sets of textbooks were ranged in-between these two sets of books in terms of the depth and breadth of content coverage.

#### **4.4.6 Summary of section**

This section highlighted the variation of textbooks in terms of content composition, organization, the breadth and depth of topics being introduced. It was deduced that this variation does exist even between textbooks subscribing to the same curriculum. In general, most textbooks focused more on the Number and Algebra strand content and less on Chance and Data. However, there were many differences in every strand and at every level.

Amongst the six sets of textbooks used in this study, the Chinese CSS textbook stood alone as being different from the rest in terms of its topic breadth and depth, as well as its presentation and approach on the delivering the content. It is the only set of non-English textbooks examined in the study.

The Australian text PLC, BH and Singapore SS have very interesting text content, though the level of discussion in BH was not as rigorous as the other two sets of textbooks. BS was written for lower ability target students, consequently the textbook content operated at a lower standard than its “compatriot”, the SS. RH appeared to have the least topic coverage mainly because it caters for just two years of the mathematics programme.

#### **4.5 Strengths and weaknesses of the textbooks**

It was informative to read the textbooks from cover to cover and to note the spectrum of content presentation and approaches in these textbooks. This section was written based on my personal opinion and judgment which may differ from other readers. In this section I attempt to formulate a list of exemplary characteristics of the textbooks reviewed from the perspectives of the key textbook users: the teachers and the students, based on my years of teaching experience.

PLC and BH textbooks were very obviously two sets which endeavoured to inject a colourful and interesting flavour in the text content for their intended users – the students. They included many striking pictures, anecdotes and drawings. It was interesting to note that the Australian textbooks have a cosmopolitan flavor in that they endeavored to reflect the cultural diversity of the country. Names like “Chang” and “Kumar” were used as often as “Donna” and “James”. It also sought to avoid stereotyping in referring to a basketball player as a “she”. There were also visible inputs of technology in the content, such as use of graphic calculators and computer in the enrichment sections.

The PLC content was particularly well organized with many of the topics being reviewed, consolidated and expanded on at every level. The textbooks included a variety of interesting and challenging questions. The section on “Parabola” at Year 9 was particularly well presented with a great deal of detail. It included some more advanced mathematics topics such as “rationalization of the denominator” and “graphs of half planes”.

BH textbooks were similarly structured as the PLC textbooks, however the Year 9 textbook was from a different publisher to the Year 8 and 9 textbooks, hence the content organization differed rather distinctly from the other two books. The outstanding feature of this year 9 textbook was that every chapter commenced with a skills-check which listed the necessary skills for the content, as well as an outcome list which stated the expected achievement after completing the chapter. It also stressed the Curriculum and Standard Framework (CSF II) in the content set-up. Much of the topics covered in Year 9 were an expansion of the Year 7 and 8 works. It covered “surds”, but unlike PLC, it did not apply the concept to include “rationalization of denominators”. It should be noted that the “sets” language was used in the “Inequalities” topic in the Year 9 textbooks, which might be an indication that “sets” could have been introduced in the earlier textbooks of the same series.

SS textbooks contained a sprinkle of anecdotes, interesting information and notes along with the book content which the students would possibly find interesting. Even though the textbook was not as colourful and attractive as PLC and BH, it offered a rich and challenging content with numerous questions and exercises for reinforcing the concepts and consolidating the skills. The textbooks covered some advanced mathematics topics such as “functions”, “coordinate geometry” and “three-dimensional problems”.

BS followed similar path as SS but with fewer anecdotes and interesting notes. The language and descriptions used were relatively nominal by comparison with BH, PLC and SS. Instead there was a vocabulary list and a summary at the end of every chapter which could be useful to students. However, its intended target students are not from the upper echelon of the lower secondary Singapore students. By adopting this set of textbooks for use in the Brunei schools, the more able students might be handicapped by the reduced content offered by the textbooks, and they would be disadvantaged in international mathematics competitions.

The RH text took the form of a series of worksheet with exercises guide the learning process. The fact that the lower secondary mathematics course in Western Australia commences at Year 8 placed a shorter time frame on the mathematics programme. Consequently, the topics, content depth and width covered compared poorly with the

other textbooks. Some of the content arrangement was rather un-connected – for example, Year 8 introduced several units of measurement, but introduction of the metric system was delayed to Year 9. It did give a feeling that the “cart was put before the horse” on the presentation of area and perimeter content before the revision of the metric system.

The CSS text concentrated purely on discussion of the topics in the traditional mathematics mode with few mathematical anecdotes. It covered the topics to greater depth and breadth, yet with fewer worked examples for illustration. The content was structured with relatively fewer problems for consolidation of concepts, especially when compared to the SS textbook which consist of a rich resource of questions to reinforce learning. It appeared that to effectively use CSS textbooks as a teaching and learning resource, the teachers would have to put in extra effort to enrich the rather “dry” approach adopted in the textbooks to ensure the learning process was an interesting one.

#### **4.6 Discussion and summary**

A TIMSS report (Beaton, Mullis, Martin, Gonzalez, Kelly, & Smith, 1996) reported that in almost all the participating countries, textbooks were the major written source mathematics teachers used in deciding how to present a topic to their classes. In the case of Singapore, 89% of the eighth grade (Secondary 2) mathematics teachers in the TIMSS reported they decided how to present a topic mainly based on textbooks. Therefore textbooks play an important role in mathematics instruction.

It is important to reconcile past research findings that textbooks contribute to and influence students’ mathematics learning to the findings of this study. The textbook content was analysed and compared in detail in the previous sections. The performance of the textbook users in the international comparative studies would provide information on how effective the textbooks were in equipping the students with mathematics knowledge, based on the past research findings that textbooks were found to be one of the key factors affecting learning. Table 4.8 reports the best

performers in TIMSS-R. It is worth noting that China did not participate in that comparative study.

Table 4.8 *Tabulation of best performers in TIMSS-R*

<b>Items</b>	<b>Best performance</b>
Fractions and number sense	608 (SIN)
Measurement	599 (SIN)
Data representation, analysis and probability	576 (KOR)
Geometry	575 (JPN)
Algebra	586 (TAP)
Overall	604 (SIN)

*Note:* SIN: Singapore; KOR: Korea; JPN: Japan; TAP: Chinese Taipei.

*Source:* “TIMSS 1999 International Mathematics Report: Finding From IEA’s Repeat of the Third International Mathematics and Science at the Eighth Grade”, by Mullis, Martin, Gonzalez, et al., 2000. The international average for each content area as well as for the overall performance was scaled to be 487.

It was noted that the best performers of the five strands tested were from Asia, with Singapore being the overall winner. However, it was also noted that though the Singapore textbook content was deemed interesting and rigorous by comparison to the other textbooks in this study, the students performed well in the Number and Measurement strands, however they were not the best performers in other strands.

The Educational Testing Service (ETS) which claims to be the world’s largest private educational testing and measurement organisation, has carried out two large-scale international studies entitled IAEP (International Assessment of Educational Progress) (Mead, 1995). Chinese students participated in IAEP2 which covered 5 content areas: Number and operations, Measurement, Geometry, Data analysis, Statistics and probability, Algebra and functions. The purpose of IAEP was to collect and report data on what students know and can do on educational and cultural factors associated with achievement, and on students’ attitudes. Table 4.9 tabulated the best performers of the 13-year-old group in this study.

Table 4.9 *Tabulation of best performers (Percent Correct) in IAEP studies*

<i>Items</i>	<i>13 year-old</i>	
	Best performers (%)	Int'l Ave (%)
Number and operations	84.9 (CHI)	61.0
Measurement	71.4 (CHI)	46.9
Geometry	80.2 (CHI)	62.2
Data analysis, statistics, and probability	81.8 (SWI)	69.1
Algebra and function	82.4 (CHI)	54.2
Overall	80.2 (CHI)	58.3

*Note.* 1. N.O. = Number and operations; Mea. = Measurement; Geo. = Geometry; D.S.P. = Data analysis, statistics, and probability; A.F. = Algebra and function;  
2. CHI: Mainland China; SWI: Swaziland.

*Source.* "Learning Mathematics", by Lapointe, Mead, and Askew, 1992.

It was noted that at the 13 year-old level, students from mainland China were the top performers in all strands except for Chance and Data. They were the overall top performers, however the students were relatively weak in *Data Analysis, Statistics and Probability* and scored 75.4% in the study, which was a better result than the international average of 69.1%, but gained them a tenth place in the comparative study. The textbook content analysis in the previous section highlighted that only 5% of the Year 9 textbook content was devoted to the Chance and Data strand, which was the least strand weighting in comparison to the other textbook strand content. The Year 9 students were introduced to statistics content only, without any probability content.

IAEP also investigated students' mathematics achievement in three process aspects, which included Conceptual Understanding (understanding of mathematical facts and concepts), Procedural Knowledge (application of knowledge and concepts in solving routine problems using procedure taught in the classroom), and Problem Solving (application of several skills to a unique situation, which usually involved multiple steps) (Lapointe, Mead, & Askew, 1992). Results showed that 14 year-old mainland China students ranked 1<sup>st</sup> in all three aspects. However, 9 year-old level mainland China students did not do well on Problem solving and had an average score of 55.7% which was lower than the international average of 58.5%, and ranked 10<sup>th</sup>

among 14 educational systems. In the previous discussion on the findings of the lower secondary mathematics programme, the Chinese textbooks CSS was found to focus mainly on Algebra and Space, with nominal other strand content. This led to a speculation that the students might have covered the Number and Measure strand content during the primary school years so that they have the mathematics skills to tackle Algebra and Space problems. However, recalling the statement from Milgram (2003) quoted in Chapter 1, the discrepancy of the Chinese students performance between the “below average placement” of the 9 year-old students and the “excellent performance” of the 13 year-old in this comparative study raised new queries about mathematics education in China: “What have the students been taught in the primary school which produced a below par performance by the 9 year-old group, but which then led to an excellent performance in the 13 year-old group?”

Another international mathematics testing event which was conducted yearly is the International Mathematics Olympiads (IMO). Table 4.10 provides a tabulation of the students’ achievement from Australia, Mainland China, Singapore and Brunei. Brunei participated in this testing just once in year 2000 and was ranked joint-last. Mainland Chinese students had been ranked consistently better than the Australian and Singaporean students, while the Australians outperformed the Singaporean students’ in all years except in 2004.

Summarizing the above discussion, the Lower secondary Chinese students put forth an excellent performance in the international comparative studies in which they participated. However, their weakness in the Chance and Data strand was also duly highlighted in the testing. Other studies also found that Chinese students did not demonstrate such superior performance on more challenging tasks, such as open-ended problems (Brenner, Herman, Ho, & Zimmer, 1999; Cai, 1998), which was also one aspect of mathematics that was not observed often in the textbook content.

Table 4.10 *Students' performance in the International Mathematics Olympiads (1995 – 2004)*

Year	No of participating countries/regions	Australia	Brunei	Mainland China	Singapore
2004	85	27 <sup>th</sup>	N/A	1 <sup>st</sup>	18 <sup>th</sup>
2003	82	26 <sup>th</sup>	N/A	2 <sup>nd</sup>	36 <sup>th</sup>
2002	83	26 <sup>th</sup>	N/A	1 <sup>st</sup>	30 <sup>th</sup>
2001	87	25 <sup>th</sup>	N/A	1 <sup>st</sup>	29 <sup>th</sup>
2000	82	16 <sup>th</sup>	81 <sup>st</sup>	1 <sup>st</sup>	37 <sup>th</sup>
1999	81	15 <sup>th</sup>	N/A	1 <sup>st</sup>	36 <sup>th</sup>
1998	76	13 <sup>th</sup>	N/A	~	22 <sup>nd</sup>
1997	82	9 <sup>th</sup>	N/A	1 <sup>st</sup>	41 <sup>st</sup>
1996	75	23 <sup>rd</sup>	N/A	6 <sup>th</sup>	25 <sup>th</sup>
1995	73	21 <sup>st</sup>	N/A	1 <sup>st</sup>	26 <sup>th</sup>

Note .1. All the results are retrieved September 15, 2005, from <http://olympiads.win.tue.nl/imo/>.

They are also available online in other IMO relevant websites.

Note .2. Brunei participated just once in IMO during year 2000, was ranked last, tied with another country.

Note .3. China did not participate in 1996.

Brunei did not participate in any of the international comparative studies except on one occasion when they were ranked joint last in the IMO. But it was noted in earlier discussion on topic details that the Brunei schools are using textbooks which are written for the Normal stream students in Singapore while the Singaporean participants were from the Express stream. Hence the Brunei students' relative poor standing was not a surprise though of course there were other factors affecting performance, such as the selection criteria of participating students, the relatively weak command of English language.

Singapore students were the best performers in the TIMSS and TIMSS-R, but they did not fare as well as the Chinese and Australian students in IMO or IAEP. This result highlighted the varied assessment yardsticks used by the different international testing bodies which consequently fleshed out the strengths and weaknesses of the curricula as reflected in students' performances.

The textbook findings in this study discussed the focus of different sets of textbooks. The Australian textbooks focus more on the Chance and Data strand content than

their Asia counter-parts. Drawing on my past experience as a Mathematics department head, my personal observation was that the Asian students are generally weaker in this strand than their Western peers. This trend was also as observed in teachers from the UK and Australia, who are better versed in Chance & Data than their Asian counter-parts.

In conclusion, the TIMSS curriculum study reported that “Textbooks affect which topics teachers teach and how much time they spend on them. They also affect gains in student achievement” (Schmidt et al., 2001). It also commented on the “lack luster” performance of US students and highlighted the fact that U.S. eight-grade students study arithmetic, for example, but the children in the top achieving countries study algebra and geometry” (Schmidt, McKnight, Cogan, Vakwerth, & Houang, 1999). It is indeed pertinent to conclude that the textbook is a critical factor in learning.

## Chapter 5

### Findings from Teachers' Interviews

#### 5.1 Introduction

This chapter reports the findings from the teachers' interview. The data collection was described in Chapter 3 along with a tabulation of the background details of participating teachers (Table 3.3). Staff members from four schools, (Presbyterian Ladies College, Brunei Government School, Brunei Private School and Singapore Raffle Girls School) participated in the interviews. As mentioned in Chapter 3, each teacher was labeled with an indicator (for identification purposes) comprising of letters representing the school and a number to differentiate the level undertaken by the teacher. For examples: a PLC year 9 teacher was indicated by PLC9; Singapore Raffle Girls School Sec 2 teacher was SRG8 and so on.

The interview questionnaire was designed to obtain teachers' background information and to solicit teachers' views on textbook's content, the textbook as a teaching and learning tool, as well as their views and comments on international or migrant students (Appendix D). Altogether 15 teachers participated in the interviews and the transcripts of their responses can be found in Appendix DA, DB ... to DO. Findings from teachers' responses are reported under each participating school, and an overview is provided for a comparison of teachers' responses to gauge the extent to which their responses differed or concurred with one another.

Throughout this chapter, referencing of the interview transcripts is denoted by the appendix title followed by the page numbers, for example, (App. DG, p. x). The appendix text used as a basis for quotes is underlined.

The findings are examined in terms of the research questions listed in section 5.3. The research questions relevant to this chapter on teacher interviews are research question 4, 5 and 6; with question 5 solely addressed by the teachers' response in this chapter, and the issues in questions 4 and 6 addressed in both chapter 4 and this chapter.

The chapter concludes with a brief summary of the findings.

## 5.2 Teachers' interview data

With reference to Table 3.3, all teachers participating in the interview were degree holders except for the two Brunei government participants who are Teachers' Certificate holders. The teachers' teaching experience is charted in Figure 4.11 where the y-axis represents the 15 participating teachers' years of service. Starting from the origin, these teachers are denoted by PLC7, PLC8, PLC9, BGS7, BGS7, BGS8, BGS8, BGS9, BGS9, BPS7, BPS8, BPS9, SRG7, SRG8 and SRG9. The Brunei Government School had the youngest group of teachers, while the Brunei Private School had the oldest. In Figure 4.16, participant BGS9 had been employed for just one month during the interview, which accounts for the lack of significant indication on the bar graph.

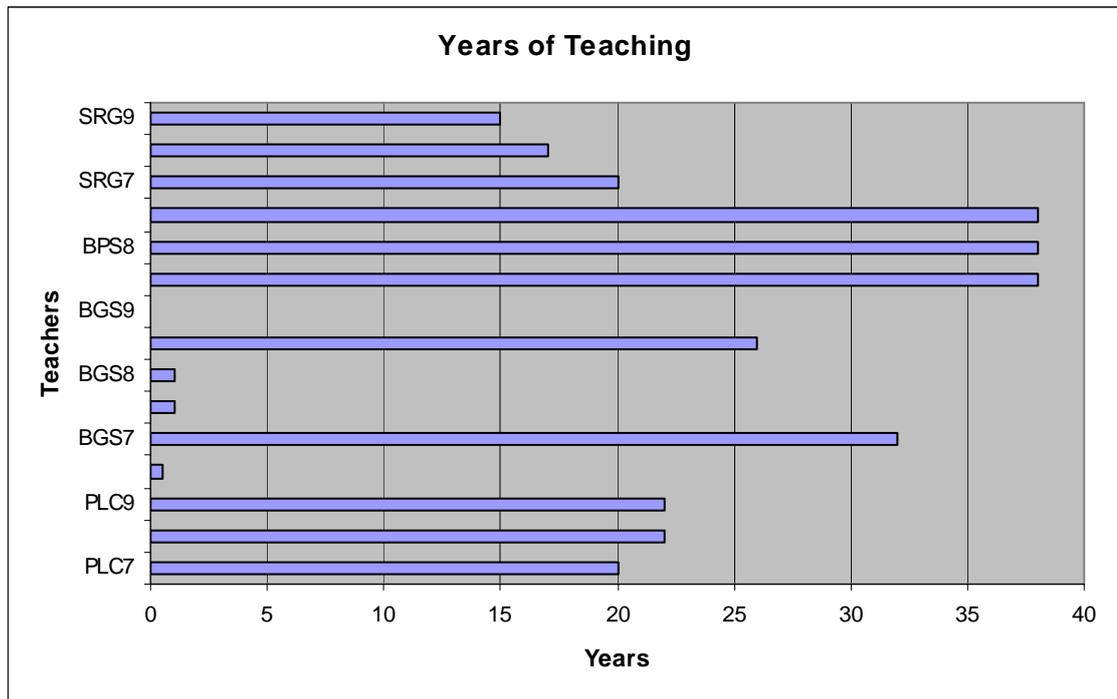


Figure 5.1 *Teachers' years of teaching*

The teachers' responses were scrutinized and compared. It should be explained here that the teachers from Presbyterian Ladies College and the Brunei Private School responded to the questionnaire giving many details and showing great professional

etiquette in sharing their experience, even though it took up much of their valuable time. Those from the Singapore Raffle Girls School portrayed a rather hasty response similar to teachers from Brunei Government School who responded with rather short replies. My first impression while examining the completed questionnaire was that the Australian teachers from PLC set themselves apart by being very professional and thorough in their responses giving a glimpse of their enthusiasm in their teaching role. Similar impression was perceived from the teacher from Brunei Private School which is hailed to have a sound mathematics programme. The teachers from Singapore and Brunei Government responded to the questionnaire with short answers which might mean they were too busy or had little to share.

### **5.2.1 Data from the Australian teachers**

Both PLC teachers (PLC8 and PLC9 are the same person as deduced from the personal particulars listed and the hand writings) undertake multi-levels of mathematics at secondary level on top of performing other duties. They use a varied teaching technique involving technology, group activities and project work.

PLC7 enthuses on the textbook content and considers this an exemplary textbook. Her comments on the textbook content were: “Very well presented. Concepts are presented clearly, with all examples worked fully and supporting written explanations, included where necessary.” (App. DA, p. 267).

On the issue of the textbook as a teaching tool, her comment was: “I am very happy with all topics which are presented in this textbook and further to this, the book has been well received by students.” (App. DA, p. 268).

PLC7 has a very positive comment on international students / migrant children joining the class: “My experience has been that whilst students may have trouble reading, writing and /or speaking the English language – if a concept is demonstrated well, mathematical ideas and processes can be communicated without language; mathematics seems to transcend language barriers” (App. DA, p. 269) which greatly mirrors the competent skill of the teacher in her role.

PLC8 / 9 shared the same enthusiasm as PLC7 about the textbooks, though the font size of the year 9 text is too small for the teacher's personal preference. Below are some comments on the textbooks:

"The current text is the best for our syllabus available in this state." (App. DB, p. 270)

"For many years we put up with "The least worst" text available, but our current text, while not totally comprehensible, does the best we've seen in a long time!" (App. DB, p. 271)

"CONSISTENTLY well graded – better than other texts, and far more available!" (App. DC, p. 273)

"This text has been around in its current form for quite a while, and we believe has no peers. We incorporate more technology ideas from newer texts into our use of this text." (App. DC, p. 275)

On the issue of international students / migrant children joining the class, the comments were as follows:

"We have high achieving / striving students – many from ESL / ESL-like backgrounds. We like to strongly ground the fundamentals in the early secondary years before moving "out" higher up. Consequently many new arrivals have a lot of catching up to do, even if they have covered some material previously." (App. DB, p. 272)

"ESL students have difficulties particularly with the jargon of mathematics. Students from other schools often lack the Algebra skills we expect. Some students are "ahead" when they start but need to fill their gaps as they go." (App. DC, p. 275)

The school has its own mathematics syllabus to which the teachers adhere. Algebra is considered an important strand at Year 9. It is particularly important to note that

the teachers were very comfortable and knowledgeable in discussing the various aspects of the questionnaire. Both teachers provided additional resources to substantiate the textbook in their teaching, “I prepare additional resources because of my methods of teaching and learning, not because of any significant inadequacy of the textbook.” (App. DA, p. 268).

In summary, teachers from PLC thought highly of their textbooks as a teaching and learning tool; they were familiar with the text content and they applied a variety of teaching strategies other than just “chalk and talk”; were well versed in their school mathematics syllabus, demonstrated an awareness of their students’ strength and weaknesses, and they possessed a preparedness to assist ESL students in class.

### **5.2.2 Data from Brunei government school teachers**

Amongst the six lower secondary mathematics teachers, two were from Teachers’ Training College with Certificates of Education and were non-graduates. Amongst the other four graduate teachers, one was at the time an education officer with barely one month of teaching experience, which implied that she obtained the degree from an overseas university under a government sponsorship scheme. In other words, the education officer might have been an excellent student during the secondary school years, so earning a government scholarship to study abroad. The other three were graduates from the local university.

The Brunei government schools generally timetables the teachers to undertake a group of students through the education programme, and students’ performances are indirectly used to assess a teacher’s teaching skills. Consequently, unlike PLC teachers, these Brunei government teachers are allocated specific teaching levels in order to minimize preparatory work.

The common responses to the question on mathematics-teaching tools/techniques used were: “Chalk and talk”, “notes, quizzes and games”, “Mind capturing, brain storming, related to everyday examples” and “Chalk, modals, straws and assessment books”. A graduate responded with “yes”, which prompted doubts on her English

reading skills. A Certificate of Education teacher responded with “class-room teaching”, again suggesting problems with the English language.

Year 7 teachers suggested more worked examples are necessary to explain certain topics, and suggested that students find algebra, geometry, and mensuration difficult. One Year 8 teacher believed the textbook to be very helpful, but mentioned that students find algebra, volume, rate, ratio and proportion difficult. The other Year 8 teacher mentioned that some of the topics were too advanced for the students but did not list what those difficult topics were. One of the two Year 9 teacher suggested, “The questions in the textbooks should be designed similar to the PMB syllabus” (App. DH, p. 290) (Note: PMB is the lower secondary public examination for year 9 students). This teacher also believed that the difficult topic was “rate, ratio and proportion”. The other Year 9 teacher who taught a lower ability class (the level I students) mentioned that some students found fractions, directed numbers and circles to be most difficult.

None of the teachers had experience with international students, which is hardly surprising as the Brunei government schools generally cater for local students, while most expatriate children attend private schools.

In summary, the graduate teachers had relatively little teaching years and were not experienced enough to elaborate on the questions raised. This could be a reflection of their limited command of the English language even though it is the medium of instruction in Brunei. A probable reason for teachers’ short responses was that these teachers are assigned several other duties and responsibilities in addition to their teaching, hence they were too busy to spare much time in answering questionnaires.

### **5.2.3 Data from Brunei private school teachers**

By comparison to the government school, the Brunei private school had a relatively small student population. The mathematics teacher participant undertakes the lower secondary mathematics programme in school. She uses different tools and techniques in her teaching such as manipulative materials, calculators / computers (when appropriate), OHPs, textbooks, workbooks, worksheets, cooperative work,

discussion, questioning and making conjectures, along with a problem solving approach.

This teacher considered the Year 7 (Form 1) text content similar to the primary school textbooks with very few interesting examples and anecdotes to give real life relevance. Below is a quotation from among her comments:

“Text used is nothing but a rehost of Primary 4 – Primary 6 texts. My impression is that the authors were writing from the point of view that Form 1 work is simple straightforward revision of Primary 4 – Primary 6 work. And they may well be right considering the very low standard of teaching & learning going on in the primary levels. However, such treatment only re-enforces among students (especially the average & above average ones) the belief that mathematics is a boring repetition of endless calculations with no relevance to real life at all.” (App. DJ, p. 296)

Her comment on the survey statement “An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence” is quoted below:

“Not so if the teacher were to depend solely on the texts in use. Rote memory learning by the student would allow (the average student) to breeze through lower secondary mathematics course (using this text) but would hardly prepared the student for the critical thinking & problem solving skills needed in the higher level maths.” (App. DJ, p. 296)

It appeared this set of textbooks was inadequate in preparing for mathematics at a higher level on the following skills: proportional reasoning, multiple representations, generalisations and modelling. Her comment on the textbooks as a learning tool is quoted below:

“Text should be problem-solving oriented, need to emphasize critical thinking and reasoning over rote learning procedural drill, need to decrease

emphasis on review of elementary topics such as whole number computation.” (App. DJ, p. 296)

However, the positive features of the textbooks were:

“The inclusion of (i) vocabulary lists (“words you need to know”) at the beginning of each unit (topic); (ii) enrichment activity (suggested work for investigation or research); and (iii) summary of salient points in the unit (“do you remember”?) are the best features of the text. More than the repetitive exercises, they help consolidate the lesson (that is, if presented by an able teacher).” (App. DJ, p. 295)

On the issue of international students / migrant children joining the class, below is her comment:

“Most of the migrant children joining the class have better mathematical background even if their mathematical ability is not necessarily stronger. After a certain period of adjustment, they are able to catch up with the class on the content and to adjust to the instructional method.” (App. DJ, p. 297)

The wealth of experience of the Brunei Private School teacher, as well as her dedication to teaching, is reflected in her comments. The efforts of such teachers play an important role in contributing to the academic success of the school, and this goes some way in explaining why private schools enjoy a good reputation in students’ academic achievement in public examinations in the country.

In summary, the teacher considered the set of textbooks inadequate in preparing students for critical thinking and problem solving skills needed in the higher-level mathematics, and in practice she compensated for this inadequacy by supplementing material in all the topics. She considered most expatriate students were able to adapt to the Bruneian mathematics classroom.

#### **5.2.4 Data from Singapore teachers**

Raffles Girls School belongs to the top echelon of the Singapore school system. The three teachers taking the lower secondary mathematics have similar qualifications. They employ similar methodology in their teaching such as: internet resources, “graphmatica” use, resource books, chalk and talk.

SRG7 found the Year 7 text content boring and lacked challenging questions. She prepared additional resources material for all topics to supplement copious problems for Algebra, Mensuration and Geometry. She commented that the students from China tended to find the text content too easy.

SRG8 felt that more illustrations on real-life applications should be added and that only a few examples were challenging. The revision exercise could be improved if graded revision exercises were given at the end of each chapter. She thought Algebra was very well presented in the book, yet feedback from teachers of the higher level suggested the need to consolidate students’ Algebra and graphing skills. This teacher had no international students in her class.

SRG9 was happy with the Year 9 textbook as a teaching tool: “General a very well planned textbook. Easy to read and understand. Occasionally there are mistakes / printing error.” (App. DO, p. 310) She noted the book focused more on thinking / providing more guiding on thinking. As with SRG8, feedback from teachers of the higher level suggested the need to consolidate students’ Algebra and graphing skills. This teacher was unable to comment on the international students in class: “...because it depends on their education background and the country they were residing.” (App. DO. P. 312)

In summary, all three teachers made short responses to the questionnaire. The teachers supplemented the text content with other resources to provide more questions that were more challenging. SRG9 in particular noted that the trend in the Year 9 text focused on thinking, though she did not elaborate on this matter. None of the three teachers made additional comments on the major section of the questions.

Overall, the short responses indicated that little time was spent on the questionnaire, which could be reflective of the busy life of the Singapore teachers.

### **5.2.5 Overview of teachers' interview data**

The Australian teachers thought highly of their textbooks as a teaching and learning tool. Their willingness to spend time on a set of questionnaire outside their work regime and share their opinion reflects a fine quality welcomed in a good teacher. They were familiar with the text content and used a variety of teaching strategies in their teaching. They demonstrated an awareness of their students' strength and weaknesses, possessing a preparedness to assist ESL students in class.

The young Brunei Government School teachers lacked the experience to contribute much to the questionnaire. They appeared to be handicapped by their lack of English linguistic skills and hence there was little feedback on their opinions. They offered few comments on the textbook as a teaching and learning tool, and they were unable to comment on expatriate students due to the lack of such students in school.

The Brunei private school teacher considered the set of textbooks inadequate in preparing students for critical thinking and problem solving skills needed in the higher-level mathematics, and supplemented the textbooks with more challenging questions. She had favorable opinions on the adaptability of expatriate students to the Bruneian mathematics classroom.

The Singapore teachers did not hold a high opinion of the textbooks used. All three supplemented the text content with more challenging questions. There was little elaboration on the comments made, if any. The "hasty" responses recorded were, perhaps, an indication of the busy life of the Singaporean teachers. One of them commented that students from China would find the textbook easy.

### **5.2.6 Cultural implication of the textbook and interview data**

The teachers' interview data portrayed a distinct difference in responses between the Australian teachers and the Asian teachers. The Australian teachers were very articulate and vocal in expressing their thoughts. They were excellent subjects in the

interviews and contributed much valuable insight on the textbooks used. Similarly the Brunei private school teacher who is a Philipino provided detailed responses to the questionnaire, and these were forthright and insightful. The Brunei government teachers and Singaporean teachers responded to the questionnaire in a minimalist fashion, which may have been a reflection of their busy lives as teachers. Yet it could also be a reflection of the consequence of being brought up under the Asian/Chinese doctrine of “children should be seen but not heard” which is one of the characteristics of the Asian culture in that children are discouraged in being too vocal as those who express their view freely are considered to be impolite. Teachers from Singapore and Brunei government schools may well be the subjects of studies conducted in their small countries and hence may have found this survey bothersome.

The Asian textbooks, especially those from China, reflect a different concept from their Australian peers in their presentation. Textbooks from the State of Victoria are colourful with many anecdotes and pictures to keep the subject interesting and attractive to the users. The Asian textbooks tend to maintain a mostly “mathematical” content. This observation may reflect the difference in the learning value between the Asians and the Australians. The Confucius’ doctrine on learning as being a noble task that would bring a future goal of better job opportunity and life style is possibly one motivation which prompts students into devoting their time to diligent works. The textbook writers may sacrifice interesting features to produce a textbook which covers more mathematical ideas and problems but less interesting pictures and anecdotes to reduce publication cost and make the book an affordable commodity for students. The writers are aware that omitting to embroider the textbooks with “niceties” will not necessarily affect the students’ interest in the subject. This may explain why the Chinese textbook is so “barren” in its presentation as compared to the Australian textbooks.

### **5.3 Research questions**

In this section the textbook findings, as presented in Chapter 4 along the interview findings as presented in the previous sections of this chapter, are considered in terms of the research questions. Issues in research question 1 – 4 were discussed in

Chapter 4. However, the teachers' interviewing data also addresses issues associated with research question 4, which examines the strength and weaknesses, and any exemplary characteristics, of the textbooks. The majority of the findings for question 4 are derived from the textbook data analysis and were discussed in Chapter 4. Research question 5 solicits teachers' opinion on the textbook used. These two questions intertwine from the teachers' perspective to a certain degree, and hence it is appropriate to examine both research questions 4 and 5 from the teachers' interviewing data collected. Research question 6 is also addressed by a consideration of the findings from both sets of data.

### *Research questions*

#### **1. For each country, what is the strand weighting for each level and for the whole lower secondary mathematics programme?**

The topics in the textbooks' contents were differentiated into the Number, Measurement, Space, Chance & Data and Algebra strands. Appendix A is a detailed record of the complete content break-down on an Excel spreadsheet which provides an overview of the lower secondary mathematics curricula based on the textbooks used, while Appendix G summarises the strand weighting which was calculated by dividing the number of pages devoted to a particular strand by the total textbook content pages, then converting to a percentage. A detailed discussion of this issue was presented in Chapter 4, Section 4.3. In summary, all textbooks had different content emphasis based on the curricular requirement. Even textbooks subscribing to the same curriculum varied from each other in this aspect. However, the China Shanghai textbook CSS shows a large deviation in its content matter from the other textbooks, as it focused more on the Space and Algebra strands. To address this research question Table 5.1, showing the strand weighting analysis of the text content for the six sets of textbooks, was tabulated.

Table 5.1 *Strand weighting analysis of the text content*

Strands and levels	Textbooks Strand Weighting (%)					
	Australia		RH	Brunei	Singapore	China
	BH	PLC		BS	SS	CSS
<b>Number Strand</b>						
Year 7	21.1	28.2	N/A	53.8	58.4	0
Year 8	22.1	32.1	36.0	16.5	8.9	19.2
Year9	18.6	19.6	36.5	0	0	0
Overall program	20.6	26.6	36.1	25.8	24.1	6.2
<b>Measure Strand</b>						
Year 7	16.6	23.6	N/A	24.2	13.0	0
Year 8	14.3	16.8	18.7	9.4	27.0	0
Year9	23.5	22.9	20.8	24.0	17.6	12.5
Overall program	18.3	20.6	19.3	19.2	18.8	3.8
<b>Space Strand</b>						
Year 7	27.8	20.0	N/A	14.2	10.5	33.5
Year 8	23.1	12.3	20.0	16.6	20.2	41.3
Year9	10.4	14.8	16.7	37.3	28.4	41.9
Overall program	20.2	15.0	19.0	21.7	19.3	38.5
<b>Chance &amp; Data</b>						
Year 7	12.1	16.4	N/A	0	8.4	0
Year 8	18.9	8.2	8.4	18.8	5.0	0
Year9	16.0	10.0	4.2	8.9	11.5	18.8
Overall program	15.6	10.8	7.2	8.5	8.4	5.6
<b>Algebra Strand</b>						
Year 7	22.3	11.8	N/A	7.7	9.6	66.5
Year 8	21.6	30.6	16.9	39.8	39.0	39.5
Year9	31.5	32.6	21.9	30.0	42.6	26.9
Overall program	25.3	27.0	18.4	24.8	29.5	45.9

**2. What are the differences and the similarities of the students’ expected mathematics knowledge in these countries based on their yearly progress?**

The main objective of this research question was to provide an insight into the students’ expected progress. Table 4.3 – 4.7 in Chapter 4 Section 4.4 charted the path of a particular topic in a strand on a timeline through the three years for each curriculum and represented the textbook content organisation in terms of the timing of a particular topic in the curricula. This piece of information is a yardstick to determine students’ expected knowledge at the particular level and facilitates

comparisons across curricula. The analysis and discussion of these raw data was reported in Section 4.4. Appendix B provides a detailed comparison of this issue.

Content coverage under the Number strand was similar for four sets of textbooks: BH, PLC, BS and SS, in terms of the topic included. However the timeline of the topic coverage differed between the Australian and Asian texts in that for the Australian textbooks the coverage of most topics was spread out over the whole lower secondary program duration while BS and SS covered most topics during Year 7 with topics like Interest, Profit and Loss, Indices continued from Year 7 into Year 8. The SS textbooks included more complex questions for revision than the other three sets of books. Consequently an Australian student from the Victorian state joining the Singaporean program at Year 8 level might find that the work on Number at this level is nominal yet operating at a higher degree of difficulties than his/her home program due to the fact that his Singaporean peers have covered most of the Number strand content during Year 7.

On the other hand, RH from Western Australia covered fewer topics and at a later timeline because of its different school system. Thus a WA student joining the Year 9 class in Victoria would have much to learn in order to catch up with his Victorian peers. CSS included a minimalist Number strand content which demanded higher mathematical skills, which was indicative that the Chinese students might have covered the basic Number strand topics during their primary school years. However, an Australian student completing the Year 9 PLC programme would have covered more Number strand content than students using the other textbooks, though the degree of difficulty of some of the revision questions and the breadth and depth of the topics might not be as advanced as those in CSS and SS.

The textbooks exhibited similar topic coverage progress for the Measurement strand content as that for the Number strand, with the Asian textbooks, except CSS, covering most of the Measurement strand content in the early part of the lower secondary program while the Australian texts spread the content over a longer duration. However, SS and CSS covered more trigonometry topics which included

the Sine and Cosine Rule during the Year 9 study, while the other textbooks covered only basic Trigonometry ratio and simple application. RH did not cover any trigonometry topics, which implied that a student from Western Australia may have a lot to catch up if he/she were to join the Year 9 class in the Eastern state, Singapore or China. A Brunei student entering a Year 8 class in Singapore may find the Singapore text questions demand higher mathematics skill than he/she may be used to in his home mathematics curriculum.

The Space strand topics coverage differed substantially amongst the textbooks. The Australian texts covered Nets, Isometric, Oblique and Perspective Drawings but omitted Circle Properties and Theorems whilst the Asian texts did the reverse. As for the Number strand, the Asian textbooks covered most Space strand content during Year 7 and 8. Hence a Singaporean student joining PLC at Year 9 would be weak in Nets construction and Isometric Drawing, whereas a PLC student joining the Singapore school at Year 10 level would have missed the Circle Theorems. A student from China would have covered more Space strand content at a more advanced level than students from the other three countries, particularly in Geometrical Proofs which were covered in greater detail in this set of textbooks.

As mentioned earlier in Chapter 4, the Chance and Data strand was covered in detail in the Australian textbooks while the Asian texts omitted the entire Probability chapter. The coverage of the Statistics component of this strand in the Asian textbooks was rather brief in comparison to the Australian textbooks. A Brunei student joining the Victoria school at year 8 would have to catch up with a substantial amount of Chance and Data work, while a Year 9 student in China would be just being introduced to some statistics topics. It could be deduced that an Asian student completing Year 9 would have no basic Probability skill while the Australian students would be rather advanced in their Chance and Data knowledge.

All textbooks had similar topic coverage for the Algebra strand. The difference lay in topic breadth and depth. CSS and SS certainly covered more advanced Algebra than the other textbooks and provided more rigorous consolidation exercises. PLC

might not have covered the topics with as much breadth and depth as these two sets of books, but it did include most of the topics covered by the Asian textbooks as well as ones which were not covered by other books: “Graphs of Half Plane”. It was reasonable to deduce that Asian students were exposed to more complex Algebraic questions than their Australian peers, while the Australian students would have been introduced to more varied question types than their Asian counterparts.

The above discussion illustrated the use of Table 4.3 – 4.7 to assess students’ expected learning progress in terms of topic coverage. In summary, the expected yearly progress of students varies according to the textbook used, which reflects the strengths and weaknesses of the mathematics program it caters for. The question pool in Chapter 4, Section 4.4 also provided an inkling of the breadth and depth of the topic covered.

### **3. How do individual topics and strands featured in the textbooks vary through the various levels and at what depth and width?**

This question sought to examine and evaluate a topic or strand in great detail in terms of its depth and width throughout the programme. It was an extension to the first two research questions, and played an important role in further exploring a particular topic in the curriculum. Section 4.4 of Chapter 4 recorded a series of problems aiming at providing an insight to the degree of difficulty or complexity expected in a topic, and an inkling of the width and depth of topics presented in the textbooks.

To investigate the strand depth to a greater detail, a particular topic that was covered in all textbooks, if possible, was selected. In order to flesh out the depth of the topic coverage, the highest level of textbook covering this topic was scrutinized and problems from the text were selected to give an indication of the depth of the topic covered. Based on the assumption that the exercises in the textbooks would be graded in accordance to ascending order of difficulty, a problem from the last

exercise of the topic was selected as a yardstick for examination and cross-comparison of the topic. Below is a record of this analysis and the outcome.

### ***The Number Strand***

Table 4.3 listed the numerous topics covered under the Number strand. The topic “Powers and Roots” was selected for further comparative analysis as this was the only topic covered in all six sets of textbooks. BH and PLC covered this topic during all three years of the lower secondary mathematics programme, BS and SS textbooks covered this topic during year 7 and 8 while RH and CSS covered this topic during year 8 only. The problems selected from the highest level of textbook covering this topic were as follows:

#### ***BH year 9 textbook:***

- (a) Write down the perimeter of the rectangle as shown.  $3\sqrt{5}$
- (b) What is the exact area of this rectangle?
- (c) If this rectangle represents the available floor space of bedroom, can the floor be covered by a of piece carpet with area  $22 \text{ m}^2$ ?
- 

#### ***PLC year 9 textbook:***

A cell culture is growing so that the number,  $N$ , of cells in the culture  $t$  days after the culture was first observed is given by the rule:  $N = 1250 \times 2^t$

- (a) How many cells were in the culture at the first observation?
- (b) The cell culture had grown to what size by the end of the 5<sup>th</sup> day?
- (c) Halfway through the third day, a laboratory technician measured the size of the culture. Around what figure should the technician have obtained if the culture really were growing according to the given rule.

#### ***RH year 8 textbook:***

Two different integers are such that their square roots are also integers and have a sum of 10. What might the original integers be?

***BS year 8 textbook:***

Simplify the following, leave your answer in index notation:  $(gh)^2 \times (g^2h)^5 \div (g^2h^2)^3$

***SS year 8 textbook:***

Singaporeans consume about  $1.02 \times 10^5$  tonnes of vegetables in 1999. The bulk of the vegetables are imported from neighbouring countries. The government is encouraging local farms in Singapore to increase their production from the present level of approximately 8 000 tonnes a year to 22 800 tonnes a year in the year 2004.

- Express:
- (a) 8 000 tonnes as a percentage of  $1.02 \times 10^5$  tonnes.
  - (b) 22 800 tonnes as a percentage of  $1.02 \times 10^5$  tonnes.

***CSS year 8 textbook:***

Evaluate the following, correct to the nearest 0.01

- (a)  $\frac{3}{\sqrt{7}-2}$                       (b)  $\frac{10}{\sqrt{5}} - \frac{4}{\sqrt{5}-1}$

**Summary**

The diversity of questions was observed here. While BS and CSS focused on consolidation of skills with no word problems, the Australian textbooks and SS used real life examples to illustrate application of the indices and standard form. Obviously the mathematical skill required to solve the CSS problems were more complex than the others, but interpreting word problems was also an important aspect of mathematics which appeared to be lacking from both BS and CSS textbooks for this topic.

***The Measurement Strand***

With reference to Table 4.4, the topic chosen for further comparative analysis in order to examine the depth of the topic from the Measurement strand was “Application of Trigonometry” which was covered in all textbooks except RH. Similar criteria as for the Number Strand applied in the question selection for this purpose.

**BH year 9 textbook:**

When Colin is 85 m away from a building he notices Spiderman at an angle of elevation of  $62^\circ$  climbing the side of the building. What will be the angle of elevation when Spiderman has climbed a further 10 m?

**PLC year 9 textbook:**

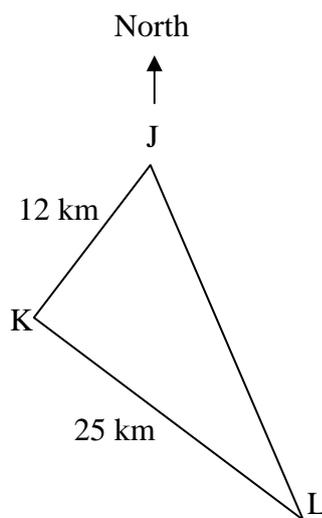
A silverfish eats its way across the front page of a book, beginning at the bottom left-hand corner and finishing at the top right hand corner. If the book is 12 cm wide and the diagonal makes an angle of  $72^\circ$  with bottom of the book, find the height of the book.

**RH textbook:** Topic content was not available.

**BS year 9 textbook:**

The diagram shows the journey of a man through three towns J, K and L. The route from J to K is of distance 12 km on a bearing  $238^\circ$ . The route from K to L is of distance 25 km where  $\angle JKL = 90^\circ$ . From L, the man traveled back to J. Find

- (a) the bearing of L from K,
- (b) the distance from L to J, correct to the nearest km.



***SS year 9 textbook:***

A boat  $A$  leaves a port  $P$  on a bearing of  $032^\circ$ , traveling at a speed of  $9$  km/h. Another patrol boat  $B$ , situated at another port  $Q$ , due south of  $P$ , sets sail to intercept the boat  $A$ . The patrol boat is capable of moving at  $13.5$  km/h. Find the bearing at which the patrol boat must sail in order to intercept  $A$ .

***CSS year 9 textbook:***

A water tank has a trapezoidal cross section  $ABCD$ . The top length  $BC$  is  $6$  m, the perpendicular distance between the two parallel sides is  $23$  m. The gradient  $AB = 1 : 3$ , Gradient  $CD = 1 : 2.5$ . Find:

- (a) The length of the slope  $AB$  and base  $AD$  correct to the nearest  $0.1$  m,
- (b) The angle of the slope  $CD$  makes with the base  $AD$ .

**Summary**

It was noted that the question type for  $BH$ ,  $PLC$  and  $BS$  were of the similar type, while the  $SS$  question was on relative velocity, and the  $CSS$  item involved gradient for length and angle calculations. For this topic,  $SS$  and  $CSS$  question types were more complex than those in the other three sets of textbooks.

***The Space Strand***

With reference to Table 4.5, topic “Similar triangles” was selected for further comparative analysis. This topic was covered in all six sets of textbooks up to year 9 level except for  $BS$  which covered this topic during year 8.

***BH year 9 textbook:***

Dirk is standing on a long ladder leaning against the wall. His friend Sean is holding up the ladder to prevent it from wobbling. Sean is  $3$  m from the wall and  $2$  m from the base of the ladder. With his arms outstretched Sean is  $2.1$  m tall. How far up the wall does the ladder reach?

**PLC year 9 textbook:**

A triangle has an area of  $20 \text{ cm}^2$ . If the lengths of its sides are halved, what is the area of the resulting triangle?

**RH year 9 textbook:**

At the same time as a tree EF casts a shadow ED of length 14.6 metres, a 1.5 metre stick BC held vertically casts a shadow BA of length 3.4 metres.

- (a) Explain why  $\triangle ABC$  and  $\triangle DEF$  are similar.
- (b) Estimate the height of the tree.

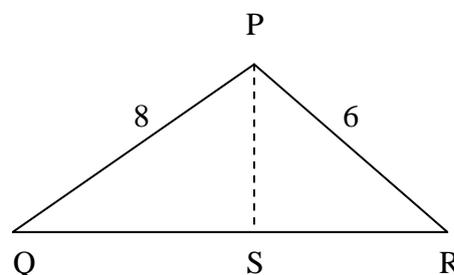
**BS year 8 textbook:**

Two prisms are similar. The ratio of their heights is  $5 : 3$ . The volume of the smaller prism is  $54 \text{ cm}^3$ . What is the volume of the larger prism?

**SS year 9 textbook:**

In the figure, the angle QPR is a right angle and PS is perpendicular to QR.  $PQ = 8 \text{ cm}$ ,  $PR = 6 \text{ cm}$  and  $QR = 10 \text{ cm}$ .

- (a) Name a triangle similar to triangle PQS.
- (b) Calculate the length of QS.



**CSS year 9 textbook:**

$\triangle ABC$  and  $\triangle DEF$  are similar. Length  $AB = 35 \text{ cm}$ , length  $DE = 12 \text{ cm}$ .

- (a) Given that the difference of perimeter of these two triangles is 60 cm, calculate the perimeter of  $\triangle ABC$  and  $\triangle DEF$ .
- (b) Given that the difference of area of these two triangles is  $588 \text{ cm}^2$ , calculate the area of  $\triangle ABC$  and  $\triangle DEF$ .

**Summary**

Questions from the BH and RH textbooks related to direct application of “similar triangles”, while PLC and BS extended the application for calculation of areas, and

that from SS and CSS involved some space and algebra skills respectively. These questions portrayed the varying complexity of the topic at the Lower Secondary level with the CSS question being the most demanding.

### ***The Chance and Data Strand***

Topic “Mean, Median, Mode and Range” was selected for further comparative analysis with reference to Table 4.6. This topic was covered in all six sets of textbooks up to Year 9 level.

#### ***BH year 9 textbook:***

A fitness class runs the following distances in 2 minutes:

520, 510, 500, 490, 480, 470, 470, 470, 470, 460, 460, 450, 440m.

- (a) Calculate the mean, median and mode.
- (b) If the two runners also ran 460 m ran again later and managed 590 m and 600 m, what would the mean, median and mode be if their new distances were substituted?
- (c) Which statistic changed least and which changed the most?

#### ***PLC year 9 textbook:***

Petrol prices vary from place to place depending on where the petrol is sold. A random sample of petrol stations in the state found the following prices per litre for unleaded petrol.

71.0	69.9	73.9	73.9	72.9	73.9
75.9	72.9	78.9	76.9	70.2	69.5
72.5	74.9	75.9	71.5	73.5	75.5
69.5	72.5	78.9	77.9	77.9	70.5

- (a) Find the range of petrol prices.
- (b) Find the mean price of petrol.
- (c) Set up a frequency table with a class interval of 1 cent beginning at 69.5 cents.
- (d) Find the modal class and mode of petrol prices.
- (e) Find the approximate mean price from the frequency table.

**RH year 9 textbook:**

The lengths of a number of adult lizards of a certain species were measured in millimeters, the results being recorded in a back to back stem and leaf plot with males and female shown separately as shown on the right. Of the lizards recorded the longest adult female was of length 143 mm and the longest adult male was of length 135 mm.

Adult females				Adult males				
			3	14				
	2	8	5	13	5			
7	5	3	7	12	7	0	9	7
	5	3	8	11	3	4		
			6	10	5	0		
				9	8			

- (a) What was the shortest length recorded for the adult female lizards?
- (b) What was the shortest length recorded for the adult male lizards?
- (c) How many adult male lizards were involved?
- (d) How many adult lizards were involved?
- (e) Determine the mean length of the adult male lizards (nearest mm).
- (f) Determine the mean length of the adult female lizards (nearest mm).

**BS year 9 textbook:**

The lengths of 50 leaves taken from a plant, measured to the nearest cm, are shown in the table below.

Length (in cm)	7 – 9	10 – 12	13 – 15	16 – 18	19 – 21
Number of leaves	2	14	22	11	1

Find the mean length of the leaves.

**SS year 8 textbook:**

- (a) The distribution of 100 values of a variable  $x$  is shown in the table below:

$x$	0	1	2	3	4	5	6
Frequency	20	30	25	16	5	2	2

For this distribution, find

- (i) the mode;      (ii) the median;      (iii) the mean.
- (b) A newsagent recorded the number of requests for a certain weekly magazine over a period of 100 successive weeks. The results are as shown below:

Number of requests per week	17	18	19	20	21	22	23
Frequency	20	30	25	16	5	2	2

Use your result from (a) (iii), state the mean number of requests per week.

The newsagent bought these magazines for 10 cents each and sold them for 20 cents each. He thus made a profit of 10 cents on each magazine sold and incurred a loss of 10 cents on each magazine that remained unsold. He decided to buy 19 copies of this magazine each week. Calculate the profit he made for the

- (i) 20 weeks when he had 17 requests per week;
- (ii) whole period of 100 weeks.

***CSS year 9 textbook:***

Find the median: 34, 40, 47, 34, 45, 34, 47, 40, 34, 40

**Summary**

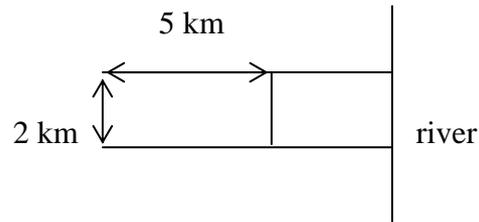
The Chance and Data problem in the CSS text was a straightforward calculation of the median of a set of numbers, which showed that at Year 9 level, the strand content coverage was rather basic. The questions from the other books were word questions related to real life examples. The Australian textbooks portrayed a higher degree of complexity in the problems.

***The Algebra Strand***

With reference to Table 4.7, the topic selected for further comparative analysis from the Algebra strand was “Quadratic equations” which was covered in five sets of textbooks at year 9 levels. RH did not cover this topic in its lower secondary mathematics programme, however, “Quadratic equations” is an important topic and it would be interesting to compare the topic coverage in different textbooks.

**BH year 9 textbook:**

The Greenwood family had a Rectangular block of land 2 km by 5 km as seen in the diagram.



They then bought the land adjoining this leading down to the river. Depending on the time of the year and the weather conditions, the width of the river can vary, so the land available for grazing sheep changes.

Write an expression for the total area available for grazing sheep at any particular time. (Assume the land remains rectangular.)

**PLC year 9 textbook:**

- (a) Solve for  $x$ :  $x^2 - 2x - 3 = 0$
- (b) Solve for  $x$ :  $x^2 - 2x - 8 = 0$
- (c) The quadratic equation  $x^2 - 2x - 5 = 0$  is difficult to solve algebraically because there are no simple factors of  $x^2 - 2x - 5$ . Using information from Parts (a) and (b) and a spreadsheet of the form given below, find the solutions to this equation correct to two decimal places.

	A	B
1	$x$	$x^2 - 2x - 5$
2		$=A^2 - 2A - 5$

**RH textbook:** Topic content was not available.

**BS year 9 textbook:**

A closed rectangular box whose dimensions are in cm and are given by  $4y$ ,  $y$  and  $(y - 1)$ . Given that the area of the material used to make the box is  $146 \text{ cm}^2$ , find the value of  $y$  correct to 2 decimal places.

**SS year 9 textbook:**

There is a two-digit number such that the sum of its digits is 6 while the product of the digits is  $\frac{1}{3}$  the original number. Find this number.

(Hint: let  $x$  be one of the digits).

***CSS year 9 textbook:***

Find  $x$ :  $(x^2 - x - 1)^2 - 6(x^2 - x - 1) + 5 = 0$

***Summary***

A diversity of the questions in different textbooks was observed. PLC has taken a technical approach on presenting a quadratic equation, while BH used a real life example for the problem and SS and BS employed similar type of word problems. All three textbooks required the students to formulate quadratic equations prior to solving them. CSS introduced quadratic equations of another form and focused mainly on algebraic skill of expansion and manipulation to solve the equations. The CSS problem might demand a more advanced mathematical skill, but it certainly lacked the challenge offered by the steps necessary to solve a word problem.

In conclusion, the topics covered in the CSS textbooks required higher mathematical skills in problem solving, though there is a scarcity of word problems included in the text. The Chance and Data content is the weakest among the six sets of textbook. By comparison to CSS, BH, PLC and SS have a less mathematically demanding strand content, but they are richer in providing a variety of question types. PLC in particular incorporated much technology usage in the content.

**4. What are the strengths and weaknesses, as well as the exemplary characteristics, of the textbooks?**

The textbooks were scrutinized to determine any individual traits of the curriculum as well as probable cultural implications. A set of teachers' interview data was incorporated into the study to complement the textbook data so as to present a more "complete" investigation with the interview data providing a stakeholder perspective for this study (Guba & Lincoln, 1989). Section 4.5 of Chapter 4 addressed this question and aimed to highlight the individual textbook characteristics and to underline the outstanding features. Below is a summary of the exemplary traits of the textbooks.

The PLC text was the most colourful amongst the textbooks. The content was interspersed with anecdotes, striking pictures and drawings. It reflected a cosmopolitan flavour using names of different races and avoided stereotyping the genders in the content. There was a good selection of problem types in the exercises and it incorporated more technological applications in the content. It covered a high number of topics; while it did not have as much depth as the SS and CSS textbook, it certainly had greater breadth than the other texts. It included a good section on the Chance and Data strand content, a good variety of interesting and challenging questions, and a very well presented and detailed section on “Parabola”. It was a textbook strongly endorsed by its users – the teachers.

The SS text was another exemplary book, which offered much depth in the topic covered, as well as many interesting anecdotes and reminders in the content. The consolidation exercises provided many questions to reinforce skills. It is not as colourful as the PLC text but the content presentation was attractive with many miniature cartoons to highlight a point. However, some of the teachers who used this book commented that the exercises were “boring” and “lacking challenging questions”.

The BH text was structured similar to PLC but a shade less colourful. The Year 9 textbook, which belongs to a different series from the Year 7 and Year 8 textbooks possessed an exemplary feature in its content – each chapter began with a “Skill-check” listing the necessary mathematics pre-requisites for the topic content, and an “Outcome List” stating the expected achievement after completing the chapter. This feature provides the students with a beginning and an end which is helpful for checking the learning process.

The BS text lacked the rigor and the breadth and depth of the SS text content. It was a watered-down version of the SS text with few challenging questions. A good feature in the text content was the inclusion of the vocabulary list and a summary at the end of every chapter, which would be helpful as a reminder for the students.

Similar to BS, the RH text is another book with relatively less depth and breadth to its content when compared to its Australian counterparts. This worksheet style textbook might save the teacher and students time in preparing and completing the worksheet respectively, but it did not offer enough topic content to equip the students with sufficient mathematical skills to compete with their peers in Victoria (Australia), Singapore or China.

Comparing it with other textbooks, the CSS text included more advance mathematics content in all strands except the Chance and Data strand. The content was presented in an exploratory discussion mode consisting mainly of guiding questions and worked examples. This textbook, with its purely mathematical approach at Lower Secondary level, might not be a captivating learning resource for students at such a young age. The teacher may have to put in extra effort to enrich the text content presentation to make learning an interesting process.

## **5. What are teachers' opinions on the textbooks used?**

The teachers' opinions were solicited to provide a user's perspective to this study. Appendix D recorded the transcripts of the teachers' response. The questionnaire was designed to draw out teachers' opinion on the use of textbook in the teaching and learning of mathematics as well as on the expatriate students in their classroom. The teachers' responses were discussed in the earlier section of this chapter. The participating teachers were from PLC in the Victoria State, a Brunei government school, a Brunei private school and a Singapore school. Below is a summary of the teachers' opinion to address this research question:

Amongst all the teachers participating in the interviews, only the PLC teachers commended their textbook highly, in particular the year 7 textbook, which was endorsed by the teacher as exemplary throughout. The PLC teachers supplement materials to the text content because that was their normal teaching practice and not because of any textbook inadequacy.

Most Brunei teachers think their text content lacks real-life examples and challenging questions. All teachers supplemented the textbooks with other resources. The Brunei private school teacher mentioned that the collection of new vocabulary and the summary at the end of every chapter were exemplary characteristics of a set of otherwise inadequate mathematics textbooks which did not contain enough content matter to prepare students on critical thinking for more advanced studies.

The Singapore teachers were similarly critical of the text content in that the work examples and problems lacked real-life examples and challenging questions. They too, supplemented the textbook content with other resources.

In summary, all except the PLC teachers were critical of the textbook as a teaching and learning tool to varying degrees. They supplemented the text content with other resource materials, which was a routine practice for some teachers, and for others it was because of textbook inadequacy. It is important to stress that the number of teachers participating in this interview was not large enough to accept their views as a total representation of the teachers' opinions, nor is it realistic to generalize the view of this small subject population.

## **6. What useful information can be passed onto teachers and administrators of expatriate students as a result of this study?**

Chapter 4 is hopefully useful in providing detailed information of other curricula to teachers and administrators of expatriate students. The method of analysing a textbook to identify the emphasis of the text content as employed in this study is a useful example for teachers to emulate when they examine mathematics textbooks. To this end a simplified textbook analysis procedure or rubric is presented on page 159. The rubric should be helpful to both the teachers and administrators of expatriate students.

Regarding the issue of expatriate students in class as stated in this research question, there were some particularly useful and encouraging remarks from the interviewing data for teachers and administrators of expatriate students. PLC teachers commented that while these students may have trouble in their English language literary skills, learning seems to transcend language barriers and does take place in a mathematics class especially when the lesson is conducted by a competent teacher. Many of the high achieving students are from the expatriate student population, though some may find the mathematics jargon difficult initially. The Brunei private school teacher made similar remarks about the expatriate students in her class and added that these students would eventually catch up with their peers. One of the Singaporean teachers commented that students from China find the mathematics content too easy. In summary, the teachers consider most expatriate students are able to cope in the mathematics classrooms of their host country.

### **Summary of section**

Research Questions One to Four aimed to explore the text content and are a significant part of this study relating to the textbooks, while research question five investigated the teachers' opinion on textbooks to provide the users' perspective of this study. Research Question Six should furnish the teachers and administrators of expatriate students with specific information regarding foreign curricula, thus assisting in identifying areas of concern in the course of teaching mathematics to the expatriate students.

Teachers should be able to use the data collection and analysis procedure described in this study to perform their own investigation of unfamiliar textbooks with the purpose of identifying the expatriate student's expected mathematics experiences. It is important to bear in mind that this is a purely theoretical evaluation procedure of textbooks. The reality of what happens in the classroom may well be quite different between countries. However as reviewed in Chapter 2, many past studies have stressed the importance of mathematics textbooks in the classroom and their influence on the teaching and learning of mathematics, which implies that what

happens in the mathematics classroom is closely linked to the content matter of the textbook.

## **5.4 Summary**

This chapter presented the findings drawn from the teachers' interviews, which included a glimpse of the cultural differences portrayed from the data collected. The research questions were reiterated to re-focus on the main objectives of the study, and a brief description of the findings was included to summarise the findings from both the textbook analysis and teachers' interview data.

The next chapter reports on the major findings and the research questions as well as discusses them in relation to the significance of the study in terms of the implication of textbooks in assessing students' past learning, the limitation of the study, and recommendations for further research.

## Chapter 6

### Discussion and Conclusions

#### 6.1 Introduction

The rationale behind this study originated from the concerns that school administrators and teachers of expatriate students have over the progress and placement of these students in the mathematics classrooms of various countries. This generated the idea of finding a way to assess students' past learning experiences through the examination of textbooks. The aim of this study was to present a method of investigating lower secondary school mathematics textbooks with the purpose of evaluating students' expected past learning experiences, and comparing students' expected mathematics learning across the different curricula.

Six sets of textbooks from four countries in the Asia-Pacific rim were selected for this study; amongst which three sets were from Australia where there is no uniform national curriculum, and three sets from countries which subscribed to a national curriculum, namely Brunei, Singapore and China. The chosen Australian textbooks were those in common use in state schools and private schools in the State of Victoria, as well as in state schools in Western Australia. The choice of the Australian textbooks was deliberate to enable investigation of the variations of the mathematics textbook content between the states of Victoria and Western Australian as well as between a state school and a private school which subscribes to the Victorian school curriculum.

The textbooks' contents were categorized into five separate strands: Number, Measurement, Space, Chance & Data and Algebra strand; and the analysis of each was guided by the six research questions formulated to provide a framework for the study. The first four research questions were related to the textbook content in order to facilitate a comparison between the various curricula as represented by the texts. Research question 5 explored the teachers' opinions on the textbooks used as well as those of the expatriate students, while research question 6 sought to derive

other useful information for school administrators and teachers regarding the expatriate students in their classrooms.

Chapter 1 of the thesis mapped out the background rationale and aims of the study and listed the research questions which formed the platform upon which the data collection and analysis was built. Chapter 2 reviewed the relevant literature and discussed findings in order to make a case regarding the connection between the textbooks and the curriculum as well as the importance of textbooks on the teaching and learning of mathematics. Chapter 3 described the methodology used in this study, which entailed an analysis of the textbook content and the teachers' interview data. The interview questionnaire was designed to solicit teachers' opinions on the textbooks used and comments on the expatriate students in their classroom. Chapter 4 analysed the data obtained from the textbook content and recorded the findings which addressed the issues raised in research questions 1 – 4. Chapter 5 examined the teachers' interviews and incorporated their opinion with the findings from Chapter 4 to formulate the answers to research questions 5 and 6.

In this chapter the major findings are presented, follow by the significance, implications and limitations of this study. Recommendations for further research are outlined as well as a summary, concluding remarks and a personal reflection.

## **6.2 Major findings**

Past research findings as discussed in Chapter 2 had established a connection between the intended curriculum and textbook content in that textbook generally reflects the curriculum it serves and consequently the text content analysis provides a yardstick for a comparison of the mathematical curricular content across the nations involved. The findings addressed the issue set out in the research questions and were discussed and summarized as below.

First, the Australian curricular guidelines allow much freedom in the interpretation of the curricular statement, and this has led to the publication of an assortment of textbooks with varied presentations and content matter even for textbooks used within the same state. The two sets of textbooks used in the State of Victoria

exhibited a variation in the content matter though they subscribed to the same curriculum and guided their readers to eventually undertake the same public examination at Year 12. The variation between states is greater when one considers that the Western Australia schools commence lower secondary education at Year 8 level, while those in the Victoria commence at Year 7. As the result of the shorter Lower Secondary duration, the WA mathematics textbooks cover fewer topics and have less breadth and depth than those used in Victoria.

Second, amongst the three sets of Australian textbooks, the PLC texts had the most detailed topic content, in addition to having a colourful presentation with many interesting anecdotes. Their key user, the teachers, endorsed this set of textbooks to be exemplary throughout, stating that they feel it is the best in the State of Victoria. The text content included two important algebraic topics: “Graphs of half planes”, which was not covered in the other five sets of textbooks; as well as “Rationalisation of denominators” which was covered by the CSS textbooks but not the others. It also incorporated much technological application such as the use of computers and scientific and graphic calculators.

Third, amongst the teachers’ interview data collected from teachers from a Singapore School, Brunei Government school, Brunei Private school, as well as a Victoria Private School PLC, the PLC teachers expressed their satisfaction with the various aspects of the textbook used, while the other textbook users generally felt that the consolidation exercises provided in the textbooks lacked challenging problems for the students so that the teachers supplemented the deficiency with questions from other resources. On the issue of expatriate students, teachers who had such students in their classroom commented that these students would eventually catch up with their peers in the learning of mathematics in their host countries, and that some of them would eventually excel in the subject, although initially a number of the ESL students might find the mathematics jargon used confusing.

Fourth, the set of Brunei textbooks BS were adapted from the Singapore Normal stream textbooks, consequently their content substance is thinner than those of the Singapore Express stream textbooks, the SS. The Singaporean students were streamed upon entry into the Lower Secondary level whereas the Bruneian students

were not. Hence while the Singaporean Express stream students were learning higher mathematics in topics of Space and Algebra, the Brunei students, inclusive of all abilities, were being exposed to a watered-down content from their Singaporean Express stream peers. According to the observation of A. Graham Down from the Council for Basic Education (Apple, 1992) who contends that “Textbooks, for better or worse, dominate what students learn”, it can be construed that the better ability Bruneian students were probably handicapped by the “limited content” imposed by the textbooks used in comparison to their Singapore Express Stream peers. The textbooks used are certainly not the sole factor contributing to the poor performance of Brunei students during the only international mathematics competition (International Mathematics Olympiad 2001) in which they participated, though it appears to have played a major part in furnishing the students with inadequate mathematical skills in the testing arena.

Fifth, the set of China CSS textbooks bear very little resemblance to the other textbooks in terms of content details and strand weightings. It focused mainly on the Space and Algebra strands while covering a nominal but more advance portion of the Number and Measure strand content. Much of the basic Number and Measure strand content covered in other textbooks was omitted in CSS, which could be an indication that these topics had been covered during the primary school years. The comments from the teachers’ interview data might implicate or validate this observation – for example, one of the Singapore teachers commented that “*students from PRC (People’s Republic of China) find this textbook easy*”, while teachers from Presbyterian Ladies College remarked that “*We have high achieving / striving students – many from ESL / ESL-like backgrounds*” which may link the ESL students to the Chinese students as there is a high Chinese student population in Australia and many are in ESL classes. The consistently good performance attained by the Chinese students in the International Mathematics Olympiad might be attributed to the fact that while students in other countries are learning the Number and Measurement strand content, the Chinese students of the same year group are learning topics only from the Space and Algebra strands.

Sixth, the level at which a topic was introduced and covered during the Lower Secondary years was charted (see Tables 4.3 – 4.7), which reflects the students’

progress on learning the topic. These tables, together with a list of questions selected from the consolidation exercises in the textbooks, provided an inkling on how much topic breadth and depth was presented in each individual set of textbooks. It led to the conclusion that the Asian textbooks covered much of the Number and Measurement strand content during the early part of the Lower Secondary School education, and that they (except the Brunei School textbooks) included more complex consolidation questions with multiple steps than the Australian textbooks. The Australian textbooks spread out the strand content coverage over the Lower Secondary period and provided more varied types of questions in the exercises, such as investigative problems and project work. Amongst these texts, the Chinese books incorporated the least number of problems in the consolidation exercises after each topic discussion.

Seventh, the Chance & Data strand has a nominal weighting in all textbooks, especially in the Asian ones. PLC had the widest coverage of the Chance & Data strand and had allocated sections of textbooks to this strand at every level. All three Australian textbooks covered both the Statistics and Probability aspects of this strand while the Asian textbooks focused only on the statistics content. The China Shanghai textbook did not commence work on this strand until Year 9 and it focused mainly on the statistical calculations including Standard Deviation and Variance which were not covered in other textbooks. This 'late' start on the Chance & Data strand might be one of the possible reasons why the Chinese students failed to achieve a good performance in this strand during the international comparative study IAEP conducted by Educational Testing Service (ETS). The outcome of the study showed that the Chinese students achieved first place in all mathematical strands except for the Chance & Data strand where they ranked 10<sup>th</sup> in the testing (Lapointe, Mead, and Askew, 1992).

In summary, the findings of this comparative study highlighted the variation of the Lower Secondary mathematics curricula across Australia, Brunei, China and Singapore, as represented by the different textbooks used in these countries, which illustrated the deviation of the learning paths undertaken by students from these countries. In terms of the rationale of this study, these findings should help to furnish information about these countries and absolve some concerns the teachers

and school administrators possess over the presence in their classroom of expatriate students from these countries. Below is the textbook analysis procedure applied in this study which may be useful to teachers to assess their expatriate students' past learning:

### **Procedure on Textbook Analysis for Use by Teachers of Expatriate Students**

1. Obtain copies of the expatriate student's former mathematics textbooks which include those for the present and past years of study (See \* if the books are not available).
2. Categorise the textbook content into five strands, namely Number, Measurement, Space, Chance & Data and Algebra.
3. List down the main topics for each strand and note the level at which the topic is introduced.
4. Repeat steps 2 & 3 for the teacher's own school textbook.
5. Tabulate the above information for both sets of textbooks for easy comparison.
6. Refer to the given review exercises in the textbooks to compare the depth and the breadth of the topic introduced. For example: "Transformation" is covered by both sets of textbooks but the degree of difficulties may vary between the textbooks.
7. The above information would allow the teacher to gain an insight of the expatriate student's past learning in comparison with the school curriculum and to offer assistance to the student accordingly.

\* To gain an inkling of the students' achieved past learning, the teacher may interview the students and possibly the parents.

### **6.3 Significance of the study**

There are several major significant aspects of this study. First, this comparative study provides a detailed analysis of six sets of textbooks for the whole Lower Secondary duration, which compares considerably with other studies reviewed in Chapter 2 that have focused only on a single topic or a single level. This analysis offers a more complete scenario of the Lower Secondary mathematics programs of four countries in the Asia-Pacific rim where comparative studies of the mathematics programs is lacking. It highlighted the content weighting and charted a topic by topic content coverage on a timeline to facilitate comparison of this topic coverage across different mathematics curricula aiming to address issues of expatriate students faced by the school administrators and teachers.

Second, it facilitated a comparison of the mathematics programs as represented by three sets of Australia textbooks from two states, which reflected the differences in curricular goals of the states. The varied learning paths represented by the textbook content served to highlight the difficulties in selecting a representative textbook for participation in the large scale international comparative studies such as TIMSS, where countries without a uniform national curriculum have to nominate a textbook which best represents their country. It supplements the TIMSS report and other large scale international comparative studies by providing information on Australian textbooks not selected for these studies, and on Brunei and China textbooks – countries that did not participate in TIMSS, and particularly of Brunei which did not participate in other comparative studies.

Third, the study identified the exemplary features of the textbooks examined, which were obtained from the text content analysis as well as from the teachers' interviews, the findings of which were described in Chapters 4 and 5. It is important to stress that the findings on exemplary characteristics of textbooks were empirical and mainly subjective, incorporating the view of teachers who participated in the interviews. These findings were based on my interpretation of the content analysis as well as of the opinion of the participating teachers, however, considering my years of teaching experience at school level as well as those participating teachers', this

information, even if only “partial”, should be useful to textbook writers and curricular planners.

Finally, the literature review discussed in Chapter 2 reported a number of studies on the evaluation of textbooks where various methodologies were employed to investigate content. Shield (2005) reported the development of a methodology to evaluate textbooks, which involves a set of curriculum principles, syllabus content statements, published research and specific curricular goals which form the basis of evaluation; with a review of the topic “Ratio and Proportion” as an example. Taking into consideration the rationale of this present study and its aim to furnish information about other mathematics curricula to teachers, a simpler approach was attempted as most teachers would normally have a heavy workload and little free time to facilitate a complicated analysis. The approach, as demonstrated in Chapter 4, based the analysis solely on an easily accessible resource – the textbooks – without much attention paid to learning theories, paradigms, curricular goals and syllabuses. The procedure involved categorizing the textbook content into the five main strands, then charting individual topic on a time-line on when it was covered, and finally examining the revision or consolidation exercises to gain an idea of the breadth and depth of the topic covered. This method enables the teachers to learn about other mathematics curriculum and gain an insight into the expatriate students’ past learning, and to identify their relative strengths and weaknesses as compared to the home students so that appropriate help could be offered to the expatriate students. For an experienced teacher, it is hopefully an easy-to-use diagnostic procedure which will achieve the assessment outcome without taking up too much time and effort.

In summary, this study has attempted to contribute to an area of mathematics education which had been unexplored until two decades ago (Ball & Cohen, 1996). The growing number of expatriate students in the classrooms will soon be a widespread component of the student population of future schools in this technological era with high people mobility. The outcomes of this study aims to serve the school administrators and teachers well.

## 6.4 Implications of the study

There are several implications of this study's outcomes. The diversity of the mathematics curricula in different countries was reflected in the textbook used, which represented different learning paths offered by the various curricula with their own individual traits. The fact that the Singaporean students scored top position in TIMSS and TIMSS-R, yet they did not perform as well as the Chinese or Australian students in International Mathematics Olympiads (see Table 4.10) was evidence that every mathematics program has its strengths and weaknesses, which are exposed under different testing criteria and reflected in the participating students' performance. Based on the observation that students' performance in these comparative studies reflects their learning that is dictated mainly by the textbooks they used (Fuller & Clarke, 1994; Heyneman, Farrell, & Sepulveda-Stuardo, 1978; Schiefelbein & Simmons, 1981; Keitel et al, 1980), it is logical to deduce that there exists "inadequacies" in the textbooks that are "revealed" when they are tested with different yardsticks. It is also sensible to deduce that rankings from these international comparative studies are not an "absolute" indicator of how good or bad a mathematics program is. Rather it should be used as a comparative index on an international mathematics platform for self improvement of the program, if that be necessary.

The textbook findings might offer an explanation about the performance of Chinese students in the international comparative studies. Their performance in the IAEP studies (see Table 4.9) illustrated their prowess in all strands except for the item on "Data Analysis, Statistics and Probability". The findings showed that the Chinese students appeared to have learned much about the Number and Measurement strand in their primary school years and were focusing on the higher mathematics during the lower secondary years. They did not commence the Chance & Data content until Year 9 and omitted the "Probability" content. These findings further reinforced the importance of the textbook on the performance of students in these international comparative studies. It also highlighted the 'deficiency' of the mathematics curriculum in China in the Chance & Data strand as compared to other countries. Li (2004) discussed the integration of the Chance & Data strand into the curriculum in

China, and stated that until 2001, “probability” was not taught at school in most areas in China.

This study points to the inadequacy of the textbooks used in the Brunei schools in comparison to those used in the Express stream in Singapore. Both countries have similar cultural and educational background, and subscribed to the Cambridge Examination Board for the public examinations at Year 10 and Year 12 levels. According to the observation “Mathematics has long been regarded by many as a subject for which the textbook is the main resource and is a world-wide phenomenon” (Robitalle and Garden, 1989; Schmidt et al, 1996), the better ability Bruneian students may be placed at a disadvantage because of them being exposed to a much watered-down mathematics content by comparison. There is very little comparative information on the mathematics education of Brunei against other countries due to the fact that it had not participated in any of the large scale international comparative studies. It is important for the Education Authority in Brunei to realize that participation in future comparative studies will help to keep the country abreast of the global development in the field concerned. This study also described the shortfall of the textbook used, which hopefully will be rectified by the Brunei Education Department such that the better ability students will be offered a more rigor mathematics exposure in the form of more challenging textbooks. Roger Howe (see Confrey & Stohl, 2003) from Yale University aptly described the importance of a challenging education for the best students:

“One issue of vital importance to mathematics education that is not captured by broad measures of student achievement is the maintenance of a challenging high-quality education for the best students. The primary object of concern these days in mathematics education seems to be the low-achieving student, how to raise the floor. Certainly this is the spirit evoked by No Child Left Behind. This is a very important issue, but it should not blind us to the fact that the old system, the system often denigrated today, is the one which got us where we are, to a society transformed by the impact of technology... The percentage of people who need to be highly competent in mathematics has always been and will continue to be small, but it will not get

smaller. We must make sure that mathematics education serves these people well.” (p. 76)

The diversity of the learning paths as portrayed in the findings also implied the complexity in comparing the expected mathematics knowledge of students with different curricular background, as in the case of university entrance assessment. Students acquired mathematical skills formulated by the program undertaken, leading them to the tertiary entrance level. Consequently, universities with international applicants have the daunting task of assessing students’ ability based on their examination results for university intake. There is an assortment of examination boards existing giving rise to a multitude of result outcomes, such as: Cambridge ‘A’ Levels, International Baccalaureate, High School Certificates, Tertiary Entrance Examinations in Western Australia, and so on. In general, a conversion table is used for cross comparison of these different sets of examination results. However, in view of the disparity of the various curricula as portrayed in this study, the higher school curricula may be equally diverse and hence formulating such a conversion table is definitely a complex task.

Finally, it is worthwhile repeating that as textbooks play an important role in mathematics education, sourcing out the appropriate mathematics books available in the market is a frequent and necessary task due to numerous publications of mathematics resource books. The textbook content analysis procedures described earlier may be adopted by the teachers to investigate any new publication for their suitability in meeting the needs of their mathematics programs.

## **6.5 Limitations**

There are several limitations to this study. Firstly, almost half of the schools approached to participate in the Teachers’ Interview did not respond to the invitation. Consequently the interviewing data collected was small. This sample was certainly not substantial enough to be considered as a general representation of teachers’ opinions for the particular curriculum and did not carry enough “weight” to bring closure to the study’s goals. Nevertheless it did provide a glimpse of the key stakeholders’ perspectives.

Secondly, Tables 4.3 – 4.7 which charted the topics coverage for analyzing the learning progress of students were based on the assumption that the whole textbook content for every level was taught within the particular school year. One of the questions in the Teachers' Interview Questionnaire: "*Do you have enough curriculum time to complete the text content?*" was designed to investigate if the teaching progress agreed with the above assumption. Most teachers' responses were that there was often insufficient time to cover the whole text content due mainly to the student factor. Consequently, there would be a disparity between the actual mathematical content taught and the assessed mathematical skills on students' past learning via analysis of the textbooks, which introduced an element of inaccuracy into the assessment of students' past learning based purely on textbook analysis. Nevertheless, this discrepancy can easily be rectified by interviewing the student concerned to gain an idea of the topic omitted.

A third limitation to this study concerns the shelf life of a textbook. Due to the rapid evolution of technology during this computer era, incorporating the use of technological devices into the teaching and learning of mathematics has become an essential ingredient of the mathematics curriculum. In many countries, ICT has become an important and essential feature of the mathematics classrooms. Consequently the life of a mathematics textbook is becoming relatively shorter than what it used to be perhaps a decade ago. As mentioned earlier, a constant concern that I have had while conducting this study was that the textbooks selected would cease to be used in schools, which would have then rendered the teachers' interview data invalid. To date it was with great relief that I have learned that these books will not be phased out from the schools, though PLC appears to be considering to do so. However, even with the eventual invalidation of the interviewing data, this study should still be of significant use to interested parties in mathematics education in that the diagnostic procedures introduced will remain valid.

The final limitation of this study concerns the Australian textbooks. While all textbooks reviewed are currently being used in schools, the three sets of Asian textbooks were government mandated textbooks selected because the textbooks best portrayed the national curriculum. However, the Australian curriculum had undergone recent reform and modernization. The new Victorian syllabus has

incorporated many features to its curriculum such as communication, modeling, real world problem solving, mathematical reasoning and so on. Both sets of textbooks reviewed did not include any of these topics. Hence examining the Australian textbooks may not achieve a true picture of student's expected learning during this transition period. In Australia, textbook writers are often engaged to write "conforming" textbooks after the release of a new syllabus document. This may be the reason why PLC is going to abandon their textbook, even though all teachers interviewed responded to it in a very positive way.

## **6.6 Further research**

The varied characteristics of the mathematics curricula discussed in this study denote a need to explore the curricula before and after the Lower Secondary school years. The scrutiny of the primary school mathematics textbooks will provide an insight into the Primary curricular content which is the platform upon which the Lower Secondary curriculum is built, while investigation of the Upper Secondary textbooks offers a means to examine a curriculum which is an extension of the Lower Secondary one. This later analysis would provide a basis to compare the various curricula to see if the mathematics educations prescribed by these curricula generate similar standards prior to tertiary education even though the learning routes vary. Such an investigation would be particularly useful for the purpose of assessing students' mathematical knowledge at any tertiary institutions which accepts a high international student intake.

A detailed teachers' interview checklist and larger sample of teachers will certainly help to paint a clearer picture on the pros and cons of the textbook used which will benefit curriculum planners and textbook writers. I had initially planned to investigate the teachers' opinion about the textbook used and compare the interview data collected from two different Australian states – WA and Victoria, as well as from a private and a state school in Australia. Both comparative investigations were aborted due to the lack of respondents. Further research on collecting and expanding the interview data from these schools to facilitate these comparisons will provide better insight on the textbook user's opinions as well as shed some light on the teaching practice in these schools. It will not only supplement the textbook

study, it may also provide an indication to the quality of teaching and learning in these schools for comparison purpose.

Another area for further research relating to this study is the investigation of student selection criteria for participation in international comparative studies in the various countries. As mentioned earlier, countries like Australia which do not have a uniform national curriculum are required to recommend a set of textbooks that best represent the country to participate in large scale international comparative studies such as TIMSS. Obviously each country differs in their selection criteria, though countries with a uniform national curriculum would probably have a more straightforward set of criteria than those without. Each country's standing in these comparative studies depends on the performance of these students. An investigation into this issue would shed light on how these selection criteria are designed, thus giving an insight on what is deemed the important student qualities (in the selectors' opinion), which might be useful to the organizers of these studies in formulating their study outcomes.

## **6.7 Summary and concluding remarks**

What began as the concerns of school administrators and teachers over the presence of expatriate students in their classroom led to a need to assess the students' expected past learning. A subsequent literature review established the link between students' mathematics knowledge and the textbooks used, and hence provided a means to assess students' expected past learning through the evaluation of textbooks. The literature review was followed by structuring the methodology including selection of textbooks and countries whose mathematics curricula are of interest to people in this part of the world. This study presented an analysis of six sets of Lower Secondary textbooks from countries in the Asia-Pacific rim, along with an examination of teachers' interview data collected. The outcome has provided teachers with a method to assess students' expected past mathematical skills. It also furnished detailed content matter about other countries' mathematics textbooks, as well as recorded the opinion of teachers from other countries regarding the textbook used. The study findings should be useful to several groups of people including curriculum

planners, textbook writers, parents and students, not to mention the school administrators and the teachers.

In conclusion, this study offers the teachers and school administrators an easy-to-use procedure for evaluating textbooks to assess students' expected learning progress, and highlights the traits of curricula from a few countries to provide a general idea of the mathematics ability expected in the expatriate students from those countries. A quote by Robitaille (1995) on the importance of a teacher's role in education is a suitable concluding remark to this research, which began with the concerns of teachers:

*“Teacher is the key textbook user; evaluation of text from the teacher’s perspective is of utmost importance, as they are the link between the curricular planner, textbook writers and the target – the students”.*

## **6.8 Personal reflection**

This study represented a learning journey which was not thought of as being feasible four years ago when I started reading the various research papers and working through the numerous assignments in the coursework component of my doctoral program. It was a journey dotted sometimes with exhaustion but frequently with much enlightenment and enjoyment, and was most rewarding in terms of personal development. The most notable feature of arriving at the end of the journey was the realization that I have a lot more to learn, as this learning journey has opened my eyes to an even wider field of knowledge which seemed to be growing larger over the period while I was conducting this piece of research.

Upon retrospection, I am indeed fortunate to have the opportunity to be a student, an engineer, a teacher, a school administrator, an education officer and now a research student. These various roles and the accompanying experiences not only helped to initiate this study which culminated in the thesis as a record of my learning, they also provided me the insight to appreciate my present learning a lot more than if I had missed out on the working experience and commenced this study immediately following the “student” role. It is certainly the best learning journey that I have

undertaken, and I sincerely hope the fruition of this study will contribute to an increasingly important and popular research area in mathematics education.

## References

- Adams, L.M., Tung, K.K., Warfield, V.M., Knaub, K., Mudavanhu, B., and Yong, D. (2000, November). *Middle school mathematics comparisons for Singapore Mathematics, Connected Mathematics Program, and Mathematics in Context (including comparisons with the NCTM Principles and Standards 2000)*. A report to the National Science Foundation, November 2, Seattle, WA: University of Washington. (Unpublished manuscript).
- Alexander, R. (2000). *Culture and pedagogy*. United Kingdom. Blackwell Publishing.
- Apple, M.W. (1986) *Teachers and Texts. A political economy of class and gender relations in education*. New York: Routledge & Kegan.
- Atkin, J. M., & Black, P. (1997). Policy perils of international comparisons: The TIMSS case. *Phi Delta Kappan*, 79(1), 22-28.
- Australian Education Council (1994). *Mathematics – A curriculum profile for Australian schools. A joint project of the States, Territories and the Commonwealth of Australia initiated by the Australian Education Council*, (1994). Curriculum Corporation.
- Baker, D. P. (1997). Good news, bad news, and international comparisons: Comment on Bracey. *Educational Researcher*, 26(4), 16-17.
- Ball, D. L., & Cohen, D. K. (1996). Reform by the book: What is – or might be – the role of curriculum materials in teaching and instructional reform? *Educational Researcher*, 25(9), 6-8, 14.
- Bao, J. (2002). Comparative study on composite difficulty of Chinese and British school mathematics curriculum. *Global Education*, 31(9).

- Beaton, A. E., Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., Kelly, D. L., & Smith, T. (1996). *Mathematics achievement in middle school years: IEA's Third International Mathematics and Science Study (TIMSS)*. Boston, MA: Centre for the Study of Testing, Evaluation, and Educational Policy, Boston College.
- Beatty, A. (Ed.). (1997). Learning from TIMSS: Results of the Third International Mathematics and Science Study. *Summary of a symposium*. Washington, D.C.: National Academy Press.
- Bierhoff, H. (1996). Laying the foundations of numeracy: A comparison of primary school textbooks in Britain, Germany and Switzerland. *Teaching Mathematics and its Application*, 15(4), 1-157.
- Bishop, A. J. (1988). *Mathematical enculturation: A cultural perspective on mathematics education*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Bracey, G. (1993). American students hold their own. *Educational Leadership*, 50(5), 66-67.
- Bracey, G. (1996). International comparisons and the condition of American education. *Educational Researcher*, 25(1), 5-11.
- Bracey, G. W. (1998). TIMSS, rhymes with "dime," As in "witted." *Phi Delta Kappan*, 79(9), 686-687.
- Bracey, G. (2000). The TIMSS final year and report: A critique. *Educational Research*, 29(4), 4-10.
- Cai, J. (2000). Understanding and representing the arithmetic averaging algorithm: An analysis and comparison of US and Chinese students' responses. *International Journal of Mathematics Education in Science and Technology*, 31(6), 839-855.

- Cai, J. (2001). Improving mathematics learning: Lessons from cross-national studies of US and Chinese students. *Phi Delta Kappan*, 82(5), 400-405.
- Cai, J. (2004). Why do U.S. and Chinese students think differently in mathematical problem solving? Exploring the impact of early algebra learning and teachers' beliefs. *Journal of Mathematical Behaviors*, 23(2), 133-165.
- Cai, J., Lo, J. J., & Watanabe, T. (2002). Intended treatment of arithmetic average in U.S. and Asia school mathematics textbooks. *School Science and Mathematics*, 102(8), 1-13.
- Carter, J., Li, Y., & Ferrucci, B. J. (1997). A comparison of how textbooks present integer addition and subtraction in PRC and USA. *The Mathematics Educator*, 2(2), 197-209.
- Channelnewsasia.com (2004). Singapore students beat 48 countries to top in Science and Mathematics.  
<http://www.channelnewsasia.com/stories/singaporelocalnews/print/1222874/1.html>  
 [12/12/04]
- Confrey, J., & Stohl V. (Ed.) (2003). *On evaluating curricular effectiveness – Judging the quality of K – 12 mathematics evaluations*. National Research Council of the National Academies. The National Academies Press, Washington, D. C.
- Dacey, J. S. (1989). Peak periods of creative growth across the lifespan. *Journal of Creative Behaviours*, 23(4), 224-47.
- D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the learning of mathematics*, 5(1), 44-48.
- Days, H. C., Wheatley, G. H., & Kulm, G. (1979). Problem structure, cognitive level, and problem-solving performance. *Journal for Research in Mathematics Education*, 10(2), 135-146.

- Ellerton, N. F., & Clements, M. A. (2000). The translation of paper-and-pencil mathematics tests: The question of equivalence. In M. A. Clements, H. Tairab, & K. Y. Wong (Eds.), *Science, mathematics and technical education in the 20<sup>th</sup> and 21<sup>st</sup> centuries* (pp. 113-122). Gadong: University Brunei Darussalam.
- Fan, L. (1999a). Applications of arithmetic in US and Chinese textbooks: A comparative study. In G. Kaiser, E. Luna, & I. Huntley (Eds.), *Studies in mathematics education series: II International comparisons in mathematics education* (pp. 151-162). London: Falmer Press.
- Fan, L. (1999b). The sources of teachers' knowledge of instructional materials. *The Mathematics Educator*, 4(2), 42-69.
- Fan, L., & Kaeley, G. S. (2000). The influences of textbooks on teaching strategies: An empirical study. *Mid-Western Educational Researcher*, 11(2).
- Fan, L., & Zhu, Y. (2000). Problem solving in Singaporean secondary mathematics textbooks. *The Mathematics Educator* 2000, 5(1/2), 117-141.
- Fan, L., & Zhu, Y. (2004). How have Chinese students performed in mathematics? A perspective from large-scale international mathematics comparisons. In L. Fan, N.Y. Wong, J. Cai, & S. Li (Eds.) *How Chinese learn mathematics: Perspectives from insiders*. Singapore: World Scientific Publishers
- Fujii, T. (2001). The changing winds in Japanese mathematics education. *Mathematics Education Dialogue*, 2001 (November). Retrieved June 19, 2002, from <http://www.nctm.org/dialogues/2001-11/20011105.htm>.
- Fuller, B., & Clarke, P. (1994). Raising school effects while ignoring culture? Local conditions and the influence of classroom tools, rules, and pedagogy. *Review of educational Research*, 64(1), 119-157.

- Gerdes, P. (1996). Ethnomathematics and mathematics education. In A. J. Bishop, K. Clements, C. Keitel, J. Kilpatrick, & C. Laborde (Eds.), *International handbook of mathematics education* (pp. 909-943). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Gilbert, R. (1989) Text analysis and Ideology Critique of Curricular Content. In S. Castell, A. Luke, and C. Luke, (Eds.) *Language, Authority and Criticism. Readings on the School Textbook*. London: Falmer Press.
- Graybeal, S. S. (1988). *A study of instructional suggestions in fifth-grade mathematics and social studies teacher's guides and textbooks*. Unpublished doctoral dissertation, University of Chicago.
- Greene, J. C. (2001). Mixing social inquiry methodologies, In V. Rochardson (ed.), *Handbook of research on teaching, 4*, 251-258. Washington, DC: American Educational Research Association.
- Guba, E. G. & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Newbury Park, CA: Sage Publications.
- Haggarty, L. & Pepin, B. (2002). An investigation of mathematics textbooks and their use in English, French and German classrooms: who gets an opportunity to learn what? *British Educational Research Journal*, 28(4), 567-590.
- Hantrais, T. & Mangen, S. (Eds.) (1996) *Cross-National Research Methods in Social Sciences*. New York: Pinter
- Harries, T. & Sutherland, R. (1998). *A comparison of primary mathematics textbooks from five countries with particular focus on the treatment of number*. QCA Final Report.
- Hembree, R. (1992). Experiments relational studies in problem solving: a meta-analysis. *Journal for Research in Mathematics Education*, 23(3), 242-273.

- Hess, R. D., & Azuma, H. (1991). Cultural support for schooling: Contrasts between Japan and the United States. *Educational Researcher*, 20(9), 2-8
- Heyneman, S. P., Farrell, J. P., & Sepulveda-Stuardo, M. A. (1978). *Textbooks and achievement: What we know*. Washington, DC: World Bank.
- HMI (1992) *Mathematics Key Stages 1.2 and 3*. A report by HM Inspectorate on the Second Year 1990-1991. London: HMSO.
- Howson, A. G. (Ed.) (1995). *Mathematics textbooks: A comparative study of Grade 8 Texts*. Vancouver, Canada: Pacific Educational Press.
- Husen, T. (1996). Lessons from the IEA studies. *International Journal of Educational Research*, 25(3), 207-218
- Jaeger, R. M. (1992). Weak measurement serving presumptive policy. *Phi Delta Kappan*, 74(2), 118-128.
- Johnson, D.C. & Millet, A. (1996) (Eds.). *Implementing the mathematics National Curriculum policy, politics and practice*. London: Paul Chapman.
- Kaiser, G. (1999). International comparisons in mathematics education under the perspective of comparative education. In G. Kaiser, E. Luna, & I. Huntley (Eds.), *International comparisons in mathematics education* (pp. 140-150). London, Falmer.
- Keitel, C., & Kilpatrick, J. (1999). Rationality and irrationality in international comparisons. In G. Kaiser, E. Luna & I. Huntley (Eds.). *International comparisons in mathematics education* (pp. 213-256). Falmer Press: London.
- Keitel, C., Otte, M. and Seeger, F. (1980) *Text-Wissen- Ta Tigkeit: Das Schulbuch im Mathematikunterricht*. Ko nigstein/Ts: Scriptor.

- Keys, W., Harris, S., & Fernandes, C. (1996). *Third international mathematics and science study. First national report (Part I)*. Berkshire, U.K.: National Foundation for Educational Research.
- Keys, W., Harris, S., & Fernandes, C. (1997). *Third international mathematics and science study. First national report (Part II)*. Berkshire, U.K.: National Foundation for Educational Research.
- Krammer, H. P. M. (1985). The Textbooks as classroom context variable. *Teaching & Teacher Education*, 1(4), 273-278.
- Kulm, G., Morris, K., & Grier, L. (2000). Project 2061 Appendix C – Methodology, from <http://www.prject2061.org/tools/textbook/matheval/appendix/appende.htm>
- Lapointe, A. E., Mead, N. A., & Askew, J. M. (1992). *Learning mathematics*. New Jersey: Educational Testing Service.
- Li, J. (2004). Teaching approach: Theoretical or experimental? In L. Fan, N.Y. Wong, J. Cai, & S. Li (Eds.) *How Chinese learn mathematics: Perspectives from insiders*. Singapore: World Scientific Publishers.
- Lim, T. H. & Clements, M. A. (2000). Language and algebra in Bruneian context. In M. A. Clements, H. Tairab, & K. Y. Wong (Eds.), *Science, mathematics and technical education in the 20<sup>th</sup> and 21<sup>st</sup> centuries* (pp. 155-165). Gadong: University Brunei Darussalam.
- Li, Y. (2000). A comparison of problems that follow selected content presentations in American and Chinese mathematics textbooks. *Journal for Research in Mathematics Education*, 31, 234-41.
- Mayer, R. E., Sims, V., & Takika, H. (1995). A comparison of how textbooks teach mathematical problem solving in Japan and the United States. *American Educational Research Journal*, 32, 443-60.

- Mead, N. A. (1995). International Assessment of Educational Progress. *In International comparative studies in education: Descriptions of selected large-scale assessments and case studies* (pp. 48-57). Washington, DC: National Research Council. (ERIC Document Reproduction Service No. ED 383761).
- Medrich, E. A., & Griffith, J. (1992). *International mathematics and science assessment: What have we learned?* National Center for Education Statistics Research and Development Report (NCES Publication No. 92-011). (ERIC Document Reproduction Service No. ED 342680).
- Milgram, R. J. (2003). *An evaluation of CMP*. Available: ers/milgram/report-on-cmp.html” <http://math.stanford.edu/pub/papers/milgram/report-on-cmp.html> [6/4/03]. (Unpublished manuscript).
- Millett, A. & Johnson, D. C. (1996). Solving teachers’ problems? – the role of commercial mathematics scheme. In Johnson, D. C. and Millett, A. (1996) (Eds.), *Implementing the mathematics National Curriculum policy, politics and practice*. London: Paul Chapman.
- Ministry of Education, (1999). *Education Statistics Digest 1999*. Singapore: Ministry of Education.
- Moely, B. E. (1977). Organization in memory. In R. V. Kail, Jr., & J. W. Hagan (Eds.), *Perspectives on the development of memory and cognition* (chapter 7). Hillsdale, NJ: Erlbaum.
- National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA:NCTM.
- Ornster, P. A., & Liberty, C. (1973). *Rehearsal Processes in Children’s Memory*. Paper presented at the biennial meeting of the society for research in child development. Philadelphia, PA. (ERIC Document Reproduction Service No. ED 085 077).

- Postlethwaite, T. N. (1999). *International studies of educational achievement: Methodological issues*. Hong Kong: Comparative Educational Research Centres, The University of Hong Kong.
- Quek, T. (2000, April 8). US education chief praises Singapore way. *The Straits Times*, p. 8. Singapore.
- Robitaille, D. F. & Garden, R. A. (1989a). *The IEA study of Mathematics II: Contexts and Outcomes of School Mathematics*, Oxford: Pergamon Press.
- Robitaille, D. F., & Garden, R. A. (Eds) (1989b). *The IEA study of mathematics II: Contexts and outcomes of school mathematics*. Oxford: Pergamon Press.
- Robitaille, D. F. & Travers, K. J. (1992): International studies of achievement in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 687-709). New York: Macmillan.
- Rotberg, I. C. (1990). I never promised you first place. *Phi Delta Kappan*, 72(4), 296-303.
- Schiefelbein, E., & Simmons, J. (1981). *The determinants of school achievement: A review of the research for developing countries*. Ottawa: International Development research Centre.
- Schmidt, W. H., McKnight, C. C., Cogan, L. S., Jakwerth, P. M., & Houang, R. T. (1999). *Facing the consequences: Using TIMSS for a closer look at US mathematics and science education*. Dordrecht, The Netherlands: Kluwer Academic Press.
- Schmidt, W. H., McKnight, C. C., Houang, R. T., Wang, H., Wiley, D. E., Cogan, L. S., et al. (2001). *Why schools matter: A cross-national comparison of curriculum and learning*. San Francisco, CA: Jossey-Bass Press.

- Schmidt, W. H., Mcknight, C. C., Valverte, G. A., Houg, R. T., & Wiley, D. E. (1997). *Many visions, many aims: A cross-national investigation of curricular intentions in school mathematics* (Vol. 1). Dordrecht: Kluwer Academic Publishers.
- Schmidt, W. H., et al. (1996). *Characterizing Pedagogical flow. An Investigation of Mathematics and Science Teaching in Six Countries*. Dordrecht: Kluwer.
- Sosniak, L. A., & Stodolsky, S. S. (1993). Teachers and textbooks: materials use in four fourth-grade classrooms. *The Elementary School Journal*, 93(3), 249-275.
- Shield, M. J. (2005). Building a methodology for the comparison and evaluation of middle-years mathematics textbooks. *Paper published in Proceedings and presented at the Mathematics Education Research Group of Australasia Inc. MERGA conference in Melbourne, Australia, July 2005.*
- Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: The Free Press.
- Theisen, G., & Adam, D. (1990). Comparative education research. In R.M. Thomas (Ed), *International comparative education: Practices, issues and prospects*. Oxford, Butterworth-Heinemann.
- Thomson, S., & Flaming, N. (2004). *Summing it up: Mathematics achievement in Australian schools in TIMSS 2002*. Melbourne: Australian Council for Educational Research.
- Tobin, K., & Fraser, B. J. (1998). Qualitative and quantitative landscapes of classroom learning environments. In B. J. Fraser, & K. G. Tobin (Eds.), *International handbook of science education: Part one* (pp. 623-640). Dordrecht, The Netherlands: Kluwer Academic Press.

- Tyson, H., & Woodward, A. (1989). Why students aren't learning very much from textbooks. *Educational Leadership*, 47(3), 14-17.
- Viadero, D. (2000). Expert exports. *Education Week*, 12(3), 18-19. (Also see online <http://www.edweek.org/tm/tm-printngstory.cfm?slug=03singapore.h12>)
- Wang, J. (1996). Letter to the editor. *Journal for Research in Mathematics Education*, 27(5), 619-620.
- Wang, J. (2001). TIMSS primary and middle school data: Some technical concerns. *Educational Researcher*, 30(6), 17-21.
- Woodward, A., & Elliott, D. I. (1990). Textbook use and teacher professionalism. In D. L. Elliott & A. Woodward (Eds.), *Textbooks and schooling in the United States: Eighty ninth yearbook of the National Society for the study of Education* (Part I, pp. 178-193). Chicago, IL: University of Chicago Press.
- Yudin, L., & Kate, S. L. (1963). Concept attainment and adolescent development. *Journal of Educational Psychology*, 54(4), 177-182.
- Zhu, Y. (2003). *Representations of problem solving in China, Singapore and US mathematics textbooks: A comparative study*. Unpublished doctoral dissertation, National Institution of Education, Nanyang Technological University, Singapore.

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## Appendix A: Year 7 Textbook Content Cover Page

(Note: The textbook content was recorded on Excel Spreadsheet which covered the six sets of textbooks in the five categorized strands. The page number was indicated at the top left hand corner of each page. Below is a diagram indicating the position of the pages in the spreadsheet.)

BH PLC	RH BS	SS CSS
Number Strand		
Page 1 Page 2 Blank	Page 8 Page 9 Page 10	Page 15 Page 16 Page 17
Measure Strand		
Page 3	Page 11	Page 18
Space Strand		
Page 4 Blank Page	Page 12 Blank Page	Page 19 Page 20
Chance & Data Strand		
Page 5	Page 13	Page 21
Algebra Strand		
Page 6 Blank Page Blank Page	Page 14 Blank Page Blank Page	Page 22 Page 23 Page 24
Revision		
Page 7	Blank Page	Page 25

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(Note: The textbook content was recorded on Excel Spreadsheet which covered the six sets of textbooks in the five categorized strands. The page number was indicated

at the top left hand corner of each page. Below is a diagram indicating the position of the pages in the spreadsheet.)

BH PLC	RH BS	SS CSS
Number Strand		
Page 1 Page 2 Page 3	Page 10 Page 11 Page 12	Page 19 Page 20 Page 21
Measure Strand		
Page 4	Page 13	Page 22
Space Strand		
Page 5 Blank Page	Page 14 Page 15	Page 23 Page 24
Chance & Data Strand		
Page 6	Page 16	Page 25
Algebra Strand		
Page 7 Page 8	Page 17 Page 18	Page 26 Page 27
Revision		
Page 9	Blank Page	Page 28

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(Note: The textbook content was recorded on Excel Spreadsheet which covered the six sets of textbooks in the five categorized strands. The page number was indicated at the top left hand corner of each page. Below is a diagram indicating the position of the pages in the spreadsheet.)

BH PLC	RH BS	SS CSS
Number Strand		
Page 1 Page 2	Page 10 Page 11	Page 16 Blank Page
Measure Strand		
Page 3 Page 4	Page 12 Blank Page	Page 17 Blank Page
Space Strand		
Page 5 Blank Page	Page 13 Blank Page	Page 18 Page 19
Chance & Data Strand		
Page 6	Page 14	Page 20
Algebra Strand		
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## Appendix BA: Summary of topic sequence for individual strand

Schools		BH	PLC	RH	BS	SS	CSS
Number strand chapter number	Year 7	1, 2, 7, 13	1, 2, 3, 4		1, 2, 3, 4, 7, 12	1, 2, 3, 4, 5, 6, 11, 12	
	Year 8	1, 6, 11, 14	1, 2, 3, 5, 9, A	1, 5, 7, 8, 9, 12, 13, 14, 21, 25, 27	1, 4	1	1, 2
	Year 9	1, 2	1, 5, 10, 11	1, 2, 3, 4, 12			
Measure strand chapter number	Year 7	5, 14	5, 6, 7		5, 10, 11	9, 10	
	Year 8	4, 9, 15	12, C	11, 15, 16, 18	2	3, 12, 13, 15	
	Year 9	3, 4	2, 3, 13, 14, A	5, 7, 10	1, 2, 3	6, 10	3
Space strand chapter number	Year 7	4, 9, 12, 15	8, 9, 10		8, 9	13, 14	4, 5, 9, 10, 11
	Year 8	2, 8, 13	10, 11	3, 4, 6, 10, 20, 24	9, 10	2, 4, 11	4, 7, 8
	Year 9	8	12, C	6, 14, 15	6, 7, 8, 11	4, 5, 11, 12	2, 5
Chance & Data strand chapter number	Year 7	8, 10	13, 14			15	
	Year 8	5, 12	14	2, 17, 22	11, 12	14	
	Year 9	9, 10	15, 16	13	12	13, 14	4
Algebra strand chapter number	Year 7	3, 6, 11	11, 12		6	7, 8	1, 2, 3, 6, 7, 8,
	Year 8	3, 7, 10	4, 6, 7, 8, 13, B	19, 23, 26	3, 5, 6, 7, 8	5, 6, 7, 8, 9, 10	3, 5, 6
	Year 9	5, 6, 7	4, 6, 7, 8, 9, B, D	8, 9, 11	4, 5, 9, 10	1, 2, 3, 7, 8, 9	1

## Appendix BB: Number strand topic sequence

BH	PLC	RH	BS	SS	CSS
<b>YEAR 7</b>					
1- Number review  2- Number money  7- Whole no patterns & properties  13- Operations & Order	1- Whole number revision  2- Number pattern  3- Fractions  4- Decimals & percentages		1- The whole no  2- Integer  3- Meaning of fraction  4- Decimal  7- Rate, ratio & proportion  12- Percentages	1- The whole number  2- Factors & multiples  3- Number sequences and problem solving  4- Fractions & decimals  5- Real no  6- Estimation and approximation  11- Ratio, rate & proportion  12- Arithmetical problems	
<b>YEAR 8</b>					
1- Positive and negative numbers  6- Operations & applications  11- More operations & applications  14- Indices	1- Puzzles & problems  2- Arithmetic  3- Directed no.  5- Indices  9- Percentage  A- Learning experience	1- Using whole numbers  5- Consecutive integers  7- Making generalizations  8- Squaring, cubing  9- How big is a million  12- Understanding decimals  13- Decimals  14- Fraction  21- Avoiding confusion  25- Negative no  27- Out of 100	1- Everyday mathematics  4- Indices	1- Arithmetic problem & standard form	1- Roots of numbers 2- Radical expressions in the square root form

<b>YEAR 9</b>					
1- Mathematical technique	1- Number & pattern	1- Numbers			
2- Surds	5- Surds	2- Proportion			
	10- Indices	3- Fractions			
	11- Ratio, percentages & practical applications	4- Negative no			
		12- Number patterns			

## Appendix BC: Measure strand topic sequence

BH	PLC	RH	BS	SS	CSS
<b>YEAR 7</b>					
5- Length, mass & time  14- Area, Volume & Capacity	5- Length & perimeter  6- Area & volume  7- Time & mass		5- Measures and money  10- Perimeter & area  11- Surface area & volume	9- Perimeter & area of simple geometrical figures  10- Volume & surface area	
<b>YEAR 8</b>					
4- Perimeter & areas  9- Areas & volumes  15- Rates	12- Measurement  C- Learning experience	11- Inside & around the outside  15- Interpreting scale  16- Take your time  18- Measuring with cube	2- Mensuration	3- Scales & maps  12- Pythagoras' theorem  13- Measurement  15- Trigonometrical ratios	
<b>YEAR 9</b>					
3- Measurement  4- Pythagoras & trigonometry	2- Estimation & approximation  3- Pythagoras' theorem  13- Measurement  14- Trigonometry  A- Learning experience	5- Revision of the metric system & time  7- Perimeter & area  10- Circles	1- Pythagoras theorem  2- An introduction to trigonometry  3- Application of trigonometry	6- Area and volume of similar figures & solids  10- Trigonometry	3- Trigonometric ratio of acute angles

## Appendix BD: Space strand topic sequence

BH	PLC	RH	BS	SS	CSS
<b>YEAR 7</b>					
4- Triangles and quadrilaterals  9- Coordinates, maps & networks  12- Polygons & polyhedra  15- Coordinates & graphs	8- Angles  9- Polygons  10- Location		8- An introduction to geometry  9- Polygons	13- Basic geometrical concepts & properties  14- Angle properties of triangles and quadrilaterals	4- Translation & parallel lines  5- Axial symmetry and isosceles triangles  9- Rotation & circle  10- Central symmetry and parallelogram  11- Congruent triangles
<b>YEAR 8</b>					
2- Maps & coordinates  8-2-dimensional & 3-dimensional shapes  13- Construction	10- Space, geometry & figures  11- Space, geometry and angles	3- Playing the angles  4- Drawing 3 dimensions on 2 dimensions  6- Designing a logo  10- Tiling  20- Making a box  24- Making it right	9- Symmetry  10- Congruent and similarity	2- Congruence & similarity  4- Symmetry & angle properties of polygons  11- Motion geometry	4- Geometry proofs  7- Geometric construction & calculations  8- Quadrilaterals
<b>YEAR 9</b>					
8- Geometry	12- Space & geometry  C- Learning experience	6- Polygons  14- Transformations  15- Ratio and similarity	6- Straight line graphs  7- Symmetry property of a circle  8- Angle properties of a circle  11- Transformations	4- Congruent and similar triangles  5- Coordinate geometry  11- Geometrical properties of circles  12- Tangents and the alternate segment theorem	2- Similar figures  5- Circles

## Appendix BE: Chance & Data strand topic sequence

BH	PLC	RH	BS	SS	CSS
<b>YEAR 7</b>					
8- Probability  10- Statistical Data	13- Probability  14- Statistics			15- Statistics	
<b>YEAR 8</b>					
5- Statistics & technology  12- Probability & simulation	14- Certain & in-between	2- Getting to know you  17- What are my chances  22- Survey	11- An introduction to statistics  12- Averages	14- Statistics - measure of central tendency	
<b>YEAR 9</b>					
9- Probability  10- Statistics	15- Interpretation of data and statistics  16- Probability	13- Making sense of data	12- Grouped data	13- Frequency distribution  14- Measure of central tendency	4- Basic statistics

## Appendix BE: Chance & Data strand topic sequence

<b>BH</b>	<b>PLC</b>	<b>RH</b>	<b>BS</b>	<b>SS</b>	<b>CSS</b>
<b>YEAR 7</b>					
8- Probability  10- Statistical Data	13- Probability  14- Statistics			15- Statistics	
<b>YEAR 8</b>					
5- Statistics & technology  12- Probability & simulation	14- Certain & in-between	2- Getting to know you  17- What are my chances  22- Survey	11- An introduction to statistics  12- Averages	14- Statistics - measure of central tendency	
<b>YEAR 9</b>					
9- Probability  10- Statistics	15- Interpretation of data and statistics  16- Probability	13- Making sense of data	12- Grouped data	13- Frequency distribution  14- Measure of central tendency	4- Basic statistics

## Appendix BF: Algebra strand topic sequence

BH	PLC	RH	BS	SS	CSS
<b>YEAR 7</b>					
3-Number patterns & symbols  6- Expressions, symbols & rules  11- Equations & inequations	11- Algebra symbols  12- Solving equations by inspection		6- Introduction to Algebra	7- Basic algebra  8- Algebraic Equations	1- Linear equations in one variable  2- System of linear equations in 2 variables  3- Linear inequality in one variable  6- Multiplication & division of polynomials  7- Factorisation of polynomials  8- Fraction expression
<b>YEAR 8</b>					
3- Variables & relationship  7- Linear equations  10- Graphs	4- Symbolic expression  6- Sets & problem solving  7- Factors & fractions in Algebra  8- Equations & inequations  13- Location & paths  B- Learning experiences	19- Every picture tells a story  23- What's my rule  26- Finding the missing number	3- Algebraic manipulation & formulae  5- Simultaneous & fractional equations, and inequalities  6- Quadratic equations  7- Rectangular coordinates & graphs  8- Graphs of equations	5- Expansion & factorization of algebraic expressions  6- Solving quadratic equations by factorization  7- Algebraic manipulation & formulae  8- Simultaneous linear equations  9- Linear graphs & their applications  10- Graphs of quadratic functions	3- Directly & indirectly proportional functions  5- Linear functions  6- Quadratic equations with 1 unknown & quadratic functions

<b>YEAR 9</b>					
5- Expanding and factorizing	4- Algebraic expansions, simplification & factorization	8- Using letters	4- More on quadratic equation & linear inequalities	1- Solutions to quadratic equations	1- Application of quadratic equations
6- Linear relationship	6- Linear equations and inequations	9- Equations	5- More on algebraic fractions & fractional equations	2- Indices & quadratic manipulation	
7- Quadratics	7- Linear graphs & simultaneous equations	11- Graphs	9- Further graphs of equations	3- Linear inequalities	
	8- Formulae and their applications		10- Variation	7- Variations	
	9- The quadratic function			8- Graphical solution of equations	
	B- Learning experience			9- Further graphs & graphs applied to kinematics	
	D- Learning experience				

## **Appendix C: Topic details**

Appendix CA: Number strand topic details

Appendix CB: Measure strand topic details

Appendix CC: Space strand topic details

Appendix CD: Chance & Data strand topic details

Appendix CE: Algebra strand topic details

## Appendix CA: Number strand topic details

Schools		BH	PLC	RH	BS	SS	CSS
Number strand chapter number	Year 7	1, 2, 7, 13	1, 2, 3, 4		1, 2, 3, 4, 7, 12	1, 2, 3, 4, 5, 6, 11, 12	
	Year 8	1, 6, 11, 14	1, 2, 3, 5, 9, A	1, 5, 7, 8, 9, 12, 13, 14, 21, 25, 27	1, 4	1	1, 2
	Year 9	1, 2	1, 5, 10, 11	1, 2, 3, 4, 12			

### Expected Learning Outcomes

#### Balwyn High School

##### *Year 7*

##### **Chapter 1:** Number review

- Use place-value knowledge to read, write and order negative whole numbers and decimal numbers from thousandths to millions;  
(read, write, compare and order whole numbers to 7 digits and numbers with decimal fractions to two decimal places)
- Compare and order common fractions  
(compare and order common fractions with related denominators)
- Rename common fractions as decimals and percentages  
(Convert a simple common fraction to a decimals and vice versa)
- Recall automatically multiplication and division facts, simple common fraction facts and frequently used common fractions, decimal and percentage equivalences;  
(automatically recall frequently used common fraction, decimal and percentage equivalences)
- Use estimation strategies to check the results of written or calculator computations;  
(use front-end estimation to check computations)
- Use written methods to multiply and divide whole numbers  
(multiply whole numbers by 2-digit whole number without using a calculator)  
(divide whole numbers by 1-digit whole numbers without using a calculator and check the answer using multiplication)
- Analyse a problem situation which may involve several different operations, decimal numbers, negative whole numbers and common fraction; express the problem symbolically and choose appropriate computational method to solve it;  
(select the relevant information to solve a problem or carry out a practical task and determine whether additional information is required)  
(restate verbally-expressed problems symbolically in terms of the operation needed)
- Construct, verify and complete number sentences involving the four operations, brackets, decimal numbers and fractions.  
(complete number sentences)

The text includes extension questions, which is categorized as “ R & S ” (Reasoning and Strategies), Challenge and Technology. The number of such questions is as listed;

R & S: 3

Challenge: 5

Technology: 0

R & S question: Magic Square

Make up your own magic square and share them with the class.

## Chapter 2: Numbers and money

- Compare and order common and decimal fractions, percentages and ratios; (make comparisons between common fractions, decimals and percentages)
- Extend the use of basic number facts to mentally compute operations on fractions and decimals, and squares and square roots; (mentally compute operations involving simple decimals)
- Use estimation strategies to check computations with fractions and decimals; (check that the quotient is greater than the dividend when dividing by a number between 0 and 1)
- Use written methods to carry out the four operations on decimal numbers; (add columns of and subtract decimal fractions with unequal numbers of places) (use written methods to multiply whole numbers and decimals by three-digit numbers) (use a division algorithm to divide decimal fractions, money amounts and other measurements by single-digit whole numbers or decimals with one non-zero digit, interpreting remainders and rounding where necessary)
- Select and use an appropriate sequence of operations and appropriate computation methods to solve problems. (solve problems involving the 4 operations and simple ratios) (use calculators (including fraction calculator) and spreadsheets to solve problems efficiently, establishing appropriate order of operations, representation of fractions and percentages and meaning of overflow displays)

Terms introduced are: denominator, numerator, proper/ improper fractions, mixed number, equivalent fractions, recurring decimal, divisor, quotient.

R & S: 2

Challenge: 1

Technology: 2

One technology question: Decimal Patterns

Q2 Write the decimals for  $\frac{1}{99}, \frac{4}{99}, \frac{12}{99}$  and predict the decimals for  $\frac{15}{99}, \frac{24}{99}, \frac{98}{99}$ , use your calculator to check the predictions.

## Chapter 7: Whole number patterns and properties

- Find prime factors and understand the use of whole-number powers and the square root sign; (Express positive integer as products of prime numbers)
- Extend the use of basic number facts to mentally compute operations on fractions and decimals, and square and square roots; (Recall automatically and use perfect squares and corresponding square roots to 144)
- Use properties of numbers to carry out mental computations involving whole numbers, decimals and common fractions. (Use the distributive property in mental computation) (Extend the use of doubling and halving strategies)

The content includes introducing LCM, HCF, prime and composite numbers; triangular, square, rectangular numbers patterns were illustrated diagrammatically. It also includes an anecdote on Fibonacci Numbers. Index notation is explained followed by discussion on squares and square roots. It concludes with a discussion on the test on divisibility of numbers.

R & S: 3

Challenge: 0

Technology: 1

One example of the R & S question: Checkmate

A chess board is an 8 x 8 grid with every second square shaded. There are actually 204 squares on a chessboard.

Determine why this statement is true and what number pattern we could use to give a simple explanation.

**Chapter 13: Operations and order (fractions and percentages)**

- Use properties of numbers to carry out mental computations involving whole numbers, decimals and common fractions;  
(decompose mixed numbers to add and subtract whole and fraction parts separately)
- Use estimation strategies to check computations with fractions and decimals;  
(estimate unitary fractions of whole numbers and decimals)  
(approximate the results of computations with fractions and decimals)
- Use written methods to carry out the four operations on common fractions and decimals;  
(use written methods for finding fractions and percentages of quantities)  
(use written method for adding and subtracting common fractions)  
(use written methods for multiplying and dividing simple fractions)
- Select and use an appropriate sequence of operations and appropriate computation methods to solve problems.  
(solve problems involving multipliers or divisors which are greater than or less than one)

Reciprocal, percentage concept and the rule of dividing by a fraction is introduced.

An example from Exercise 13E

Q3 (l) Simplify  $2\frac{2}{7} \times 1\frac{1}{20}$

R & S: 2

Challenge: 1

Technology: 0

An example of review question; Exercise 13H

Q25 Pauline used 34% of her wool to knot a winter jumper. What percentage of wool does she have left?

**Year 8****Chapter 1: Positive and negative numbers**

- Compare and order negative numbers.  
[count forwards and backwards with integers]  
[compare and order quantities involving negative numbers]
- Carry out the four operations in cases where both positive and negative integers are involved.  
[add and subtract positive and negative integers, including the subtraction of a negative integers]  
[multiply positive and negative integers, including products of two negative integers]
- Select and use an appropriate sequence of operations and appropriate computation methods to solve problems.  
[solve problems involving the four operations and simple ratios]

R & S: 1

Challenge: 2

Technology: 1

**Chapter 6: Operations and applications**

- Compare and order common and decimal fractions, percentages and ratios.  
[make comparisons between common fractions, decimals and percentages]
- Extend the use of basic number facts to mentally compute operations on fractions and decimals, and squares and square roots.  
[mentally compute operations involving simple decimals]
- Use properties of numbers to carry out the mental computations involving whole numbers, decimals and common fractions.  
[decompose mixed numbers to add and subtract whole and fraction parts separately]
- Use estimation strategies to check computations with fractions and decimals.  
[approximate the results of computations with fractions and decimals]
- Use written methods to carry out the four operations on decimal numbers.  
[add columns of and subtract decimal fractions with unequal numbers of places]  
[use written methods to multiply whole numbers and decimals by three-digit numbers]

[use a division algorithm to divide decimal fractions, money amounts and other measurements by single-digit whole numbers or decimals with one non-zero digit, interpreting remainders and rounding where necessary]

- Use written methods to carry out the four operations on common fractions and decimals.  
[use written methods for finding fractions and percentages of quantities]  
[use written methods for adding and subtracting common fractions]  
[use written methods for multiplying and dividing simple fractions]  
[use written methods for multiplying and dividing by a single-digit number between 0 and 1]
- Select and use an appropriate sequence of operations and appropriate computation methods to solve problems  
[solve problems involving the four operations and simple ratios]  
[solve problems involving multipliers or divisors which are greater than or less than one]  
[use calculators (including fraction calculators) and spreadsheets to solve problems efficiently, establishing appropriate order of operations, representation of fractions and percentages and meaning of overflow displays]

R & S: 1

Challenge: 0

Technology: 2

### **Chapter 11:** More operations and applications

- Compare and order common and decimal fractions, percentages and ratios.  
[compare and order ratios]  
[use percentages to compare ratios]
- Select and use an appropriate sequence of operations and appropriate computation methods to solve problems.  
[solve problems involving the four operations and simple ratios]  
[solve problems involving rates such as price per item or part and speed]  
[solve problems involving multipliers or divisors which are greater than or less than one]  
[use calculators (including fraction calculator) and spreadsheets to solve problems efficiently, establishing appropriate order of operations, representation of fractions and percentages and meaning of overflow displays]

R & S: 1

Challenge: 0

Technology: 1

### **Chapter 14:** Indices

- Find prime factors and understand the use of whole-number powers and the square root sign.  
[express positive integers as products of powers of prime numbers]  
[simplify positive integer powers of rational numbers]  
[find rational square roots of rational numbers]
- Extend the use of basic number facts to mentally compute operations on fractions and decimals, and squares and square roots.  
[recall automatically and use perfect squares and corresponding square roots to 144]
- Develop, interpret and simplify mathematical expressions which describe rules for relationships and mensuration formulas.  
[develop rules for linear and simple exponential functions in symbolic form]
- Construct and interpret rules for simple relationships between variables and between successive terms in sequences.  
[use words, algebraic notation, flow diagrams, tables of values (ordered pairs) and Cartesian graphs to represent relationships given in any of these forms]  
[use rules to make predictions and conjectures about sequences or relationships between variables]
- Use ordered pairs to locate and describe the positions of points on a Cartesian coordinate grid.  
[obtain number pairs for two related variables and plot these using simple scaled axes]
- Sketch and interpret graphs of linear and other simple relationships  
[sketch graphs which indicate an understanding of the nature of the relationship between variables in everyday situations or in stories]

[describe the nature of the relationship between the variables indicated by the graphs obtained]

- Plot graphs of linear and other simple functions and use linear functions to model data. [sketch or plot graphs of linear and other simple functions]

R & S: 5

Challenge: 3

Technology: 0

An example of the R & S question: Bacteria

Bacteria	Time of day	Number of bacteria
The table shows estimates of the numbers of bacteria growing in a culture that has been exposed to a new type of penicillin. Draw a graph to display the data, and join your plotted points with a smooth curve. Describe the shape of the graph. Do you think the bacteria will die out completely?	9.00 a.m.	1000
	10.00 a.m.	600
	11.00 a.m.	400
	12.00 a.m.	300
	1.00 p.m.	250
	2.00 p.m.	225
	3.00 p.m.	212
	4.00 p.m.	206
	5.00 p.m.	203

## Year 9

### Chapter 1: Mathematical technique

- Convert values written in fraction, decimal or percentage form to either of the other two forms
- Deal with some aspects of ratio
- Calculate wages and salaries under a variety of payment systems
- Apply percentages to commissions, discounts, profits, losses, and the calculation of interest payable on investments
- Calculate interest payments related to credit cards
- Use a calculator sensibly and accurately to assist in all these processes

The chapter includes numerous worked examples, 2 investigations [A percentages nomogram, Egyptian fractions], 2 performance assessment tasks [Earning a living, Purchasing a car], A graphics calculator investigation [ using iteration to investigate savings plans], a computer investigation [ searching a database] and a review exercise 17 questions on skills and applications. The chapter concludes with Maths in Action which relates the Earliest calculators with questions and research, as well as Maths @ work on Accountant.

### Chapter 2: Surds

- Understand that fractions can be expressed as terminating or recurring decimals
- Understand that terminating and recurring fraction can be expressed as fractions
- Add, subtract and multiply simple surd expressions
- Carry out simple calculations and simplifications involving surds
- Use rational approximation and surd forms
- Substitute rational approximations for irrational numbers
- Use scientific calculations for calculations involving surds

The chapter includes numerous worked examples, 2 investigations [Finding the decimal value of a surd without using the  $\sqrt{\quad}$  key on a calculator, The Golden Mean], 2 performance assessment tasks [Patterns with fractions, Lake races], and concludes with a review exercise 16 questions on skills and applications.

## Presbyterian Ladies College

### *Year 7*

#### **Chapter 1: Whole number revision**

- Understanding place value
- Adding, subtracting, dividing and multiplying whole numbers
- Finding squares and square roots
- Estimating values
- Mentally doubling and halving
- Multiplying and dividing by powers of 10
- Simplifying using order of operations
- Converting numbers from different counting systems

Puzzles: 3 questions

Applications and activities: Number systems, Today's data, Number puzzle, Magic square, Basketball ladder, Word sums

Enrichment and extension: 12 questions

Q1: A five-digit number is reversed when divided by 4. The number does not contain any zeroes. Find the number.

Q12 Covert each number to a binary number and add using binary addition:

a  $2+8$                   b  $7+9$                   c  $3+15$                   d  $8+26$                   e  $16+64$                   f  $128 + 256$

Revision questions: 14 questions

#### **Chapter 2: Number Patterns**

- Finding factors, common factors and highest common factors of given numbers
- Finding multiples, common multiples and lowest common multiples of given numbers
- Expressing a number as a product of its prime factors
- Revising divisibility tests
- Expressing products of factors in index form

Puzzles: 5 questions

Applications and activities: Pascal's triangle, Factor puzzle, Brick walls

Enrichment and extension: 6 questions

Q1 A city hotel has three different flashing neon signs. The top one flashes every 9 seconds, the side one flashes every 15 seconds, the side one flashes every 15 seconds and the sign at the bottom flashes every 21 seconds. At regular intervals all three signs flash at the same time.

- At what interval do the top and side signs flash together?
- At what interval do the top and the bottom signs flash together?
- At what interval do the side and bottom signs flash together?
- At 2 a.m. the top and bottom signs flash together. Nine seconds later the top and side signs flash together. At what time will all three signs flash together?

Q6 The original Fibonacci sequence (1, 1, 2, 3, 5, 8, 13, ...) is formed by adding the last two numbers together to form the next number in pattern.

- By using 2 and 2 as the first two terms and Fibonacci's pattern, write down the first 10 terms. Find the sum of the first 10 terms.
- Write down the first terms if the starting numbers are 1 and 4. Find the sum of the first 10 terms.
- Using the original Fibonacci sequence, find the sum of the first 10 terms. Try to find a connect between the sum and the seventh term in the sequence. Test your finding on the two sequences formed in part a and part b.

Revision questions: 14 questions

#### **Chapter 3: Fractions**

- Using language of fractions
- Simplifying and finding equivalent fractions
- Converting improper fractions to mixed numbers and vice versa
- Adding and subtracting with like and unlike denominators
- Investigating, with a calculator, multiplication of fractions
- Finding fractions of whole quantities

Puzzles: 3 questions  
Applications and activities: Phases of the moon, Fraction patterns, Fraction bingo, Chinese tangrams, Squares

Enrichment and extension: 6 questions

Below is a brief outline of the first and last question

Q1: Modern fractions can be easily converted to Egyptian or unit fractions using this method. To

convert  $\frac{5}{9}$  into an Egyptian fraction, find the largest unit fraction that is smaller than  $\frac{5}{9}$ .

Q6: The fourteen-piece Greco-Roman tangram called the locus of Archimedes or the stomachion is made from a rectangle in which the length is twice as long as the width. What fraction of the whole rectangle is represented by the following pieces.

Revision questions: 21 questions

#### Chapter 4: Decimals and percentages

- Revising place value, notation and estimation of decimals
- Comparing of decimals
- Rounding off decimals
- Addition, subtraction, multiplication and division skills
- Comparing decimals with fractions and percentages
- Finding the percentage of a number

Puzzles: 4 questions

Applications and activities: The price is right? Magic squares, Calculator games, Currency

Enrichment and extension: 4 questions

Below is a brief outline of the first and last question;

Q1 Convert the following recurring decimals into fractions by using the example above;

Q4 A fencing contractor builds fences for people. The owners of a block of flats want to replace the fence along the front of the flats. They decide to use a series of pine structures shown below. Question (a-i).

Revision questions: 15 questions

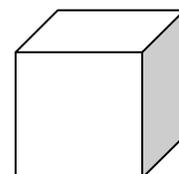
### Year 8

#### Chapter 1: Puzzles and Problems

- Discuss strategies in solving puzzles into 4 steps with numerous sub-steps
- Exercise on solving word problems, patterns in pictorial or numeral forms

A few examples of Exercise 1L;

Q10 The corners have been cut off this cube as shown. How many edges are there on this new figure?



Q11 Use each of the digits 1, 5, 6, 9 and +, ×, ÷ and ( ) only once to form a sentence whose answer is 11.

Q13 Write three questions involving only decimal numbers such that the answer is 6.05.

#### Chapter 2: Arithmetic

- Whole number and mental arithmetic, place values, the 4 operations and the order,
- Multiples and factors, Fractions and the 4 operations,
- Decimals and rounding off, the 4 operations,
- Converting fractions to decimals and vice versa

#### Chapter 3: Directed numbers

- Define the use of +ve and -ve for numbers leading to number line and the 4 operations and application of directed numbers.
- Exercise mainly on familiarization of 4 operations on directed numbers.

Examples:

Q7 Evaluate: (j)  $-\frac{9}{16} \div \frac{45}{24}$

Q8 Evaluate: (v)  $-45 \div 9 \times -6 \div -15$

**Chapter 5: Indices**

- Explain index form and notation, prime factors and rules of divisibility, large numbers and standard forms, square and cube roots, rational and irrational numbers, using indices in algebraic expressions and index rules.
- Exercises are on consolidation of the skills mentioned.

**Chapter 9: Ratio and percentage**

- Explain ratio, ratio simplification, direct and inverse ratios, dividing in a given ration, scale drawing. It also included 2 investigation problems on (1) scale drawing of school, classroom and living room, (2) golden rectangle.
- Discuss percentages and fractions, conversions, applications of percentages (simple interest, discount, commission), finding total quantity (100%), profit, loss and mark-up.

**Learning Experience s Group A:**

- This is a collections of problems on Number puzzles, arithmetic problems, number patterns and sequences, directed number puzzle, Gnomonic numbers and sundials, joopan, number used by computers, long division, puzzles and problems.

An example from exercise AH;

- Q5 A rectangular wall which is 3 m high and 4 m wide is to be painted using a roller 24 cm wide. Kevin decides to paint it starting at the top right-hand corner moving down the wall then across the bottom and up the left-hand side going around until he gets to the center.
- (a) On which circuit has he painted half the wall?
- (b) If he rolls the paint on at a rate of 1 metre per minute, how long does it takes to paint half the wall?

*Year 9*

**Chapter 1: Number and pattern**

- Examine some of the properties of numbers and patterns that emerge from them.
- Representing numbers or sets of number on number lines with closed and opened dots.
- Using  $<$ ,  $=$ ,  $>$  for numbers, square and square roots of numbers.
- Consolidate BOMDAS
- Arithmetic problems on fractions in numeral and algebraic forms
- Problem solving involving finding patterns using tables and other means

**Chapter 5: Surds**

- Explain surds, recurring and terminating decimals and the 4 operations
- Distributive law and the rationalization of denominators

**Chapter 10: Indices**

- Properties of indices and applications
- Index rules

**Chapter 11: Ratio, percentages and practical applications**

- Introduce concept of ratio and proportion
- Express a quantity as a percentage, fraction or decimal of a given quantity.
- Inter-convert percentage, fraction or decimal to any other terms.
- Explore profit and loss, discount, interest (simple and compound) on the spreadsheet and by using formula

Rossmoyne Senior High School

*Year 7*

Not applicable

## Year 8

### Chapter 1: Using whole numbers

- Identify familiar mathematical features inherent in the activities and products of own and other communities
- Adds, subtracts..., multiplies by one digit whole numbers ... drawing mostly on mental strategies
- Read, write... and compares whole numbers into the thousands
- Multiplies and divides by one-digit whole numbers
- Calculate with whole numbers... drawing mostly on mental strategies
- Choose appropriate operations
- Makes straightforward tests of conjectures
- Identifying... key information...
- Uses problem-solving strategies which include those based on developing systematic approaches
- Summarises data using key frequencies...
- Identifying and organizing key information
- Calculates with whole numbers...
- Compares the ways in which mathematics is done or used in own and other community

One investigation: Investigate other number systems and write a report comparing them

### Chapter 5: Sitting between consecutive integers

- ... understand the meaning of fractions ...
- uses a range of whole numbers ... scales ...
- ... understand the meaning of fractions and, for readily visualized fractions, estimates their ... position on a number lines ...
- Calculate with ... fractions ..., drawing mostly on mental strategies for whole numbers, money and readily visualized fractions.
- ... choose appropriate operations
- Calculate with ... fractions ..., drawing mostly on mental strategies for whole numbers, money and readily visualised fractions
- Uses examples to support or refute mathematical conjectures and attempts to make simple modifications of conjectures on the basis of examples
- ... understands the meaning of fractions & ... shows equivalence between them

### Chapter 7: Making generalizations

- Uses examples to support or refute mathematical conjectures ...
- Uses a letter to represent a variable quantity ...
- ... interprets algebraic conventions for representing generality ...

### Chapter 8: Squaring, cubing, ....

- Identifying and organizing key information
- Developing systematic approaches
- Read, write, says and understands... whole numbers and numbers expressed with integer powers
- Calculates with whole numbers, money ...
- Recognizes ... and uses patterns ...
- Extends tasks by asking further mathematical questions...

### Chapter 9: So how big is one million?

- Choose appropriate operations
- Calculates with whole numbers ... drawing mostly on mental strategies...
- Calculate with whole numbers ... and fractions...
- Compares the ways in which familiar mathematics is done or used in own and other communities
- Calculates with whole numbers ... drawing mostly on mental strategies ...
- Uses the relationship between metric prefixes to move between units ...
- Calculate with whole numbers ... and fractions ...
- Identifying and organizing key information
- Makes sensible estimates of length ... and time in standard units ...

- Calculate with whole numbers... fraction ... drawing mostly on mental strategies
- Uses the relationship between metric prefixes to move between units
- Makes sensible estimates of ... mass ... in standard units
- Takes purpose and practicality into account when selecting ... units and instructions for measuring things ...
- Uses ... whole number ... scales for measuring, including making measurements that are most accurate than the available scales allow
- Uses the known size of familiar things to help make and improve estimates ...

**Chapter 12:** Understand decimals

- Uses a range of whole number and decimal scales ....
- Reads, writes, says ... decimals ..
- Reads, writes ... compares ... decimals (equal number of places)
- Reads, writes ... understand the meaning, order and relative magnitude of ... decimals numbers
- Compares the ways in which familiar mathematics is done or used in own and other communities
- Describes how some familiar mathematical ideas are, or have been, used ...
- Calculates with whole numbers, decimals and fractions ...
- Makes sensible estimates

**Chapter 13:** Using decimals

- Calculates with ... decimals ...
- .... Identifying ... key information
- Understand the .... Four operations on whole and decimal numbers, and uses this understanding to choose appropriate operations (whole multipliers and divisors) ...
- .... Distinguishes perimeter from area ...
- Understand & applies ... area ... for shapes based on rectangles ....
- Understand the .... Four operations on whole, decimal and fractional numbers, and uses this understanding to choose appropriate operations including where fractional and decimal multipliers and divisors are required ...
- The student checks, when prompted, that ... answers make sense
- .... Choose appropriate operations ...
- Extends tasks ...

**Chapter 14:** Using fractions

- Calculates with .... Fractions ...
- Calculates with ... fractions ... drawing mostly on mental strategies for ... readily visualised fractions
- .... Choose appropriate operations ...
- .... Identifying and organizing key information

**Chapter 21:** Avoiding confusion (consolidation on BADMAS)

- Compares the ways in which familiar mathematics is done or used in own and other communities
- Calculates with whole numbers ... drawing mostly on mental strategies...
- Calculates with whole numbers ... drawing mostly on mental strategies...
- Constructs and completes equivalent statements

**Chapter 25:** Using negative numbers

- Reads ... and understands the meaning ... of .... Negative numbers
- Calculates with positive and negative numbers ... drawing mostly on mental strategies ...
- Reads ... and understands the meaning ... of .... negative integers
- Reads, writes, says and understands the meaning .... of positive and negative rational numbers
- Reads, writes, says and understands the meaning, order and relative magnitude .... of positive and negative rational numbers
- Explains rules for linking ... paired quantities using one or two operations
- Uses a letter to represent a variable quantity

**Chapter 27:** Out of 100

- Calculates with whole numbers, decimals and fractions ...
- ... understand the meaning ... of ... percentages ...
- ... understand the meaning ... of any fractions ... percentages, and knows the more common equivalences between them
- Choose appropriate operations
- Calculates using mostly strategies including for ... percentages of amounts
- Percentages of amounts

*Year 9***Chapter 1:** Number

- Reads, writes, says, counts with and compares whole numbers into the thousands ...
- Reads, writes, says, counts with and compares whole numbers into the millions ...
- ... reading whole number scale
- ... choose appropriate operations ...
- Constructs and completes statements ...
- Calculates with whole numbers ... drawing mostly on mental strategies to add and subtract two-digit numbers and for multiplications and divisions related to basic facts
- Calculates with whole numbers, money and measures ...
- Reads, writes, says, counts with and compares ... decimals (equal number of places)
- Reads, writes, says, and understands the meaning, order and relative magnitude of ... decimal numbers
- Understand the meaning, use and connections between the four operations on ... decimal numbers, and uses this understanding to choose appropriate operations (whole multipliers and divisors) ...
- Understand the meaning, use and connections between the four operations on ... decimal and fractional numbers, and uses this understanding to choose appropriate operations including where ... decimal multipliers and divisors are required.
- Calculates with ... decimals ...
- Checks ... that answers fit specifications and make sense in the original situation ...
- ... Visualise ... 3D shapes ... and interprets ... conventional mathematical drawings of them
- Asks questions to clarify the essential mathematical features of a problem and uses problem-solving strategies which include those based on identifying and organizing key information
- ... uses problem-solving strategies which include those based on developing systematic approaches

**Chapter 2:** Proportion

- ... choose appropriate operations (whole multipliers and divisors) ...
- Calculate with whole numbers, money and measures ...
- ... choose appropriate operations including where ... decimal multipliers and divisors are required
- Calculate with whole numbers, decimals and ...
- Understands the ... connections between ... operations on whole ... numbers ...

**Chapter 3:** Fractions

- Reads, writes, says and understands the meaning of fractions ...
- Calculates with ... fractions ( ... whole number multipliers and divisors ) ... mental strategies ...
- ... recurring decimals ...
- ... choose appropriate operations including where ... decimal multipliers and divisors are required

**Chapter 4:** Negative numbers

- Reads, writes, says, and understands the meaning, order and relative magnitude of ... negative integers
- Reads, writes, says, and understands the meaning, order and relative magnitude of ... negative rational numbers
- Calculates with positive and negative numbers ...
- Makes generalizations by abstracting common mathematical features from situations or data ...

## Chapter 12: Number patterns

- Recognises, ... and uses patterns involving operations on whole and fractional numbers, and follows ... rules for how successive terms in a sequence or paired quantities can be linked by a single operations
- Recognises, ... and uses patterns involving one or two operations, and follows ... rules for linking successive terms in a sequence .... using one or two operations
- Recognises, describes and uses number patterns involving one or two operations, and follows, compares and explains rules for linking successive terms in a sequence or paired quantities using one or two operations
- Uses a letter to represent a variable quantity ...
- ... compares and explains rules for linking terms in ...paired quantities ...
- ... explains why two linear expressions are equivalent
- Uses a letter to represent a variable quantity in an oral or written expression involving 1 or 2 operations
- Classifies number patterns which are linear ... Sets up equations ... solve equations ...
- Draws on mathematical knowledge to give reasons for conjectures ...
- Describes how some familiar mathematical ideas are, or have been, used by people ...

## Brunei Schools

### *Year 7*

#### **Chapter 1: Whole numbers**

- Whole numbers including 0 and natural numbers 1, 2, 3, 4, .....
- Order of operations from left to right
- Commutative, associative and distributive properties of numbers
- Two ways of approximating a number: rounding off and the nearest 10, 100, ... or to a given number of significant figures
- Explain factors of a numbers, define prime number as a natural number which has exactly 2 factors, and prime factorization of a number
- Index notation
- Explain HCF and LCM

#### **Chapter 2: Integers**

- Explain integers as positive, negative and neutral (zero)
- Integers can be represented on the number line
- If  $a > b$ , then  $-a < -b$
- Properties of the 4 operations of integers
- The order of operations for integers is the same as that for whole number
- Explain square and square roots, cube and cube roots
- Number sequence as a collection of numbers arranged according to some rule or pattern

#### **Chapter 3: Fractions**

- Explain 'fractions' as equal parts of a whole and of a set, as answers to division of whole numbers
- Explain proper, improper and mixed numbers
- Multiplying and dividing both numerator and denominator by the same number, an equivalent fraction is obtained
- A fraction is in its simplest form or reduced to its lowest terms if the numerator and denominator have no common factor other than 1
- For fractions with the same denominator, the one with the greater numerator is the greater fraction
- Before adding and subtracting fractions, rewrite improper fractions as mixed numbers and rewrite fractions so that they have a common denominator
- Before multiplying and /or dividing, rewrite a mixed number as an improper fraction
- Addition and subtraction of mixed number is done by separating the whole number part and the fractional part
- A number is a reciprocal of another if their product is 1

#### Chapter 4: Decimals

- Reinforce place value concept of decimal: tenths, hundredths, thousandths
- The order of decimal numbers can be compared by looking at the corresponding digits of the decimals
- The product of a decimal and  $10^n$ , where  $n$  is a positive integer, is obtained by moving the decimal point of the decimal  $n$  places to the right
- The quotient of a decimal and  $10^n$ , where  $n$  is a positive integer, is obtained by moving the decimal point of the decimal  $n$  places to the left
- Multiplication of decimal by a decimal or whole number, the number of decimal places in the product is the sum of the numbers of decimal places in the factors
- Division of a decimal by decimal is done by rewriting so that the divisor is a whole number
- Recurring decimals are decimals whose digit keep repeating in a particular pattern
- In a decimal, all zeros before the first non-zero digit are not significant; all other digits are significant
- Rational numbers are numbers which can be expressed as fractions
- Irrational numbers are numbers which cannot be expressed as fractions
- Explain the Real Number System

#### Chapter 7: Rate, ratio and proportion

- A rate is use to state how one quantity changes with respect to another quantity
- A ratio is a comparison of two like quantities expressed in the same unit
- A ratio  $a : b$  is in its simplest form if  $a$  and  $b$  are whole numbers and have no common factors other than 1
- A proportion is a statement expressing the equality of two ratios
- Two quantities are in direct proportion if corresponding pairs of values are in the same ratio
- Two quantities are in inverse proportion if one increases in the same ratio as the other one decreases

#### Investigation problem:

1. If  $\frac{a}{b} = \frac{c}{d} = k$ , what is  $\frac{a+c}{b+d}$ ?
  2. If  $\frac{a_1}{b_1} = \frac{a_2}{b_2} = \dots = \frac{a_m}{b_m} = k$ , what is  $\frac{a_1 + a_2 + \dots + a_m}{b_1 + b_2 + \dots + b_m}$ ?
  3. If  $\frac{a_1}{b_1} = \frac{a_2}{b_2} = \dots = \frac{a_m}{b_m} = k$ , what is  $\frac{n_1 a_1 + n_2 a_2 + \dots + n_m a_m}{n_1 b_1 + n_2 b_2 + \dots + n_m b_m}$ ?
- ( $n^1, n^2, \dots, n^m$  are any numbers)

#### Chapter 12: Percentages

- Define percentage as a fraction whose denominator is 100
- To express a fraction / decimal as a percentage, multiply it by 100%
- Quantity  $p$  as a percentage of quantity  $q$  is  $\frac{p}{q} \times 100\%$
- If  $y$  is a quantity,  $x\%$  of  $y = \frac{x}{100} \times y$  or  $\frac{xy}{100}$
- Percentage decrease is  $\frac{\text{decrease}}{\text{original quantity}} \times 100\%$  where decrease = original quantity – new quantity
- Percentage increase is  $\frac{\text{increase}}{\text{original quantity}} \times 100\%$  where increase = new quantity - original quantity

#### Investigation

The Mathematics Society in a school had a membership of 40 in 1990. At the general meeting, the girls complained that only 25% of the members were girls. So the chairman conducted a membership drive and recruited another 10 girls. The girls felt that there were still too few of them. They said that there was only an increase of 15% in female membership. The chairman replied that there was a 100% increase.

Imagine that you have been called upon to decide who is correct. Share your decision with the class.

### Year 8

#### Chapter 1: Everyday mathematics

- A discount of 20% means a reduction of 20% of the original price; a commission is an amount given for the sales made or service rendered
- Profit = selling price – cost price, Percentage profit =  $\frac{\text{Profit}}{\text{Cost Price}} \times 100\%$
- Loss = cost price - selling price, Percentage loss =  $\frac{\text{Loss}}{\text{Cost Price}} \times 100\%$
- The exchange rate is the conversion rate between two different currencies, e.g. US\$1 to S\$1.70
- Interest = Principal x Rate x Time
- In a hire purchase scheme, the buyer pays for the item by installments
- Taxes are money paid to the government on income, value of property, value of purchase, and so on
- Average speed = (Total distance traveled) / (Total time taken)

#### Investigation:

A sum of \$P is deposited in an account at an interest rate of R per annum. If the interest is automatically added to the principal after each year, find, in terms of P and R, the total amount of principal and interest after (a) 1 year, (b) 2 years.

Derive a formula to find, in terms of P, R and n, the total amount after n years

#### Chapter 4: Indices

- Introduce Laws of indices (5 laws)
- If  $a \neq 0$ , then  $a^0 = 1$ ; if  $a \neq 0$ , then
- A number is said to be expressed in standard form when it is in the form  $A \times 10^n$ , where  $1 \leq A < 10$  and n is an integer

#### Investigation:

By  $a^{b^c}$ , mathematicians mean  $a^{(b^c)}$ . For example,

$$2^{3^4} = 2^{(3^4)} = 2^{81}, \quad 2^{4^3} = 2^{(4^3)} = 2^{64}$$

That is, in a tower of indices, we obtain the answer by starting with the top index and gradually working downwards. Without using a calculator, arrange the following numbers (all with four 2's) from the smallest to the greatest.

$$2222 \quad 222^2 \quad 22^{22} \quad 2^{222} \quad 22^{2^2} \quad 2^{2^{22}} \quad 2^{2^{2^2}}$$

### Year 9

Not applicable

### Singapore Schools

#### Year 7

##### Chapter 1: Whole numbers

- represent numbers on number line and order them;
- use the symbols =, ≠, >, <, ≥, ≤;
- perform mental calculations with whole numbers
- perform calculations with whole numbers using a calculator;
- check the accuracy of a calculation by estimation.

The content consists of an introduction to the various numeral systems in the world, consolidates the four basic arithmetic operations, the order of operations and rounding off whole numbers. It also includes a section on the use of calculator. It also included the following activities and interesting information:

1. Notes / Facts /Anecdotes: 12
2. Investigations: 4

**Chapter 2: Factors and multiples**

- Learn about prime number;
- How to find the HCF and LCM of two or more numbers;
- How to find square, square roots, cubes, cube roots of numbers.

This chapter explained natural number, prime number, composite number, test of divisibility, prime factorization, index notation, LCM, HCF, Square and square roots, cube and cube roots followed by mental calculation and use of calculator.

1. Notes / Facts /Anecdotes: 13
2. Exploration questions: 7

**Chapter 3: Number Sequences and Problem solving**

- How to recognize simple patterns from various number sequences;
- To continue a given number sequence using different strategies;
- About problem solving heuristics.

The content introduces number sequences and discussed strategies for problem solving.

1. Exploration questions: 4
2. Investigations: 4

**Chapter 4: Fractions and decimals**

- Interpret the meanings of fractions and decimals and use them;
- Convert fractions to decimals and decimals to fractions;
- Compare and arrange fractions and decimals;
- Calculate with fractions and decimals, with or without the calculator;
- Round off decimals to a specific degree of accuracy.

A list of 8 questions is included in addition to the usual review questions. Below are 2 questions from the list which I think has a high degree of difficulties for this level;

$$Q3 \quad \left( 5\frac{1}{3} + \frac{2\frac{1}{4} - 1\frac{1}{5}}{1\frac{1}{3} + 1\frac{1}{2}} \right) \times \frac{1\frac{1}{3} + 1\frac{1}{2}}{5\frac{1}{3} \times \left( 1\frac{1}{3} + 1\frac{1}{2} \right) + 2\frac{1}{4} - 1\frac{1}{5}}$$

$$Q5 \quad \text{Evaluate } 0.0\dot{1} + 0.1\dot{2} + 0.2\dot{3} + 0.3\dot{4} + 0.4\dot{5} + 0.5\dot{6}$$

1. Notes / Facts /Anecdotes: 22
2. Investigations: 4

**Chapter 5: Real numbers**

- use negative numbers in practical situations;
- perform calculations with integers;
- recognize rational and irrational numbers;
- perform calculations with rational numbers;
- use a calculator to find an approximate value of an irrational number.

The content introduces the concept of negative numbers by discussing the altitude of a mountain and the temperature, follows by integers, the absolute value and its four operations, then rational and irrational number leading to real number definition.

1. Notes / Facts /Anecdotes: 11
2. Investigations: 1

**Chapter 6: Estimation and Approximation**

- Round off numbers and measures to a specific degree of accuracy;
- Make estimates of numbers and measures.

Significant figures are introduced.

1. Notes / Facts /Anecdotes: 2

**Chapter 11: Ratio, Rate and Proportion**

- Find the ratio of 2 or more quantities;
- Recognize and use common measures of rates;
- Solve problems involving rate;
- Use direct and inverse proportions;
- Solve problems involving ratios and proportions

1. Notes / Facts /Anecdotes: 20
2. Investigations: 0

**Chapter 12: Arithmetical Problems**

- Convert percentages into fractions;
- Convert percentages into decimals;
- Manipulate percentages and solve problems involving percentages
- Solve problems on personal and household finance and simple financial transactions

The content included profit and loss, discount, commission, simple interest, compound interest, hire purchase, money exchange, and taxation. Strategies in problem solving including “using a diagram and work backwards”, “using tabulation, before-and-after comparison and work backwards”, or “use an equation”.

A list of 5 question for problem solving. A question is included below to indicate the degree of difficulties of the question;

- Q3      A man bought some articles at a discount of 25% of the list price. He set the marked price of each article such that after giving a discount of 20% of the marked price he still made a profit of  $33\frac{1}{3}\%$  of the selling price. What percentage of the list price was his marked price?

1. Notes / Facts /Anecdotes: 10
2. Investigations: 1

*Year 8***Chapter 1: Arithmetic Problems and Standard Form**

- Solve problems involving ratio and proportion;
- Solve more difficult problems involving percentages and other financial problems;
- Use the standard form to express very large or very small numbers.

The content includes various arithmetic problem solving strategies. A list of 4 problem solving questions was included. Below is an example;

- Q4      Five brothers bought a car for \$42 000. The eldest brother paid one third of the sum of the amounts paid by the other brothers. The second eldest brother paid one quarter of the sum of the amounts paid by the other brothers. The second youngest brother paid one fifth of the sum of the amount paid by the other brothers. The youngest brother paid one sixth of the sum of the amounts paid by the other brothers. How much did the fifth brother pay?

1. Anecdotes / Notes: 11
2. Investigations: 2

*Year 9*

Not applicable

China Shanghai Schools*Year 7*

Not applicable

Year 8

**Chapter 1: Roots of a number**

- Explain the meaning of square root of a number and the outcome in positive and negative signs. The worked example demonstrated a prior knowledge on indices. For example;

$$\therefore 0.0324 = 324 \times 0.0001 = 2^2 \times 3^4 \times 10^{-4} = (2 \times 3^2 \times 10^{-2})^2 = 0.18^2$$

$$\therefore \pm\sqrt{0.0324} = \pm 0.18$$

Another example shows the use of algebra in the discussion: Find the square root of  $a$  ( $a > 0$ ). The answer given is  $\pm\sqrt{a}$

- Finding the approximate value of the square root of a number  $\sqrt{2}$  using the iteration method is showed, follows by calculation using calculator. A worked example on finding square root of numbers which is the product / quotient of 100, or 10000 of the base number is used. Follows by an exercise on finding square root of a number using the technique. Below is one such example;

$$\text{given: } \sqrt{3} \approx 1.732, \sqrt{30} \approx 5.477. \text{ find (a) } \sqrt{300}; (b) \sqrt{3000}; (c) \sqrt{30000}; (d) \sqrt{0.3};$$

$$(e) \sqrt{0.03}; (f) \sqrt{0.003}$$

- Similar instructional content is used to find the cube root and nth root of a number. Below are a few examples of the consolidation exercises;

$$\text{Q4: } \sqrt[3]{-\frac{64}{125}}, \sqrt[3]{3\frac{3}{8}}, -\sqrt[3]{0.001}, \sqrt[3]{0.343}$$

$$\sqrt[5]{-6400}, -\sqrt[4]{8600}, -\sqrt[5]{12.34}$$

- Explain the meaning of real number; highlight the facts: positive number  $> 0$ ; negative number  $< 0$ ; all positive numbers  $>$  all negative numbers; when comparing 2 positive numbers, the one with the great number is greater; when comparing 2 negative numbers, the one with the great number is smaller.
- Introduce fractional indices as a way to replace powers and roots. With that more index rules applied. Below is a given problem:

$$\text{Calculate to the nearest 0.001 } \left(2^{\frac{1}{2}} + 3^{\frac{1}{2}}\right)^2$$

**Chapter 2: Radical expressions in the square root form**

- Using the reasoning  $a = \sqrt{a^2}$  for ( $a \geq 0$ ) leading to solution of  $\sqrt{(-5)^2} = |-5| = 5$

and NOT  $-5$

- Multiplication and division of radical terms in the square root form

$$\sqrt{ab} = \sqrt{a} \bullet \sqrt{b} \text{ where } (a \geq 0, b \geq 0)$$

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}} \text{ where } (a \geq 0, b \geq 0)$$

With the above, exercise with problems such as below are set:

$$\sqrt{x^3y} \div \sqrt{\frac{3}{xy^2}} ; \quad 5\sqrt{3} \div (-\sqrt{6})$$

- Simplification of radical expressions in the square root form, follows by addition and subtraction of radical expressions in the square root form is described. Below is the type of questions given.

$$\sqrt{2a} - \sqrt{8a^3} + 2\sqrt{2ab^2}$$

$$\left(4a\sqrt{\frac{a}{b}} + \frac{2}{a}\sqrt{a^3b}\right) - \left(3a\sqrt{\frac{b}{a}} + \sqrt{9ab}\right)$$

- Using the “finding area of a rectangle” concept to introduce the multiplication of radical expressions leading to the 4 operations of radical expressions and rationalization of the denominators

$$(\sqrt{x} + \sqrt{y})^2 + (\sqrt{x} - \sqrt{y})^2$$

$$\frac{3}{\sqrt{7} - 2}$$

$$\frac{1}{x + \sqrt{1 + x^2}}$$

*Year 9*

Not applicable

## Appendix CB: Measure strand topic details

Schools		BH	PLC	RH	BS	SS	CSS
Measure strand chapter number	Year 7	5, 14	5, 6, 7		5, 10, 11	9, 10	
	Year 8	4, 9, 15	12, C	11, 15, 16, 18	2	3, 12, 13, 15	
	Year 9	3, 4	2, 3, 13, 14, A	5, 7, 10	1, 2, 3	6, 10	3

### Balwyn High School

#### *Year 7*

##### **Chapter 5:** Measurement: Length, Mass and Time

- Recognize and select appropriate metric units and levels of accuracy for measuring quantities and rates.  
(select the appropriate unit to specify a quantity)  
(justify choice of units according to the purpose of the measurement)  
(use common metric prefixes and notation, including converting units)  
(recognize common metric units of volume and capacity)
- Select, use and adapt instruments to measure length, mass, capacity, volume, angle and temperature.  
(use measuring instruments accurately)  
(read scales where there are 5, 10 or 20 unlabelled calibrations between labeled units)
- Use judgements of the size of metric units to make and refine estimates of quantities.  
(use known quantities to estimate length, capacity and mass)
- Measure, estimate and calculate time and duration of time.  
(use clocks (both analogue and digital), calendars, timetables and schedules, including use of seconds and the 24-hour day)  
(produce a timeline)

R & S: 4

Challenge: 2

Technology: 0

Below is an R & S: Circumferences – Investigate what happens to the circumference of circle if its diameter is:

- a. doubled
- b. tripled
- c. halved

Try a circle with a diameter of 1 cm to begin with.

Below is a Challenge: Calendars – Investigate:

- the history of our calendar
- where the names of the months come from
- whether every fourth year is a leap year

##### **Chapter 14:** Area, volume and capacity

- Recognise and select appropriate metric units and levels of accuracy for measuring quantities and rate  
(select the appropriate units to specify a quantity)  
(recognize common metric units of volume and capacity)  
(use appropriate derived units to specify rates)
- Select, use and adapt instruments to measure length, mass, capacity, volume, angle and temperature.  
(use measuring instruments accurately)  
(order objects by volume, using liquid displacement)

- Use judgements of the size of metric units to make and refine estimates of quantities.  
(judge the size of common quantities)  
(use known quantities to estimate length, capacity and mass)
- Develop and use rules to calculate perimeters of polygons and circles, areas of shapes based on triangles, rectangles and circles, and volumes and surface areas of rectangular prisms.  
(calculate the area of a triangle or one-half of the area of a suitable rectangle).

R & S: 15

Challenge: 0

Technology: 0

An example of R & S question: Milkman

A milkman has an 8 litre container of milk. He wants to share the milk equally between two friends, but he only has a 5-litre container and a 3-litre container. How can he share the milk?

## Year 8

### Chapter 4: Perimeters and areas

- Recognise and select appropriate metric units and levels of accuracy for measuring quantities and rates.  
[select the appropriate unit to specify a quantity]  
[justify choice of units according to purpose of the measurement]  
[use common metric prefixes and notation, including converting units]
- Use judgements of the size of metric units to make and refine estimates of quantities.  
[use known quantities to estimate length, capacity and mass (e.g. the dog bath needs about four or five 10 L buckets of water to fill it)]
- Obtain areas by counting squares in order to develop new rules for the area of regular shapes.  
[use counting of squares to relate base, height and area of parallelograms]
- Develop and use rules to calculate perimeters of polygons and circles, areas of shapes based on triangles, rectangles and circles, and volumes and surface areas of rectangular prisms.  
[calculate the area of a triangle or one-half of the area of a suitable rectangle]  
[take appropriate measurements and calculate perimeters and areas of circles and shapes based on rectangles and triangles]

R & S: 2

Challenge: 0

Technology: 0

### Chapter 9: Areas and volumes

- Recognise and select appropriate metric units and levels of accuracy for measuring quantities and rates.  
[select the appropriate unit to specify a quantity]  
[recognize common metric units of volume and capacity]
- Use judgements of the size of metric units to make and refine estimates of quantities.  
[judge the size of common quantities]  
[use known quantities to estimate length, capacity and mass]
- Obtain areas by counting squares in order to develop new rules for the area of regular shapes.  
[use counting of squares to relate radius and area of circles]
- Develop and use rules to calculate perimeters of polygons and circles, areas of shapes based on triangles, rectangles and circles, and volumes and surface areas of rectangular prisms.  
[use appropriate measurements and calculate perimeters and areas of circles and shapes based on rectangles and triangles]  
[investigate relationships between perimeter and area of related figures]  
[find surface areas and volumes of shapes based on rectangular prisms]

R & S: 6

Challenge: 0

Technology: 2

An example of R & S question: Dripping Tap

How would you find the volume of water in a single tap drip? Explain your method.

**Chapter 15: Rates \*\*** (includes topics from algebra and measurement)

- Interpret and evaluate information contained in tables, visual displays and databases and report on methods of data collection.  
[interpret simple time series data]
- Sketch and interpret graphs of linear and other simple relationships.  
[sketch graphs which indicate an understanding of the nature of the relationship between variables in everyday situations or in stories]  
[describe the nature of the relationship between the variables indicated by the graphs obtained]
- Recognise and select appropriate metric units and levels of accuracy for measuring quantities and rates.  
[use appropriate derived units to specify rates]
- Calculate and use rates.  
[find and use rates involving time]  
[find and use rates involving areas]

R & S: 2

Challenge: 0

Technology: 0

*Year 9*

**Chapter 3: Measurement**

- Use appropriate metric units in calculating different measurements and in practical tasks
- Use estimates correctly and accurately
- Estimate length and area and judge the reasonableness of the answer
- Use length, area and volume relationships involving triangles, quadrilaterals, circles and prisms
- Use rates in calculations

The chapter includes numerous worked examples, 2 investigations [Pamela's fence, Area of an ellipse], 2 performance assessment tasks [Do-it-yourself netball court, Cameron's swimming pool], A graphics calculator investigation [ Using programme to investigate properties of cylinders] and a review exercise with 14 questions on skills and applications.

**Chapter 4: Pythagoras and trigonometry**

- Select and use appropriate units to the required level of accuracy
- Use and convert metric units appropriately
- Use Pythagoras' Theorem and trigonometry to find side lengths and angles in right-angled triangles

The chapter includes numerous worked examples, 2 investigations [Pythagoras – another proof, Viewing artwork – here should you stand], 2 performance assessment tasks [Fire rescues, capsized at sea ] and a review exercise 16 questions on skills and applications. The chapter concludes with Maths in Action which relates The Secret Society with questions and research, as well as Maths @ work on Air Traffic Controller.

Presbyterian Ladies College

*Year 7*

**Chapter 5: Length and perimeter**

- selecting appropriate units to specify a quantity
- using common prefixes and notation, and converting between units
- using measuring instruments accurately
- using measuring instruments accurately
- devising ways to accurately measure objects too big or too small to measure individually
- reading a variety of scales accurately

- calculating perimeter of shapes

Puzzles:	3 questions
Applications and activities:	Coins, Pace lengths, Presents, Brick walls, Clinometer, Are you a rectangle or square?
Enrichment and extension:	7 questions
Revision questions:	11 questions

#### **Chapter 6:** Area and volume

- finding and comparing areas
- using grid to find area
- calculating the area of triangles and quadrilaterals
- calculating the volume of prisms

Puzzles:	3 questions
Applications and activities:	How big is your hand? The open box activity, Estimating quantities, triangles, rectangles
Enrichment and extension:	8 questions
Revision questions:	13 questions

#### **Chapter 7:** Time and Mass

- using clocks, calendars, timetables and schedules, including use of seconds and the 24-hour day
- producing and using timelines
- calculating time intervals when working with daylight saving, Australian and world time zones
- expressing units of time and mass using different units
- using and constructing timetables and calendars
- working with questions involving mass

Puzzles:	3 questions
Applications and activities:	4 questions on postal making and Chinese calendar
Enrichment and extension:	7 questions [Q7 introduces the term density]
Revision questions:	10 questions

### *Year 8*

#### **Chapter 12:** Measurement

- The metric system is investigated through a series of questions. The unit prefixes are tabulated.
- Length: perimeters of common shapes like rectangles, square, regular pentagon, regular hexagon, circles with an investigation on Pi.
- To find area of rectangle, square, triangle, parallelogram, trapezium, circle and composite figures.
- To find the volume of rectangular prism, triangular prism, cylinder and other solid figures.
- Capacity and mass.
- Time includes the 24-hour clock, timelines and timetables.

#### **Learning experience C:**

Consolidation exercises on the topic learnt with a majority of exercises on the measurement strand.

### *Year 9*

#### **Chapter 2:** Estimation and approximation

- Discuss strategy on estimating numbers, approximating lines,
- Explain approximate solutions to equations using the numerical method

#### **Chapter 3:** Pythagoras' theorem

- Investigate Pythagoras' theorem and its application in finding the sides of a right-angled triangle

- Application of Pythagoras' theorem in finding the dimension of solids

**Chapter 13:** Measurement

- Solve problems on length (perimeter, distance between 2 points), area including nets of three-dimensional figures, volume of solids (composite and hollow)
- Solve problems on time

**Chapter 14:** Trigonometry

- Define sine, cosine and tangent functions and their inverse functions
- Application of the above in finding the sides of right-angled triangles

**Learning experience A:** Includes number patterns and sequences, numbers in standard form, syllogisms, Pythagoras' theorem, Pascals' triangle and surds. It includes more problems for consolidations.

Rossmoyne Senior High School

*Year 7*

Not applicable

*Year 8*

**Chapter 11:** Inside and around the outside

- ... uses problem-solving strategies ... identifying & organizing key information
- Orders things by... Area ... counting uniform units ...
- Measures area by counting uniform units including ... part units ...
- Takes ... practicality into account when selecting ... instruments for measuring ...
- ... measures length ...
- .... Distinguishes perimeter from area ...
- Understanding relationships involving the perimeter of polygons, the area of regions based on squares ...
- Calculates with whole numbers ... drawing mostly on mental strategies ...
- Understanding relationships involving.... area of regions based on squares ...
- Checks, when prompted, that answers ... make sense
- Understands & applies ... length, area ... for shapes based on rectangles ...
- Uses examples to support or refute mathematical conjectures ...
- Visualises ... straightforward translations....
- Understands and applies directly length, area ...
- Understanding relationships involving.... area of regions based on squares ... and uses these for practical purposes
- ... uses problem-solving strategies ... developing systematic approaches
- Takes purposes and practicality into account when selecting attributes, units ... for measuring things ...
- ... judges whether estimates are reasonable ...
- Uses a letter to represent a variable quantity ...

**Chapter 15:** Interpreting scale

- Understands and uses scale factors ... for straightforward tasks ...
- Uses ... scale on maps and plans ...
- Understands and uses scale factors ...
- Uses ... direction and grids on maps ...
- Uses distance, direction and grids on maps and plans and in descriptions of locations and paths
- Uses coordinates ... on maps ...
- .... Measures .... angles, reading whole number scales
- Uses ... bearings ... on maps ...
- Uses ... bearings an scale on maps ...
- Understands and uses scale factors ...
- Identifies the essential features of a location or arrangement needed to serve a purpose and represents in networks and other diagrams

**Chapter 16:** Take your time

- ... compares and orders things by ... time ...
- Makes sensible estimates of ... time in standard units
- ... uses straightforward arithmetic to determine, elapse time ...
- ... uses standard scales to measure ... time
- .... Distinguishes ... time from elapse time ...
- ... identifying and organizing key information
- Calculate with whole numbers ...

**Chapter 18:** Measuring with cubes

- Understands ... the volume of prisms based on cubes ...
- Visualises .... 3D shapes and ... interprets ... mathematical drawings of them
- Understands and applies directly ... volume relationships for shapes based on .... rectangular prisms
- Understands ... the volume of prisms based on cubes ...
- ... developing systematic approaches
- .... Uses the relationship between metric prefixes to move between units
- Understands and applies directly length, area and volume relationships for shapes based on rectangles and rectangular prisms
- ... identifying and organizing key information
- Visualises .... 3D shapes and ... produces conventional mathematical drawings ...
- Understands and applies ... volume relationships ...
- Makes generalizations ...
- .... Choose appropriate operations ...
- Makes sensible estimates ...

*Year 9***Chapter 5:** Revision of the metric system and time

- .... Reading whole number scales
- Uses a range of whole number and decimal scales ...
- ... chooses units of a sensible size for ... comparisons to be made
- ... uses the relationship between metric prefixes to move between units
- Select appropriate attributes ... and chooses units of a sensible size ...
- Uses the known size of familiar things to help make and improve estimates ...
- Takes purpose and practicality into account when selecting attributes, units ...
- Makes sensible estimates of length ... mass ... and time in standard units and identifies unreasonable estimates of things
- Uses familiar mathematical ideas to ... explain some features of their world

**Chapter 7:** Perimeter and area

- ... distinguishes perimeter from area ...
- Understands and applies directly length, area ... relationships for shapes based on rectangles ...
- ... uses problem-solving strategies which include those based on developing systematic approaches
- ... measures length ...
- Draws on mathematical knowledge to give reasons for conjectures before testing them, and refines and modifies conjectures as a result and of testing
- Takes purpose and practicality into account when selecting ... units & instruments for measuring ...
- Decides what measurements are needed in order to complete a practical task and ensures that units used are consistent with each other ...

**Chapter 10:** Circles

- Takes purpose and practicality into account when selecting attribute, units ...
- Uses familiar mathematical ideas to ... explain some features of their world
- Makes or collects measurements to planned levels of accuracy and integrates measurement information from several sources in order to complete a practical task

- Calculates with whole numbers, decimals and fractions ...
- Understands and applies directly length, area ... relationships for ... circles ...
- Uses a letter to represent a variable quantity in an oral or written expression involving 1 or 2 operations
- Uses & interprets basic algebraic conventions for representing situation involving a variable quantity ...
- Sets up equations to represent one constraint in a situation, solve equations ...

## Brunei Schools

### *Year 7*

#### **Chapter 5:** Measure and money

- Introduces the SI units and the prefixes: kilo, hecto, deca, deci, centi, milli
- The basic unit of length, mass and capacity are metre, kilogram and litre respectively
- Absolute error of a measurement =  $\frac{1}{2} \times$  unit of measure
- 1 hour = 60 minutes (min), 1 minute = 60 seconds (s)
- The 12-hour time notation uses 'am' and 'pm' to denote 'before noon' and 'after noon' respectively
- The 24-hour time notation uses 4 digits, the first two refers to the hours and the last two refer to minutes
- 100c = \$1

#### **Investigation:**

Can you help George?

He has a number of coins in these denominations: 10c, 20c, 50c. He wants to make a sum of \$1.90 using exactly 9 of these coins. Help George by showing him the different ways he can do this.

#### **Chapter 10:** Perimeter and area

- Explain perimeter and listed formulae for area of rectangle, square, parallelogram, triangle, trapezium
- Formulae for circumference and area of circle

#### **Chapter 11:** Surface area and volume

- Prism: Surface area = sum of areas of all faces; volume = area of uniform cross-section  $\times$  height
- Cylinder: Curve surface area =  $2\pi rh$  surface area =  $2\pi r^2 + 2\pi rh$  volume =  $\pi r^2 h$
- Density of a substance = (Mass of the substance) / (Volume of the substance)

Investigation:

There is a relationship connection the number of faces (F), the number of vertices (V) and the number of edges (E) of a prism. Try and find this relationship. It may be useful for you to tabulate the numbers as follows;

Prism	Number of faces (F)	Number of vertices (V)	Number of edges (E)
Cube	6	8	12
Cuboid			

Check whether this relationship is also true for other solids bounded by flat faces, e.g. a pyramid.

### *Year 8*

#### **Chapter 2:** Mensuration

- For a sector,  $(\text{length of arc}) / 2\pi r = (\text{area of sector}) / \pi r^2 = x / 360$

Solid	Surface Area	Volume
Pyramid	Sum of areas of all faces	$1/3 \times \text{base area} \times \text{height}$
Cone	$\pi r^2 + \pi r l$	$1/3 \pi r^2 h$
Sphere	$4 \pi r^2$	$4/3 \pi r^3$

**Investigation:**

A cone of base radius  $r$  cm, slant height  $l$  cm and height  $h$  cm has a surface area  $A_1$  of  $(\pi r^2 + \pi r l)$  cm<sup>2</sup> and a volume  $V_1$  of  $1/3 \pi r^2 h$  cm<sup>3</sup>.

- (a) If we double the base radius (i.e.  $2r$  cm), slant height (i.e.  $2l$  cm) and height (i.e.  $2h$  cm), find an expression for
  - (i) its surface area  $A_2$  in terms of  $r$  and  $l$ ,
  - (ii) its volume  $V_2$  in terms of  $r$  and  $h$ ,
 What can you say about  $A_2$  and  $V_2$  compared to  $A_1$  and  $V_1$  respectively?
- (b) If we treble the base radius (i.e.  $3r$  cm), slant height (i.e.  $3l$  cm) and height (i.e.  $3h$  cm), find an expression for
  - (i) its surface area  $A_3$  in terms of  $r$  and  $l$ ,
  - (ii) its volume  $V_3$  in terms of  $r$  and  $h$ ,
 What can you say about  $A_3$  and  $V_3$  compared to  $A_1$  and  $V_1$  respectively?
- (c) If the base radius is  $kr$  cm, slant height  $kl$  cm and height  $kh$  cm, where  $k$  is a positive real number, what can you say about  $A_k$  and  $V_k$  compared to  $A_1$  and  $V_1$  respectively?

*Year 9*

**Chapter 1: Pythagoras' theorem**

- Explain Pythagoras' theorem: in a right-angled triangle, where  $c$  is the hypotenuse,  $c^2 = a^2 + b^2$

**Investigation:**

A water lily, with its stem vertical, is 20 cm above the surface of the water. When swayed by the breeze, the water lily, with its stem straight, touches the water at a spot 40 cm from where it originally cuts the water surface. How deep is the water?

**Chapter 2: An introduction to trigonometry**

- Define sine, cosine and tangent in terms of the sides of right-angled triangle

**Investigation:**

Investigate how the values of  $\sin x$  and  $\cos(90^\circ - x)$ , where  $0^\circ \leq x \leq 90^\circ$ , are related.

**Chapter 3: Applications of trigonometry**

- Describe angle of elevation and angle of depression
- Define bearing: always measured clockwise from the north line and stated as a three-digit number.

**Investigation:**

1. In  $\triangle ABC$ ,  $AB = 5$  cm,  $BC = 8$  cm and  $\angle ABC = 35.2^\circ$ , what is the area of  $\triangle ABC$ ?
2. Find the area of a triangle  $ABC$  given two sides,  $a$  and  $b$ , and the included angle,  $\angle c$ .

Singapore Schools

*Year 7*

**Chapter 9: Perimeter and Area of Simple Geometrical Figures**

- Find the perimeter and area of simple geometrical figures
- Solve problems involving these figures and figures related to them

The figures in the content are rectangles, parallelograms, triangles, trapeziums and circles. A list of 7 problem solving questions is included in addition to the review questions. Below is an example of the questions given;

Q6 Kunar walks round a rectangular field the length of which is twice its width. He then walks round another rectangular field half as wide but having the same perimeter as the first field. If the difference in area between the two fields is 432 m<sup>2</sup>, find the length of the second field.

1. Anecdotes / Notes: 8
2. Investigation: 1

### Chapter 10: Volume and Surface Area

- Find the volume and surface area of cubes, cuboids, prisms and cylinders;
- Solve problems involving volumes made up of the above solids;
- Solve problems involving density.

The content included discussion of hollow objects. There are 5 problems solving questions additional to the review questions. Below is an example;

Q5 A cuboid of dimension 70 cm by 50 cm by 30 cm has “square holes” measuring 10 cm by 10 cm in the center of three faces of the cuboid, as shown. Calculate the volume and the surface area of the remaining solid.

1. Anecdotes / Notes: 14
2. Investigation: 0

### Year 8

#### Chapter 3: Scales and Maps

- Read and make scale drawings.

A house plan was used as a scale drawing. A list of 3 problem solving questions and 1 exploration was included. Below is a problem solving question and the exploration question.

Q3 A model of a ship is made to a scale of 1 : 200. The volume of a hall on the model is 250 cm<sup>3</sup>. Find the volume of the hall on the actual ship in m<sup>3</sup>.

Exploration Problem: Look at the atlas which you use for your Geography lessons and find out the scales used in maps of Singapore, Southeast Asia, Asia and a world map. Are the scales used the same for all the different maps?

1. Anecdotes / Notes: 1
2. Investigations: 0

#### Chapter 12: Pythagoras' Theorem

- Find the length of a side of a right-angled triangle using Pythagoras' theorem;
- Solve problems involving Pythagoras' theorem.

Two questions for problem solving were included in addition to the review questions. Below is an example;

Q1 Given a triangle ABC where  $(BC)^2 = 370$  units,  $(AC)^2 = 74$  units and  $(AB)^2 = 116$  units, calculate the area of the triangle. [Hint:  $370 = 9^2 + 17^2$ ,  $74 = 5^2 + 7^2$  and  $116 = 4^2 + 10^2$ ]

1. Anecdotes / Notes: 6
2. Investigations: 0

#### Chapter 13: Mensuration

- Find the arc length of a circle by expressing the arc length as a fraction of the circumference of the circle;
- Find the area of the sector of a circle by expressing sector area as a fraction of the area of the circle;
- Find the area of the segment of a circle;
- Find the volume and surface area of a sphere, a pyramid and a cone;
- Solve problems involving arc length, sector area of a circle;
- Find the volume and surface area of a sphere, a pyramid and a cone;
- Solve problems involving arc length, sector area of a circle and segment area, volume and surface area of a sphere, pyramid and a cone.

The content approaches the some of the figures discussed by explicit illustration of diagrams... There is additional list of 6 problem solving questions and 3 exploration questions. Examples of the problem solving questions are given below;

- Q3 A square is inscribed in a circle of radius  $x$  cm. Find the area of the square in terms of  $x$ .  
 Q4 The surface area of a cube is  $x$  cm<sup>2</sup> and its volume is  $y$  cm<sup>3</sup>. If  $x = y$ , find the length of a side of the cube.

1. Anecdotes / Notes: 9
2. Investigation: 1

**Chapter 15:** Trigonometrical ratios

- Find the length of a side of a right-angled triangle and an angle of a right-angled triangle using the sine, cosine and tangent ratios for acute angles;
- Solve trigonometrical problems in two dimensions

The content also included a practical application of trigonometry. There are 5 questions on the problem solving list. Below are some questions;

- Q2 If  $2 \sin^2 x + 3 = 7 \sin x$ , find a possible value of  $x$  in the range  $0^\circ < x < 180^\circ$   
 Q4 Given that  $\sin^2 x + \cos^2 x = 1$ , find the value of  $\sin^2 2x + \cos^2 2x$ .

1. Anecdotes / Notes: 9
2. Investigations: 0

*Year 9*

**Chapter 6:** Area and volume of similar figures and solids

- Solve problems using the relationship between areas of similar figures;
- Solve problems using the relationship between volumes of similar solids.

The content discussed the rules on the relationship between areas and volume of similar figures. 4 questions are included in the problem-solving list. Below is an example;

- Q3 Two similar solids have volume  $V$  and  $v$  such that  $V = 27v$ . If their surface areas,  $S$  and  $s$  respectively are such that  $S = ks$ , write down the value of  $k$ .

1. Anecdotes / Notes: 4
2. Investigation: 2

If  $P_1$  and  $P_2$  denotes the perimeters of two similar figure, what conclusion can you get about  $\frac{P_1}{P_2}$  ?

**Chapter 10:** Trigonometry

- Determine the trigonometrical values of obtuse angles;
- Solve any scalene triangle given: two sides and one angle or two angles and one side or three sides;
- Find the area of complicated triangles;
- Find the angle between a line and a plane;
- Solve those involving distance and height by simplification.

Sine rule, cosine rule, bearing and three-dimensional problems are part of the content. Under the problem solving section, 3 different methods were used to solve a problem on finding area of an hexagon. There are 8 questions under the exploration list. Below is a question from the list.

- Q5 Three points A, B, and C lie on horizontal ground. T is the top of a vertical tower standing on A. The bearing of B and C from A are  $135^\circ$  and  $225^\circ$  respectively, and the bearing of C from B is  $250^\circ$ . If the length of BC is 50 m and the angle of elevation of T from B is  $35^\circ$ , calculate the height of the tower and the angle of elevation of T from C.

1. Anecdotes / Notes: 27
2. Investigations: 0

*Year 9*

**Chapter 3:** Trigonometric ratio of acute angles

- Discuss the derivation of tangent, cotangent, sine and cosine of the acute right-angled triangle
- Derive the standard angles of  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$ , etc; solving trig problems based on such angles. E.g.

Solve:  $2 \sin^2 60^\circ - \cos^2 30^\circ + \tan 60^\circ \cdot \cot 60^\circ$

- Solving the trig problems of right-angled triangles with the use of calculator
- Using trigonometry to find: angles, sides and area of different type of triangle; the angle of elevation and depression as in use for the cranes in lifting, the flight path of a plane during taking off and landing, the height of a tall building, the angle of a tunnel, drains, roads etc. Word problems are set on the practical application of the trigonometry functions

## Appendix CC: Space strand topic details

Schools		BH	PLC	RH	BS	SS	CSS
Space strand chapter number	Year 7	4, 9, 12, 15	8, 9, 10		8, 9	13, 14	4, 5, 9, 10, 11
	Year 8	2, 8, 13	10, 11	3, 4, 6, 10, 20, 24	9, 10	2, 4, 11	4, 7, 8
	Year 9	8	12, C	6, 14, 15	6, 7, 8, 11	4, 5, 11, 12	2, 5

### Balwyn High School

#### *Year 7*

##### **Chapter 4:** Triangles and quadrilaterals

- Use appropriate geometric techniques such as paper-folding, ruler / compass / protractor, and a computer drawing package to accurately draw simple two-dimensional shapes, attending to essential details  
(determine what minimum information is needed to copy a triangle)  
(draw shapes accurately according to specified details, such as a kite in terms of its diagonals)
- Use angle relations involving transversal and pairs of parallel lines to solve problems, giving a reason for the solution.  
(name and apply complementary / supplementary angle relationships)  
(identify parallel and perpendicular lines and faces (planes) in two and three dimensions.

R & S: 2

Challenge: 1

Technology: 1

An example of challenge question: Triangle puzzle

Construct the equilateral triangle, cut out the pieces and arrange them to form a square.

##### **Chapter 9:** Coordinates, maps and networks

- Make and analyse models of solid objects.  
(visualize and draw views of three-dimensional shapes from different perspectives)
- Draw and interpret diagrams representing familiar situations.  
(represent physical features of a situation diagrammatically)  
(represent non-physical features of a situation diagrammatically)
- Use coordinates in 4 quadrants, grids and bearings to specify location of points.  
(produce a two-dimensional grid to specify location, such as a seating plan)  
(specify location using simple bearings or grid references)
- Use information on a map to specify and obtain distances, heights and directions.  
(choose and use suitable scales for accurate maps and plans)

R & S: 5

Challenge: 0

Technology: 0

An example of R & S question: Dream island

- a. Draw a map of an imaginary island. Be sure to show the scale and the direction of north.
- b. Using your ruler and a protractor, draw a course for a ship that will sail right around your island. The course should be made up of a series of straight line sections.
- c. State the length and the compass direction or true bearing of each section of the course.  
What is the total length of the course?

##### **Chapter 12:** Polygons and polyhedra

- Make and analyse models of solid objects

- (design the net of and make a simple polyhedron or cone to specified dimensions)
- Establish congruence by superimposition, including cases involving rotation and reflection. (rotate, reflect and translate two dimensional shapes in order to demonstrate congruence) (reflect a picture in a line, or rotate a picture through  $90^\circ$  or  $180^\circ$ , or translate a picture in a specified direction)
- Investigate and apply properties of regular and irregular polygons and circles (correctly apply and use terms such as square, rectangle, rhombus, trapezium; scalene, isosceles, equilateral and right-angled triangle; sector, arc, circumference and perimeter; vertices, edges, faces and diagonals)
- Demonstrate and use relationships between the number of sides of regular and irregular polygons (3-, 4-, 5-, 6-sided) and the sum of interior and exterior angles)

R & S: 5

Challenge: 1

Technology: 1

An example of technology question: Logo

Use the Logo computer programme to write instructions for producing each of the following regular polygons:

- a. square   b. pentagon   c. hexagon   d. octagon

### Chapter 15: Coordinates and graphs

- Use coordinates in 4 quadrants, grids and bearings to specify location of points (correctly locate and read points in the 4 quadrants) (specify location using simple bearings or grid references)
- Make judgements about, and verify truth values for propositions expressed as linear equalities and inequalities. (interpret Cartesian graphs to identify numbers, or pairs of numbers, for which a simple linear equation or inequality is true)
- Use ordered pairs to locate and describe the positions of points on a Cartesian coordinate grid. (relate the points on a Cartesian coordinate grid to the values of the variables graphed) (obtain number pairs for two related variables and plot these using simple scaled axes)
- Sketch and interpret graphs of linear and other simple relationships. (sketch graphs which indicate an understanding of the nature of the relationship between variables in everyday situations or in stories) (describe the nature of the relationship between the variables indicated by the graphs obtained)

R & S: 3

Challenge: 2

Technology: 1

An example of a R & S question: Treasure Hunt

- a. What is the shortest route for Okey to take on the treasure hunt on Turtle Island (Question 8h)?
- b. How many different routes are there?

### Year 8

#### Chapter 2: Maps and coordinates

- Use coordinates in 4 quadrants, grids and bearing to specify location of points. [correctly locate and read points in the 4 quadrants] [produce a two-dimensional grid to specify location, such as a seating plan] [specify location using simple bearings or grid reference]
- Use information on a map to specify and obtain distances, heights and directions. [choose and use suitable scales for accurate maps and plans] [interpret and use scales to measure lengths] [investigate and measure pathways on a map, including shortest paths] [specify directions from one point to another using compass bearings]

- Construct and interpret rules for simple relationships between variables and between successive terms in sequences.  
[use words, algebraic notation, flow diagrams, tables of values (ordered pairs) and Cartesian graphs to represent relationships given in any of these forms]
- Use ordered pairs to locate and describe the positions of points on a Cartesian coordinate grid.  
[relate the points on a Cartesian coordinate grid to the values of the variables graphed]

R & S: 3

Challenge: 2

Technology: 0

### Chapter 8: Two-dimensional and three-dimensional shapes

- Make and analyse models of solid objects  
[design the net of and make a simple polyhedron or cone to specified dimensions]  
[visualize and draw views of three-dimensional shapes from different perspectives]
- Establish congruence by superimposition, including cases involving rotation and reflection.  
[rotate, reflect and translate two-dimensional shapes in order to demonstrate congruence]  
[reflect a picture in a line, or rotate a picture through  $90^\circ$  or  $180^\circ$ , or translate a picture in a specified direction]
- Make designs that exhibit symmetries.  
[design simple tessellations]
- Enlarge (or rotate) two-dimensional figures or three-dimensional objects using scale factors.  
[use a simple scale factor, such as 1:3, to enlarge (or reduce) a three-dimensional object such as a pyramid]
- Investigate and apply properties of regular and irregular polygons and circles.  
[correctly apply and use terms such as square, rectangle, rhombus, trapezium; scalene, isosceles, equilateral and right-angles triangle; sector, arc, circumference and perimeter; vertices, edges, faces and diagonals]

R & S: 1

Challenge: 6

Technology: 1

### Chapter 13: Constructions

- Use appropriate geometric techniques such as paper-folding, ruler / compasses / protractor, and a computer drawing package to accurately draw simple two-dimensional shapes, attending to essential details.  
[use appropriate geometric tools to bisect a line segment and an angle]  
[draw shapes accurately according to specified details, such as a kite in terms of its diagonals]
- Make and analyse models of solid objects.  
[design the net of and make a simple polyhedron or cone to specified dimensions]  
[visualize and draw views of three-dimensional shapes from different perspectives]  
[identify vertices, edges, and faces of polyhedra]
- Make design that exhibit symmetries.  
[design simple tessellations]  
[modify shapes to produce Escher-type tessellations]
- Use angle relations involving transversal and pairs of parallel lines to solve problems, giving a reason for the solution.  
[name and apply complementary / supplementary angle relationships]  
[solve simple problems involving supplementary angles, alternate angles and vertically opposite angles]
- Investigate and apply properties of regular and irregular polygons and circles.  
[correctly apply and use terms such as square, rectangle, rhombus, trapezium; scalene, isosceles, equilateral and right-angled triangle; sector, arc, circumference and perimeter; vertices, edges, faces and diagonals]

R & S: 7  
Challenge: 0  
Technology: 1

### Year 9

#### Chapter 8: Geometry

- Accurately construct figures involving triangles, quadrilaterals and circles given all necessary dimensions
- Apply known properties of geometric figures, including angle properties associated with intersecting, parallel and perpendicular lines, triangles and quadrilaterals, to find other angles
- Enlarge or reduce two-dimensional figures using projections and scale factors
- Find the lines of symmetry of two-dimensional shapes
- Use congruence and similar conditions for triangles to solve mathematical and practical problems
- Use tessellations to visualize and sketch areas generated by the translation, rotation and reflection of lines

The chapter includes numerous worked examples, 3 investigations [The trihexaflexagon, Drawing Escher-style pictures, Impossible objects ], 2 performance assessment tasks [Electric fencing, Billiards], a computer investigation [Regular polygons – what’s their angle? ] and a review exercise 17 questions on skills and applications. The chapter concludes with Maths in Action titled “So, you like my proportion?”, questions and research, as well as Maths @ work on Graphic Designer.

### Presbyterian Ladies College

### Year 7

#### Chapter 8: Angles

- Naming and classifying different types of angles
- Identifying the relationships of complementary and supplementary angles
- Solving simple problems involving complementary and supplement angles and angles in a circle
- Measuring an angle of any size using a protractor
- Using a protractor to draw an angle of any size

Puzzles: 3 questions  
Applications and activities: Arrow angles, Paper angles, Pizza angles, light angles, Angles on a compass, Angles in a polygons, golf angles  
Enrichment and extension: 7 questions  
Revision questions: 11 questions

#### Chapter 9: Polygons

- Identifying a polygon
- Identifying the relationship between the number of sides of regular and irregular polygons (3-, 4-, 5-, 6-sided) and the sum of their interior angles
- Naming triangles according to their side or angle properties
- Identifying the interior and exterior angle properties of a triangle
- Identifying special quadrilaterals and their properties
- Finding the angle sum of a quadrilateral
- Recognizing angle relationships in parallel lines
- Using angle relationships to work out angle size

Puzzles: 3 questions  
Applications and activities: Polygon patterns, Tangrams, Escher art work  
Enrichment and extension: 8 questions  
Revision questions: 7 questions

#### Chapter 10: Location

- Drawing and interpreting diagrams in two dimensions

- Using directions in two dimensions
- Locating points on a map
- Using the Cartesian plane
- Using true bearings and compass directions and applying them to maps
- Using scales on maps

Puzzles: 2 questions  
 Applications and activities: Classroom plan, Where do you relax? Dream home, Treasure map, Orienteering, Class grid  
 Enrichment and extension: 7 questions  
 Revision questions: 8 questions

### *Year 8*

#### **Chapter 10:** Space, geometry and figures

- Exploring solid figures polyhedra and prisms, cones and cylinders, pyramids and spheres which includes drawing solid figures as oblique and isometric drawings,
- Exploring plane figures polygons, LOGO, circles, triangles (side-named and angle-named ) and constructions,
- Explain symmetry, transformations and congruence figures.

#### **Chapter 11:** Space, geometry and angles

- Explain angles leading to copying, measuring and constructing angles, as well as describing different types of angle, angles associated with parallel lines and a transversal.
- Angles associated with triangle, quadrilateral and polygons.
- Investigate properties of quadrilaterals and construct polygons.

### *Year 9*

#### **Chapter 12:** Space and Geometry

- Explore lines and angles (bearings) of intersect and parallel lines, triangles, quadrilaterals, circles
- Constructions (the various techniques)
- Problems on congruent and similar triangles, triangle properties and theorems

**Learning experience C:** include investigate symmetry, tessellations and nets, Areas and angles, Transformation (translation, reflection and rotation) as well as problem solving in geometry and algebra.

## Rossmoyne Senior High School

### *Year 7*

N/A

### *Year 8*

#### **Chapter 3:** Playing the angles

- ... sketches ... paths ... which satisfy provided conditions
- Checks ... that answers fit specifications ...
- Measures ... angle, reading whole number scales
- Checks, when prompted, that answers are roughly as expected ...
- ... choose appropriate operations...
- .... subtracts whole numbers....
- Applies properties of ... intersecting lines
- ... reading whole number scales

#### **Chapter 4:** Drawing 3D on 2D

- Visualises ... 3D shapes ... and interprets ... conventional mathematical drawings of them
- Visualises ... models of 3D shapes and arrangements and interprets and produces conventional mathematical drawings of them

- Visualises and makes models of 3D shapes and arrangements and interprets and produces conventional mathematical drawings of them
- Visualises and sketches the effect of ... rotation ... of figures and objects using suitable grids
- Interprets and meets specifications requiring the accurate construction and placement of figures and objects including manipulating shapes and arrangements mentally

Included a research project: There are other very effective ways of making a flat drawing have a three dimensional appearance, though unfortunately these are not easy to create for ourselves. You may have seen books with pictures that are viewed through glasses with coloured lenses. Some cleverly created pictures produce a 3D image when stared at. Research these ideas. Have you any of these books or pictures? Look up *single image stereograms* and 3D glasses on the internet. Write a report about these ideas.

#### Chapter 6: Designing a logo

- Recognises ... translations ...
- Visualises and sketches the effect of straightforward translations ... using suitable grids
- ... measures length ...
- Visualises ... 3D shapes & ... produces conventional mathematical drawings of them
- Interprets and meets specifications requiring the accurate construction and placement of figures and objects including manipulating shapes and arrangements mentally
- Visualises and sketches the effect of straightforward ... rotations ... using suitable grids
- Visualises, produces ... rotations ...
- Visualises and sketches the effect of straightforward ... reflections ... using suitable grids
- Understands and uses scale factors ... including making figures and objects on grids ...
- Visualises and sketches the effect of straightforward ... enlargements ... using suitable grids
- Understands and uses scale factors ... including making figures and objects on grids and with cubes
- Recognises rotations, reflections & translations in arrangements and patterns ...
- ... translates, rotates and reflects figures and objects systematically to produce arrangements and patterns
- Visualises and sketches the effect of straightforward translations, reflections, rotations and enlargements of figures and objects using suitable grids
- Recognises rotations, reflections ...
- Visualises and sketches the effect of straightforward ... reflections, rotations
- Checks ... that answers fit specifications ...
- ... uses problem-solving strategies which include those based on developing systematic approaches

#### Chapter 10: Tiling

- ... compares figures ... on the basis of spatial features ...
- ... describes ... figures ... on the basis of spatial features, using conventional geometric criteria
- Draw on mathematical knowledge to give reasons for conjectures ...
- ... describes and compares ... figures ... on the basis of spatial features, using conventional geometric criteria
- Checks, when prompted, that answers are roughly as expected and that methods and answers makes sense
- .... And judge whether ... measurements are reasonable
- Calculate with whole numbers ...
- ... applies distinguishing features of common classes of mathematical figures ...
- Selects ... figures ... on the basis of spatial features, using .... geometric criteria
- Recognises ... and uses patterns involving operations on whole ... numbers, ...
- Uses examples to support or refute mathematical conjectures ...
- Produces mathematical arguments to convince others of the truth of propositions, including those involving deductions from known information
- ... translate, rotates & reflects figures ... systematically to produce ... patterns

#### Chapter 20: Making a box

- Visualises ... 3D shapes ...
- ... making nets of 3D models which can be seen and handled ...
- ... interprets ... conventional mathematical drawings of 3D shapes

- Visualises and makes models of 3D shapes ...
- ... produces conventional mathematical drawings of 3D shapes ...
- Uses examples to support or refute mathematical conjectures ...
- Measures ... length ...
- Selects ... figures ... on the basis of spatial features ...
- The student visualises ... 3D shapes...
- Uses distance ... on ... plans ...
- Uses ... scale on ... plans ...

**Chapter 24: Making it right**

- ... applies properties of .... Classes of figures, including quadrilaterals ...
- ... applies distinguishing features of common classes of mathematical figures...
- Draw on mathematical knowledge to give reasons for conjectures ...

*Year 9*

**Chapter 6: Polygons**

- Selects ... figures and objects on the basis of spatial features, using conventional geometric criteria
- ... applies properties of ... the classes of figures which can be reasoned about in terms of the properties of triangles ...
- ... applies properties of ... the classes of figures which can be reasoned about in terms of the properties of triangles and ... intersecting lines
- ... accurately describes specific translations , ... rotations ...
- Uses examples to support or refute mathematical conjectures and attempts to make simple modifications of conjectures on the basis of examples
- Draws on mathematical knowledge to give reasons for conjectures before testing them, and refines and modifies conjectures as a result of testing

**Chapter 14: Transformations**

- Recognises rotations, reflections and translations ...
- Visualises, produces and accurately describes specific translations ...
- Visualises and sketches the effect of straightforward ... reflections, ... using suitable grids
- Visualises, produces and accurately describes specific ... rotations ...
- Visualises ... straightforward translations, reflections, rotations ... using suitable grids
- Visualises, produces and accurately describes specific translations, reflections, rotations ...
- ... applies transformations to problems ...
- Describes how some familiar mathematical ideas are, or have been, used by people ...
- Visualises ... 3D shapes ... and interprets and produces conventional mathematical drawings of them

**Chapter 15: Ratio and similarity**

- Uses ... scale on maps ...
- Uses ratios ...
- Read, writes, says and understands ... straightforward ratios ...
- ... solves linear equations ...
- Understands ... scale factors ...
- Visualises and sketches the effect of straightforward ... enlargements ... using suitable grids
- ... describes specific ... enlargements
- Understands ... the effect of scaling linear dimensions on lengths, areas and volumes of figures ...
- Understands and uses similarity ... to solve problems involving triangles ... (perhaps) : Sets up equations ... solve linear equations using analytic methods

Brunei Schools

*Year 7*

**Chapter 8: An introduction to Geometry**

- Introduces the basic terms like points, lines and planes
- Defines angles: acute, right, obtuse, reflex, complementary, supplementary
- Sum of angles at a point =  $360^\circ$ ; sum of adjacent angles on a straight line =  $180^\circ$ ; vertically opposite angles are equal
- Symbols: // parallel,  $\perp$  perpendicular
- When a transversal cuts two // lines, theory: corresponding angles are equal, alternate angles are equal, interior angles on the same side of the transversal are supplementary
- Construction technique:
  1. a line segment of a given length
  2. an angle of given size
  3. an angle equal to a given one
  4. a bisector of an angle
  5. a line  $\perp$  to a given line from a given point
  6. a line // to a given line
  7. a perpendicular bisector of a line segment

### Chapter 9: Polygons

- Describe polygons: a polygon is a plane figure which is bounded by line segments; An n-gon is a polygon with n sides; a regular polygon is a polygon with equal sides and equal interior angles
- Classify triangles: according to their sides – scalene, isosceles, equilateral; according to their angles – acute-angled, right-angled, obtuse-angled
- For a triangle:  $\angle$  sum of triangle =  $180^\circ$ ; ext.  $\angle$  of triangle = sum of int. opp.  $\angle$ s of triangle
- Special quadrilaterals: parallelogram, rectangle, square, rhombus, kite, trapezium
- For an n-gon, sum of interior angles =  $(n - 2) \times 180^\circ$ ; For a polygon, sum of exterior angles =  $360^\circ$
- A scale drawing is a drawing where the dimensions on paper are in proportion to actual dimensions

**Investigation:** A tessellation problem

## Year 8

### Chapter 9: Symmetry

- For a plane figure, the following terms are introduced: lines of symmetry, rotational symmetry, order of rotational symmetry, center of rotational symmetry
- A solid may have no plane of symmetry, or one or more planes of symmetry: An irregular-shaped stone does not have a plane of symmetry
- A regular n-gon has n lines of symmetry and rotational symmetry of order n
- The order of rotational symmetry of a solid depends on the axis in consideration

**Investigation:**

Given a  $3 \times 3$  square with 3 shaded squares, each has a line of symmetry.

- (a) How many more patterns, with 3 shaded squares, can you find with one line of symmetry? Record your patterns.
- (b) Find a pattern, with 3 shaded squares, which has 2 lines of symmetry. Is it the only one? If not, find all such patterns.
- (c) Find all patterns, with 4 shaded squares, which have
  - One line of symmetry,
  - Two lines of symmetry,
  - Three lines of symmetry,
  - Four lines of symmetry.

Do a similar study for a  $4 \times 4$  square with different patterns of 3 shaded squares, 4 shaded squares, 5 shaded squares and 6 shaded squares

### Chapter 10: Congruency and similarity

- Describes congruent figures as having the same shape and size, i.e. all angles and sides the same
- 4 Tests for congruency of triangles: SAS; ASA, AAS or SAA; SSS; RHS

- If two triangles are similar, the ratios of the corresponding sides are the same, and all angles the same
- 3 Tests for similarity of triangles: 3 pairs of equal corresponding angles, 3 pairs of corresponding sides in the same ratio, 2 pairs of corresponding sides in the same ratio and a pair of equal included angle
- For 2 similar figures, ratio of the areas = (ratio of the corresponding length)<sup>2</sup>
- For 2 similar solids, ratio of the surface areas = (ratio of the corresponding lengths)<sup>2</sup>  
ratio of the volumes = (ratio of the corresponding lengths)<sup>3</sup>

## Year 9

### Chapter 6: Straight line graphs

- Gradient of a line =  $\frac{y_2 - y_1}{x_2 - x_1}$  where  $(x_1, y_1)$  and  $(x_2, y_2)$  are the coordinates of any two points on the line.
- $y = mx + c$  is a linear equation where  $m$  is the gradient and  $c$  is the  $y$ -intercept
- Horizontal line has gradient = 0 with equation of line  $y = k$  (where  $k$  is any constant)
- Vertical line has gradient which is undefined. The equation of vertical line is  $x = k$  where  $k$  is a constant
- Parallel lines have the same gradient
- The length of a line segment  $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$  where  $(x_1, y_1)$  and  $(x_2, y_2)$  are the coordinates of A and B respectively
- The coordinates of the mid-point of AB are  $(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$  where  $(x_1, y_1)$  and  $(x_2, y_2)$  are the coordinates of A and B respectively

#### Investigation:

What is the relationship between the gradient of a line and the gradient of a line perpendicular to it?

### Chapter 7: Symmetry properties of a circle

- Explain Chord, tangent to a circle
- The perpendicular bisector of a chord passes through the center of a circle
- In a circle, equal chords are equidistant from the center
- A tangent to a circle is perpendicular to the radius drawn at the point of contact
- Tangents to a circle from an external point are equal in length

### Chapter 8: Angle properties of a circle

- Angles in the same segment are equal
- An angle at the center is twice any angle at the circumference, subtended by the same arc
- An angle in a semicircle is right angle
- Angles in opposite segments are supplementary

### Chapter 11: Transformations

- Explain: Reflection, rotation, translation, enlargement
- Combination of transformations

#### Investigation:

Includes two problems on transformation

## Singapore Schools

## Year 7

### Chapter 13: Basic Geometrical Concepts and Properties

- Identify various plane polygons and some simple solid figures;

- Calculate unknown angles involving adjacent angles on a straight line, vertically opposite angles, angles at a point, alternate angles, corresponding angles and interior angles between parallel lines;
- Draw parallel and perpendicular lines;
- Construct angle bisectors and perpendicular bisectors.

An example from the 5 problem solving questions is given below;

Q2 Construct triangle ABC such that  $AB = 12$  cm,  $BC = 11$  cm and  $AC = 9.6$  cm. Construct the perpendicular bisectors of AB and BC. Let the two bisectors meet at K. With K as center, construct a circle to pass through A, B and C. Find out the name of circle from library.

2. Anecdotes / Notes: 9
3. Investigations: 1

**Chapter 14:** Angles properties of Triangles and Quadrilaterals

- Calculate the unknown angles involving triangles and quadrilaterals using the angle properties of these figures;
- Construct simple geometrical figures from given information.

A list of 3 exploration problems was given. Below is an example;

Construct a trapezium PQRS where  $PQ = 8.4$  cm,  $QR = 4.8$  cm,  $RS = 4.8$  cm and  $\angle Q = 70^\circ$ . Measure PS,  $\angle R$ ,  $\angle S$  and  $\angle P$ .

1. Anecdotes / Notes: 9
2. Investigations: 2

*Year 8*

**Chapter 2:** Congruence and Similarity

- Identify congruent and similar figures
- Apply some of the property of congruent and similar figures

The content discussed notations for congruence and conditions for congruency of polygons. 3 questions were included in the problem solving list. Below is an example;

Q2 Two teapots are similar in every respect. The height of the smaller teapot is 15 cm with a total surface area of  $2\,000\text{ cm}^2$  and a volume of  $6\,000\text{ cm}^3$ . If the height of the larger teapot is 25 cm, calculate its total surface area and volume.

1. Anecdotes / Notes: 7
2. Investigations: 1

**Chapter 4:** Symmetry and angle properties of polygons

- Identify line and rotational symmetry of plane figures
- Make use of the symmetrical properties of triangles, quadrilaterals and regular polygons;
- Use symmetrical properties of simple solids.

The shapes under discussion are regular polygons - triangles, quadrilaterals, parallelograms, rhombus, rectangle, square. The theorems on sum of the interior and exterior angles of a polygons are introduced. There are 6 questions for the problem solving list. Below is an example;

Q5 The ratio of an interior angle to an exterior angle of a regular polygon is  $11 : 2$ . Find the number of sides of the polygon.

1. Anecdotes / Notes: 17
2. Investigations: 2

(Are human beings symmetrical? Do you know of any animal that is not symmetrical?)

(How many straight lines you can draw to divide the square / rectangles into two congruent parts?)

**Chapter 11:** Motion Geometry

- Reflect a simple plane figure in horizontal or vertical lines;

- Rotate a simple plane figures;
- Translate a simple plane figure;
- Enlarge a simple plane figure.

The content also included discussion on combined transformations. 3 questions are given on the problem solving list. Below is an example;

Q3 The transformation P is a  $90^\circ$  clockwise rotation about the origin and the transformation Q is a reflection in the x-axis. Describe a single transformation equivalent to (a) PQ; (b) QP.

1. Anecdotes / Notes: 7
2. Investigations: 4

Below is one of the investigations given;

- (a) In a pile of 81 coins, one of them is a counterfeit and it weighs more than the others. What is the minimum number of weighings needed before you can isolate the counterfeit coin?
- (b) If the same counterfeit coin is placed on a pile of 200 coins, what is the minimum number of weighings needed before you can isolate it?

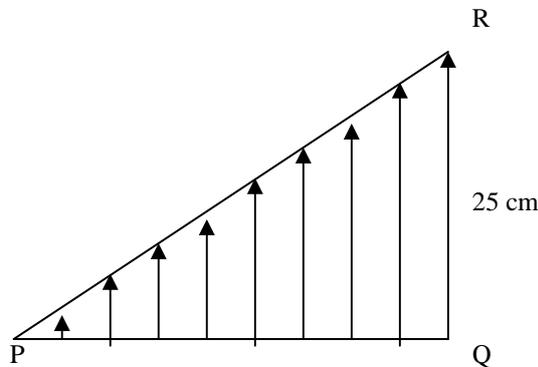
### Year 9

#### Chapter 4: Congruent and similar triangles

- To test for the similarity / congruency between two triangles
- To solve problems involving similar / congruent triangles

The content includes a section on the applications of congruent triangles. There is a list of 5 problem-solving questions, of which Q3 is given below.

Q3 In the diagram below,  $\angle PQR = 90^\circ$  and  $QR = 25$  cm. PQ is divided into 9 equal parts. Eight line segments parallel to QR are drawn up to PR from the points of division. Find the sum of the lengths of the eight line segments.



1. Anecdotes / Notes: 3
2. Investigations: 1  
Find out how you can use eight straight lines of equal lengths to make a square and four congruent equilateral triangles.

#### Chapter 5: Coordinate geometry

- The distance between two given points;
- The mid-point of two given points;
- The gradient of a straight line;
- The equation of a straight line.

The content includes a worked example on the strategies of solving an investigation given in Sec 2 on the product of the age of Mrs. Lee's four children. The method used are (1) eliminate unlikely possibilities, (2) use approximation, (3) use an equation. There is an exploration list consists of 5 questions. Below is an example;

Q5 For all real values of  $m$ , the line  $2y = mx + 4$  passes through a fixed point A. State the coordinates of A.

1. Anecdotes / Notes: 15
2. Investigations: 0

**Chapter 11:** Geometrical properties of circles

Learn how to use the angle properties of a circle to

- Find the distance between two parallel chords in a circle;
- Solve problems involving angles subtended at the center and angles at the circumference;
- Solve problems involving angles in a cyclic quadrilateral.

The content include numerous worked examples and questions to consolidate the circle theorems. There are 3 questions on the exploration list.

1. Anecdotes / Notes: 7
2. Investigations: 0

**Chapter 12:** Tangents and the alternate segment theorem

- Use the properties of tangents of a circle to find angles in the circle;
- Make use of the alternate segment theorem to find angles

There are 2 questions on the problem-solving list.

1. Anecdotes / Notes: 3
2. Investigations: 0

China Shanghai Schools

*Year 7*

**Chapter 4:** Translation & parallel lines

- Intersecting lines: define intersecting and perpendicular lines. Construct  $\perp$  from a point outside the given line,  $\perp$  bisector of a line. Discuss corresponding, alternate and interior angles
- Translation of parallel lines: Construct, define characteristics of parallel lines (corresponding angles equal, alternate angles equal and interior angles supplementary)
- To determine if the lines are parallel
- Properties of parallel lines

**Chapter 5:** Axial symmetry and isosceles triangles

- Describe symmetrical figures: double happiness, butterfly. Discussion on the axis of symmetry.
- Describe isosceles triangles: solving problems on triangles (finding angles and sides).
- Describe equilateral triangles with problem solving.

**Chapter 9:** Rotation & circle

- Rotation of figures - using arcs to construction geometrical shapes
- Relationship between angle at center, arc, chord, distance from the center to the chord etc. and the various circle theorems.
- Perpendicular to the center of chord, diameter.

**Chapter 10:** Central symmetry and parallelogram

- Central symmetry: describe the tai-chi sign. Define center of symmetry.
- Properties of parallelogram
- Translation of figures: e.g. translating plane triangles forming prism

**Chapter 11:** Congruent triangles

- Overlapping figures and congruency
- Construct triangles: technique in measuring equal angles, sides etc.
- To determine if the triangles are congruent: rules
- Congruent right-angled triangles: illustrated with practical application

## Year 8

### Chapter 4: Geometry proofs

- Euclid's elements: anecdotes,
- Proposition, axiom, theorem: explain the meaning
- Steps in proofs
- Proof worked examples
- Inverse proposition, inverse theorem: explain the definition of terminology
- Relationship of sides & angles of a triangle

### Chapter 7: Geometric construction & calculations

- Geometric construction: basic construction (draw line of same length, similar angle, angle bisector, perpendicular line from an outside point onto a line, perpendicular bisector); construction of intersecting of loci: (1) the vertex of isosceles triangles of the same base joining the mid point of the base is the perpendicular bisector of the base, (2) circles of the same size with their centres on the circumference of the base circle will have their circumference intersect at the center of the base circle, (3) draw parallel lines using the parallel line theorem concept of alternate angles, corresponding angles, and interior angles.
- Geometric calculations: applying inference in geo calculation problems, Pythagoras Theorem & its application, Formulae such as area of triangle =  $0.5 ab \sin c$ , congruent triangle rules, etc. Practical application illustrated by an arch bridge in China using the circle theorem. Reverse proof with exercise, e.g.: on a given an non-right-angled triangle, prove that  $a^2 + c^2 \neq b^2$ .

### Chapter 8: Quadrilaterals

- Parallelograms
- Characteristics of a parallelograms
- Properties of a rectangle & rhombus
- To prove if a shape is a rectangle or a rhombus
- Square
- Trapezium
- Lines joining the mid-points of 2 opp sides of triangles

## Year 9

### Chapter 2: Similar figures

- Dilation of figures and proportional segments: same shapes, ratio of segment intersected by parallel lines, To determine is the line intersects the 2 sides of a triangle is parallel to the third side
- Similar triangles: rules for similarity: (1) 2 triangles with 2 angles of the same size. (2) The ratios of the length of 2 corresponding sides of 2 triangles are the same with the included angle the same. (3) The ratios of 3 corresponding sides of the triangles are the same. (4) The ratios of the corresponding hypotenuse and another side of 2 right-angle triangles are the same.
- To determine if the triangles are similar : a detail discussion on for 2 similar triangles, the ratio of corresponding sides is the same.. leading to proof to show the ratio of the perimeters of the 2 triangles is the same (using matrix multiplication), the ratio of 2 similar triangles is  $k$ , then the ratio of the areas is  $k^2$ .
- Properties of similar triangles: its application in problem solving. Example: Finding the depth of a river.

### Chapter 5: Circles

- Relationship between a point, a line, circle & circle
- Describe a circle: 3 points not on the same straight line define a circle.
- Relationship between a line & a circle: a line outside the circle, the tangent to a circle and the intersecting line to a circle. Length of the perpendicular from the center to the given line in relation to the radius is discussed.
- Relationship between 2 circles: inscribed, concentric, touching, intersecting and the distance between the centers.
- Tangent lines: The line touching the circle at 90 deg is the tangent which is at a distance equal to the radius of the circle. Properties and definition of a tangent to a circle. The length of the tangent from an external point to a circle.

- Inscribed circles in a triangle, a quadrilateral
- The common tangent to 2 circles
- Application of tangents in construction
- Angles related to a circle, Angles at the circumference, Angle between a chord & a tangent: the circle theorems
- Regular polygons and its symmetry properties
- Calculation on regular polygons
- Construct a regular polygon

## Appendix CD: Chance & Data strand topic details

Schools		BH	PLC	RH	BS	SS	CSS
Chance & Data strand chapter number	Year 7	8, 10	13, 14			15	
	Year 8	5, 12	14	2, 17, 22	11, 12	14	
	Year 9	9, 10	15, 16	13	12	13, 14	4

### Balwyn High School

#### *Year 7*

##### **Chapter 8: Probability**

- Analyse experiments to determine the theoretical probability of events.  
(identify and list equally likely outcomes for one-step experiments)  
(determine, for a one-step experiment, the probability of a simple event by reasoning about equally likely outcomes)  
(use fractions and decimals to assign probabilities)
- Carry out experiments involving chance to estimate the probability of events and to simulate situations.  
(use the results from repeated trials of a simple experiment to estimate probabilities using long-run relative frequency)  
(design a simple random device [such as a spinner] to produce specified probabilities)  
(use a random device [such as a die, spinner or random number generator] to simulate a simple situation)
- Draw inferences from collected or published data.  
(develop informal inference from collected data and from prepared databases)  
(informally draw inferences about trends based on graphs of simple time series data)

R & S: 4

Challenge: 1

Technology: 2

##### **Chapter 10: Statistical Data**

- Present univariate data using graphical techniques and technology.  
(represent univariate data in dot plots [sometimes called line plots] with various scales such as multiples and decimals fractions)  
(construct stemplots [stem and leaf plots] to group and display univariate data)  
(represent grouped univariate data in histograms [with equal interval widths] )  
(use technology [ e.g. spreadsheets, graphic calculator ] to provide graphical displays of data)
- Summarise a data set by obtaining measures of central location and spread ‘by hand’ and by using technology.  
(obtain the range, mode, median and mean as summary statistics of a data set.)  
(use technology [ e.g. spreadsheets, graphic calculator or statistical software ] to provide summary statistics.)
- Interpret and evaluate information contained in tables, visual displays and databases and report on methods of data collection.  
(interpret information in stem plots and box plots)  
(extract and comment on information contained in a variety of tables, graphs and prepared databases)  
(interpret simple time series data)
- Interpret simple measures of location and spread and use them in comparisons.  
(explain orally or in writing the meaning of measures of location [mean, median] and spread [range] from own investigations or as found in newspapers, magazines or textbooks)  
(interpret different usages of term ‘average’ as they arise in newspaper, magazines and reports)  
(use means or medians and range to compare two data sets)

R & S: 2

Challenge: 1

Technology: 0

The Challenge question: Investigating Graphs

Collect ten different graphs from newspapers, magazines or books. Name the type of graph used each time and write a paragraph describing the information displayed on each graph. State what information is shown on each of the axes.

See if you can find at least one example of a line graph, a column graph, a picture graph and a circle graph. Also look for graphs that are designed to give the reader a particular impression.

## *Year 8*

### **Chapter 5:** Statistics and technology

- Decide the nature of data required to effectively answer specific questions and plan ways to collect and organise it.  
[plan and conduct a survey to obtain categorical data]  
[plan and conduct a survey to obtain ordinal data]
- Obtain data related to an area of interest.  
[collect information from a variety of sources including prepared databases]  
[use data collected, analysed and organized to generate new questions]
- Present collected data in tables, databases and spreadsheets.  
[organise measurements in tables with provided class intervals]  
[enter and manipulate data in a databases with defined fields or in a spreadsheet with a template set up]  
[design a simple data base to organise collected data]
- Present univariate data using graphical techniques and technology.  
[construct stemplots (stem and leaf plot) to group and display univariate data]  
[represent grouped univariate data in histograms (with equal interval widths)]  
[use technology (e.g. spreadsheets, graphics calculator) to provide graphical displays of data]
- Summarise a data set by obtaining measures of central location and spread ‘by hand’ and by using technology.  
[obtain the range, mode, median and mean as summary statistics of a data set (e.g. median, mode and range, from an ordered stemplot)]  
[use technology (e.g. spreadsheets, graphics calculator or statistical software) to provide summary statistics]
- Interpret and evaluate information contained in tables, visual displays and databases and report on methods of data collection.  
[interpret information in stem plots and box plots]  
[extract and comment on information contained in a variety of tables, graphs and prepared databases]  
[evaluate statements and assertions about a situation represented in a data display]  
[explain processes of data collection used in an investigation and evaluation the results obtained]
- Interpret simple measures of location and spread and use them in comparisons.  
[explain orally or in writing the meaning of measures of location (mean, median) and spread (range) from own investigations or as found in newspapers, magazines or textbooks]  
[interpret different usages of the term ‘average’ as they arise in newspapers, magazines and reports]  
[use means or medians and range to compare two data sets]

R & S: 1

Challenge: 1

Technology: 2

### **Chapter 12:** Probability and simulation

- Analyse experiments to determine the theoretical probability of events  
[identify and list equally likely outcomes for one-step experiments]  
[determine, for a one-step experiment, the probability of a simple event by reasoning about equally likely outcomes]  
[use fractions and decimals to assign probabilities]

- Carry out experiments involving chance to estimate the probability of events and to simulate situations.  
[use the results from repeated trials of a simple experiment to estimate probability using long-run relative frequency]  
[use a random device (such as a die, spinner or random number generator) to simulate a simple situation]
- Make prediction on the basis of samples.  
[make predictions based on samples]  
[estimate a proportion using a sample value obtained from an experiment or survey]

R & S: 6

Challenge: 1

Technology: 1

### *Year 9*

#### **Chapter 9: Probability**

- Describe in words the likelihood of an event happening
- Calculate the probability of simple events occurring by listing all possible outcomes
- Describe the probability of an event in terms of odd

The chapter includes numerous worked examples, 2 investigations [Mini-lotto, The bookie's profit margin], 2 performance assessment tasks [Spinners and dice, Races], 3 graphics calculator investigations [Investigating the 'one son' policy, Modeling the possible families, Finding the mean number of children per family], a computer investigation [ How many heads?] and a review exercise 17 questions on skills and applications. The chapter concludes with Maths in Action titles 'from splitting the pot to splitting the pea' with questions and research.

#### **Chapter 10: Statistics**

- Distinguish between various types of data including numerical and non-numerical data
- Summarise data by using measures of central tendency (mean, median and mode) and measures of spread (range and interquartile range)
- Present data using stem-and leaf plots (for continuous data) and evaluate the median from plot
- Present data using single and comparative box-and whisker plots
- Compare sets of grouped and ungrouped data using appropriate graphs
- Predict future outcomes by using scatter plots and lines of best fit

The chapter includes numerous worked examples, 3 investigations [Readability, The Fry readability test, Lines of best fit and correlation], 2 performance assessment tasks [Height and arm-span, Highfash shoe company], A graphics calculator investigation [ Investigating height using box-and-whisker plots], a computer investigation [ 'A bit hard to fathom'] and a review exercise 11 questions on skills and applications.

### Presbyterian Ladies College

### *Year 7*

#### **Chapter 13: Probability**

- Using the language of chance in everyday situations
- Comparing probabilities using language
- Using language to estimate a probability by using the results of simple experiments
- Finding the probability of a simple eveny
- Predicting and testing probabilities using spinners

Puzzles

3 questions

Applications and activities

Survey, thumbtacks, A gambles, Letters

Enrichment and extension

6 questions

Revision questions

12 questions

#### **Chapter 14: Statistics**

- Recognizing the different types of data
- Collecting and organizing different types of data
- Designing a simple database to collect data
- Representing numerical data in histograms, dot plots and stemplots
- Using means to compare two data sets
- Using Venn diagrams and two-way tables to display data
- Interpret line graphs

Puzzles	3 questions
Applications and activities	Fact files, What does your school think about...? Estimating, Quality control, Maths in the media, Research, Trends, Home and away
Enrichment and extension	5 questions
Revision questions	14 questions

#### *Year 8*

##### **Chapter 14: Chance and data**

- Explain types of data, collecting data (surveys and samples) and interpreting various forms of data and the terms (range, median, mode, mean), ordered data and measures of spread (lower, upper and interquartile range)
- Chance and probability definitions (outcomes, event, and probability) leading to construction of tree diagrams.

#### *Year 9*

##### **Chapter 15: Interpretation of data and statistics**

- Interpret data on tables, collecting data, sampling, databases, simulation
- Organizing and analyzing data: mean and median; mean, mode and range; discrete and continuous data, graphical representation of information
- Statistics and graphs for discrete data (pictographs, column graphs, dot diagrams, stem and leaf plots)
- Comparing sets of data

##### **Chapter 16: Probability**

- Discuss chances, problem solving on probability using the set strategy and formula, analyse compound events using the tree diagrams, simulation and investigate the odds

#### Rossmoyne Senior High School

#### *Year 7*

Not applicable

#### *Year 8*

##### **Chapter 2: Getting to know you**

- ... makes sensible statements about the information provided in tables, diagrams ...
- ... takes care in ... tabulating data ...
- ... displays and summarises data using frequencies ...
- ... reads and makes sensible statements about the information provided in diagrams ...
- Displays frequency and measurements data using ... some grouping ...
- ... choose appropriate operations ...
- Reads and makes sensible statements about the information provided in tables ... and comments on how well the data answers their questions
- Checks, when prompted, that ... methods and answers makes sense ...
- Calculate with whole numbers ...
- ... summarises data with ... highest, lowest and middle scores; and means
- ... summarises data with ... means and medians
- Uses examples to support or refute mathematical conjectures ...
- Comments on how well the data answers their questions

- Reads and makes sensible statements about trends and patterns ...
- Checks ... that answers fit specifications ...
- Reads and makes sensible statements about the information provided in ... diagrams ... bar graphs ...
- Reads and makes sensible statements about the information provided in ... line and bar graphs ...
- Displays frequency and measurements data using simple scales on axes ...
- Displays one-variable and two-variable data in tables and plots ...
- Displays frequency and measurements data using simple scales on axes and some grouping ...
- Describes how some familiar mathematical ideas are ... used by people to represent ... their world

Project : Newspaper search

Look for graphs displayed in newspapers, cut some out and stick them in the space below. Write a few sentences about what each graph shows. Is it informative? Is it at all misleading?

(If you need more space include more pages of your own and number them 54a, 54d, etc)

**Chapter 17:** What are my chances?

- Places events in order from those least likely to those most likely...
- ... takes care in collecting ... and tabulating data ...
- Places events in order from those least likely to those most likely ..
- Reads and makes sensible statements about the information provided in tables
- Attends to the shape, size & placement ... when matching, making ... 3D models ...
- Visualises & makes models of 3D shapes & interprets mathematical drawings ...
- Uses examples to support or refute mathematical conjectures ...
- Calculates with whole numbers ...
- ... plan what data to collect ...
- Displays frequency ... data ... summarises data with simple fractions ...
- ... comments on how well the data answers their questions

**Chapter 22:** Surveys

- Collaborates with peers to plan what data to collect and how to classify ...
- Collaborates to plan and refine survey questions ...
- Displays frequency and measurements data ... and summarises data ...
- Displays one-variable and two-variable data ... and summarises data ...
- ... makes sensible statements about the information ...
- ... makes sensible statements about trends and patterns in the data ...

*Year 9*

**Chapter 13:** Making sense of data

- Reads & makes sensible statement about the information provided in diagrams, tables, line and bar graphs ...
- ... summarises data with ... means ...
- Displays one-variable and two-variable data in tables and plots ...
- Calculates with whole numbers, decimals and fractions ...
- Measures ... angle ...
- Collaborates with peers to plan what data to collect and how to classify, sequence and tabulate ...
- ... identifying and organizing key information

Brunei Schools

*Year 8*

**Chapter 11:** An introduction to statistics

- Explain “statistics”: numerical data usually collected for a particular purpose or study ; the study of methods for collecting, organizing, presenting and analyzing data
- One or a combination of the following methods can be used to collect data: observation, interviews, questionnaires, abstraction from published statistic

- Data can be presented graphically as: pictograms, line graphs, bar charts, histograms, pie charts

**Investigation:**

Sometimes, graphs used in advertisements are misleading. An example is the graph given on page 122 where the vertical scale does not start at zero. Here, a first look at the graph gives us the impression that the slimming course is very effective; the girl lost almost half her original mass in five months. However, we know that is not true.

Collect other examples of misleading graphs from newspapers and magazines and present them to the class.

**Chapter 12: Averages**

- For a set of values,  $\text{mean} = (\text{Sum of values}) / (\text{number of values})$
- For a frequency distribution,  $\text{mean} = [\text{Sum of (frequency} \times \text{value)}] / (\text{total frequency})$
- For a set of values arranged in ascending or descending order: the median is middle value if there is odd number of values, or it is the mean of the two middle values if there is an even number of values
- For a set of values, the mode is the value with the highest frequency

**Investigation:**

A shopkeeper has 6 kg of Grade A coffee powder packed in packets of 200 g each, and 6 kg of Grade B coffee powder packed in packets of 300 g each. He intends to sell each packet at \$1.00. At this price, he will obtain \$30 for selling 6 kg of Grade A coffee powder and \$20 for selling 6 kg of Grade B coffee powder. In other words, he will obtain \$50 for selling 12 kg of coffee powder. However, he found that Grade A was not selling too well because it was too expensive and Grade B coffee powder was not selling too well also, because the flavour was unappealing. To improve sales, he decided to mix 6 kg of coffee powder with 6 kg of Grade B coffee powder. He sold the new blend of coffee powder at 250 g for \$1.00. After selling all 12 kg of the coffee powder, he received only \$48. How do you account for the missing \$2.00 in selling 12 kg of the coffee powder?

*Year 9*

**Chapter 12: Grouped data**

- The area of each column in histogram gives the frequency of that class
- To draw the frequency polygon for a frequency distribution with equal class width, we: join the midpoints of the tops of the columns in a histogram or, join the points representing the ordered pairs (mid-value, frequency)

Singapore Schools

*Year 7*

**Chapter 15: Statistics**

- Collect, classify and tabulate data
- Read and interpret tables and statistical diagrams;
- Construct bar graphs, pie charts, pictograms, stem and leaf diagram, line graphs and histograms with equal intervals.

Statistics is explained as a science of collecting, organizing, interpreting and analyzing data. This chapter includes an exploration problem on pie chart.

- Anecdotes / Notes: 4
- Investigations: 1

*Year 8*

**Chapter 14: Measures of Central Tendency**

- Find the mean;
  - Find the median;
  - Find the mode;
- of a set of data.

There are 2 questions each for problem solving and exploration. Below is an example from the problem solving list.

Q1 Given that nine numbers 16, w, 17, 9, x, 2, y, 7 and z have a mean of 11, find the mean of w, y and z.

1. Anecdotes / Notes: 3
2. Investigations: 0

### *Year 9*

#### **Chapter 13:** Frequency Distribution

- Construct a grouped a frequency table;
- Construct a histogram representing a grouped frequency table;
- Construct a frequency polygon representing a grouped frequency table.

The problem solving section includes examples from statistics and geometry with a variety of strategies for solutions. There are 3 questions on the exploration list.

1. Anecdotes / Notes: 8
2. Investigations: 0

#### **Chapter 14:** Measures of central tendency

- Calculate the mean of a grouped frequency distribution;
- Calculate the mean of a grouped frequency distribution using an ‘assumed mean’ method.

The terms averages and measures of central tendency which include arithmetic mean, median and mode are defined. There are 4 questions on the problem-solving list.

1. Anecdotes / Notes: 11
2. Investigations: 2

### China Shanghai Schools

### *Year 9*

#### **Chapter 4:** Basic statistics

- Understanding basic statistics: illustrated with data on time of discoveries, s survey on smoker and lung cancer. Explain the meaning of statistics
- Explain data collection, organization and representation (tabulations, pie and line graphs, bar charts, stem and leaf plots). Explain the terminology.
- Measure of central tendency of a set of data
- Histograms
- Frequency distribution histograms
- % frequency distribution histograms
- Represent the spread of data
- Variance & standard deviation, worked examples on the use of calculators.
- Applying standard deviation
- Examples on fieldwork of statistics
- Practical examples of statistics

## Appendix CE: Algebra strand topic details

Schools		BH	PLC	RH	BS	SS	CSS
Algebra strand chapter number	Year 7	3, 6, 11	11, 12		6	7, 8	1, 2, 3, 6, 7, 8,
	Year 8	3, 7, 10	4, 6, 7, 8, 13, B	19, 23, 26	3, 5, 6, 7, 8	5, 6, 7, 8, 9, 10	3, 5, 6
	Year 9	5, 6, 7	4, 6, 7, 8, 9, B, D	8, 9, 11	4, 5, 9, 10	1, 2, 3, 7, 8, 9	1

### Balwyn High School

#### *Year 7*

##### **Chapter 3:** Number patterns and symbols

- Develop, interpret and simplify mathematical expressions which describe rules for relationships and mensuration formulas.

[develop mathematical expressions such as  $\frac{1}{2}(x + y)$  to represent the statement 'half the

sum of two numbers' or develop an expression ( e.g.  $2n + 1$ , where n is an integer), as a formula for generating odd numbers]

[develop rules for linear and simple exponential functions in symbolic form]

- Construct and interpret rules for simple relationships between variables and between successive terms in sequences.

[use words, algebra notation, flow diagrams, tables of values (ordered pairs) and Cartesian graphs to represent relationships given in any of these forms]

[use rules to make predictions and conjectures about sequences or relationships between variables]

- Use ordered pairs to locate and describe the positions of points on a Cartesian coordinate grid.

[relate the points on a Cartesian coordinate grid to the values of the variables graphed]

[obtain number pairs for two related variables and plot these using simple scaled axes]

R & S: 5

Challenge: 0

Technology: 1

An example of the R & S question:

Make your own matchstick, coin or tile pattern. Draw the first three shapes in your pattern. Swap with a partner. Look at your partner's patterns and;

- write the number sequence formed by the shapes
- describe the pattern you see in the sequence.

##### **Chapter 6:** Expressions, symbols and rules

- Develop, interpret and simplify mathematical expressions which describe rules for relationships and mensuration formulas.

[represent and interpret simple mensuration relationships for perimeter, area or volume]

[develop rules for linear and simple exponential functions in symbolic form]

[simplify mathematical expressions using procedures including grouping like terms and the distributive law, and explain these procedures by manipulation of physical models]

- Develop linear and other simple equations and inequalities from information provided in a given context

[translate linear equations and inequalities embodied in stories, real situations and 'word-problems' into algebraic form]

R & S: 4

Challenge: 1

Technology: 0

### Chapter 11: Equations and inequations

- Develop, interpret and simplify mathematical expressions which describe rules for relationships and measurement formulas.  
[develop mathematical expressions such as  $\frac{1}{2}(x + y)$  to represent the statement ‘half the sum of two numbers’ or develop an expression ( e.g.  $2n + 1$ , where  $n$  is an integer), as a formula for generating odd numbers]
- Demonstrate the equivalent (identity) or difference between simple algebraic expressions.  
[use materials, diagrams, word, substitution of arbitrary values, and algebra manipulation of expressions to show the difference or equivalence (identity) between expressions]
- Construct and interpret rules for simple variables and between successive terms in sequences.  
[use words, algebraic notation, flow diagrams, tables of values (ordered pairs) and Cartesian graphs to represent relationships given in any of these forms]  
[use rules to make predictions and conjectures about sequences or relationships between variables]
- Develop linear and other simple equations and inequalities from information provided in a given context.  
[translate linear equations and inequalities embodied in stories, real situations and ‘word-problems’ into algebraic form]  
[express restrictions on variables embodied in stories and ‘word-problems’ in algebraic form]
- Make judgements about, and verify truth values for propositions expressed as linear equalities and inequalities.  
[use substitution of values and tables of values to verify which of the numbers, or pairs of numbers, make propositions expressed as linear or other simple equations or inequalities true or false]  
[use techniques of algebraic manipulations to obtain a value or values of a variable for which a linear or other simple equation or inequality is true over a specified domain]
- Use ordered pairs to locate and describe the positions of points on a Cartesian coordinate grid.  
[relate the points on a Cartesian coordinate grid to the values of variables graphed]  
[obtain number pairs for two related variables and plot these using simple scaled axes]

R & S: 6

Challenge: 1

Technology: 1

An example of an R & S questions: Show Time

Andy, Amy, Adam and Anna have a total of \$120 between them to spend at the show. Andy has twice as much money as Amy. But Amy has twice as much money as Adam, and Adam has twice as much money as Anna. How much money did Andy, Amy, Adam and Anna each have?

### Year 8

#### Chapter 3: Variables and relations

- Develop, interpret and simplify mathematical expressions which describe rules for relationships and measurement formulas.  
[develop mathematical expressions such as  $\frac{1}{2}(x + y)$  to represent the statement ‘half the sum of two numbers’ or develop an expression as a formula for generating odd numbers]  
[simplify mathematical expressions using procedures including grouping like terms and the distributive law, and explain these procedures by manipulation of physical models]
- Demonstrate the equivalence (identity) or difference between simple algebraic expressions  
[use materials, diagrams, words, substitution of arbitrary values, and algebraic manipulation of expressions to show the difference or equivalence (identity) between expressions]
- Construct and interpret rules for simple relationships between variables and between successive terms in sequence.  
[use words, algebraic notation, flow diagrams, tables of values (ordered pairs) and Cartesian graphs to represent relationships given in any of these forms]

[use rules to make predictions and conjectures about sequences or relationships between variables]

- Develop linear and other simple equations and inequalities from information provided in a given context.  
[translate linear equations and inequalities embodied in stories, real situations and ‘word-problems’ into algebraic form]
- Make judgements about, and verify truth values for propositions expressed as linear equalities and inequalities.  
[use substitution of values and tables of values to verify which of the numbers, or pairs of numbers, make propositions expressed as linear or other simple equations or inequalities true or false]

R & S: 2

Challenge: 0

Technology: 0

### **Chapter 7: Linear equations**

- Develop, interpret and simplify mathematical expressions which describe rules for relationships and measurement formulas.  
[develop rules for linear and simple exponential functions in symbolic form]  
[simplify mathematical expressions using procedures including grouping like terms and the distributive law, and explain these procedures by manipulation of physical models]
- Develop linear and other simple equations and inequalities from information provided in a given context.  
[translate linear equations and inequalities embodied in stories, real situations and ‘word problems’ into algebraic form]  
[express restrictions on variables embodied in stories and ‘word problems’ in algebraic form]
- Make judgement about, and verify truth values for propositions expressed as linear equalities and inequalities.  
[use substitution of values and tables to verify which of the numbers, or pairs of numbers, make propositions expressed as linear or other simple equations or inequalities true or false]  
[use techniques of algebraic manipulation to obtain a value or values of a variable for which a simple linear equation or inequality is true over a specified domain]

R & S: 2

Challenge: 0

Technology: 0

An example of the R & S question:

Anna and Barry are sharing a prize of \$120. Anna thinks she should receive twice as much money as Barry. Barry thinks he should receive money three times as much as Anna. Determine how much money each of them think they should receive.

### **Chapter 10: Graphs**

- Develop, interpret and simplify mathematical expressions which describe rules for relationships and measurement formulas.  
[develop rule for linear and simple exponential functions in symbolic form]
- Construct and interpret rules for simple relationships between variables and between successive terms in sequences.  
[use words, algebraic notation, flow diagrams, tables of values (ordered pairs) and Cartesian graphs to represent relationships given in any of these forms]  
[use rules to make predictions and conjectures about sequences or relationships between variables]
- Use ordered pairs to locate and describe the positions of points on a Cartesian coordinate grid.  
[relate the points on a Cartesian coordinate grid to the values of the variables graphed]  
[obtain number pairs for two related variables and plot these using simple scaled axes]
- Sketch and interpret graphs of linear and other simple relationships.  
[sketch graphs which indicate an understanding of the nature of the relationship between variables in everyday situations or in stories]

- [describe the nature of relationship between the variables indicated by the graphs obtained]
- Plot graphs or linear and other simple functions to model data.  
[sketch or plot graphs of linear and other simple functions using a table of values or known features of the graph of the function]  
[plot graphs of linear and other simple functions and relations specified by sets of ordered pairs using technology]

R & S: 1

Challenge: 0

Technology: 5

An example of Technology question: Using a graphics calculator for point of intersection

To find the intersection of two linear relationships, e.g.  $y = 3 - x$  and  $y = 2x - 1$ :

- Sketch both relationships on your calculator
- Press **2<sup>nd</sup> calc, intersect**
- Press **Enter** on the first curve
- Press **Enter** on the second curve
- Press **Enter** after you have moved the cursor close to the intersection point.

## Year 9

### Chapter 5: Expanding and factorizing

- Use algebraic notation to write expressions for relationships between variables
- Use factorization to show equivalence between algebraic expressions
- Rearrange algebraic expressions into more useful forms
- Use simple symbolic expressions to construct generalizations
- Simplify algebra expressions involving linear and quadratic terms

The chapter includes numerous worked examples, 2 investigations [Increasing profit, Finding a shortcut when expanding two factors], 2 performance assessment tasks [Mr Gershwin's piano, The mountaineers] and a review exercise 17 questions on skills and applications.

### Chapter 6: Linear relationships

- Represent linear relationships as algebraic expressions and graphs
- Determine the gradient or slope of a linear relationship
- Determine equations of straight-line graphs
- Solve linear equations algebraic and graphical
- Solve linear inequations using algebraic methods
- Transpose formulae and equations and determine solutions by substitution

The chapter includes numerous worked examples, 2 investigations [Perpendicular graphs, How to find the 1 000 000<sup>th</sup> term in a number pattern in a few seconds], 2 performance assessment tasks [Running a cinema, Forensic science – bone lengths], 2 graphics calculator investigations [Investigating break-even analysis, Investigating income tax], and a review exercise with 21 questions on skills and applications.

### Chapter 7: Quadratics

- Plot graphs showing quadratic relationships between two variables
- Graph quadratics, emphasizing features such as axis intercepts and turning point
- Use algebraic notation to write expressions for quadratic relationships between variables and to write them in more useful equivalent forms
- Solve quadratic equations using graphical and algebraic methods
- Solve real-life applications of quadratics, taking constraints into account.

The chapter includes numerous worked examples, 2 investigations [A parabolic nomogram, Folding parabolas], 2 performance assessment tasks [The world record for a house of cards, Let's go camping], A graphics calculator investigation [The Simpsons and quadratic relationships] and a review exercise 13 questions on skills and applications.

## Presbyterian Ladies College

### *Year 7*

#### **Chapter 11:** Algebra symbols

- Simplifying expressions and collecting like terms
- Working with symbols and pronumerals
- Translating verbal statements into mathematical expressions
- Substituting into expressions
- Writing algebraic rules

Puzzles	4 questions
Applications and activities	Body mass index, Energy expended during physical activity
Enrichment and extension	6 questions
Revision questions	12 questions

#### **Chapter 12:** Equations & Inequations

- Solving equations by inspection
- Solving equations by using flow charts
- Solving equations by using inverse operations
- Solving inequations
- Exploring the co-ordinate plane

Puzzles	3 questions
Applications and activities	5 questions
Enrichment and extension	10 questions
Revision questions	14 questions

### *Year 8*

#### **Chapter 4:** Symbolic expression

- Using number machines to illustrate rules, introduce algebraic terms and expressions,
- Apply the 3 operations (excluding division) of algebraic terms, leading to the Distributive Law.
- Exercises are on skill consolidation such as “expand and simplify”

#### **Chapter 6:** Sets and problem solving

- Define sets and set terminology and symbols,
- Venn diagrams and problem solving with explanation on ‘and’, ‘or’ and ‘only’
- The exercises consist of numerous worked examples and consolidation problems.

#### **Chapter 7:** Factors and fractions in algebra

- Explain factors, H.C.F. and algebraic fractions involving simplifications, multiplication and division, addition and subtraction.
- Consolidate with exercises.

#### **Chapter 8:** Equations and inequations

- Strategies to solve equations, equations involved 2 operations and 3 operations
- Solving inequations which use  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ . Exercises involved find “the values of the pronumerals which satisfy the given condition”.

#### **Chapter 13:** Location and paths

- Explain undirected graph (page 521—a topic of discussion not encountered in other textbooks)
- The Cartesian plane, linear relation – rules and plot, application of straight line graphs,
- Intersection of 2 straight lines, simultaneous equations and application (the Break-even point).

#### **Learning experience B:**

- Predominant with sets and algebraic problems

## Year 9

### Chapter 4: Algebraic expansions, simplification and factorization

- Define like and unlike algebraic terms prior to the 4 arithmetic operations of algebraic terms, expanding algebraic expressions, binomial expansions and perfect square, the 4 operations of rational expressions (in the form of algebraic fractions), practical use of algebraic expressions
- Factorisation using various techniques, of quadratic trinomials, of coefficient of  $x^2$  greater than 1
- Factorisation and simplification for problem on algebraic fraction

### Chapter 6: Linear equations and inequations

- Explain linear equation and strategies in solving linear equation, inequations and the significance of positive and negative coefficients of pronumerals

### Chapter 7: Linear graphs and simultaneous equations

- Explain Cartesian plane and the terms used for graphing, linear graphs, gradient, linear equation and graphical solution of linear equation
- Simultaneous equation and solutions
- Graphs of half plane ( sketching  $y > mx + c$  or  $y < mx + c$  and check if the required area is above or below the line  $y = mx + c$ ), leading to intersection of half plane.

### Chapter 8: Formulae and their application

- Explain the importance of knowing the meaning of each pronumeral
- Transposition of formulae, literal (an expression with letters) equations

An example: Solve the literal equation  $a(x+b) = cx$  for  $x$

### Chapter 9: The quadratic function

- Introduction, the parabola and how the shape is defined by the quadratic terms and the characteristics of the graph,
- The quadratic equation, the Null Factor Law, problem solving

**Learning experience B:** Linear equations, quadratics equations, common logarithms, literal equations and transposition of formulae, problem solving and pronumerals, making a parabolic reflector, decimal indices and applications, roots and reciprocal

**Learning experience D:** Journey graphs, interpreting information, graphical interpretation, tables of information, sets, a probability problem on the study of left-handers / number plates, moving averages, and the Zebra puzzle

## Rossmoyne Senior High School

## Year 7

N/A

## Year 8

### Chapter 19: Every picture tells a story

- Informally sketches and interprets graphs which describe the relationship between two quantities in everyday situation
- Uses coordinates ...
- ... plots data in first-quadrant coordinate graphs ...

### Chapter 23: What's my rule?

- Understands the ... connections between the four operations on whole and decimal numbers ...
- Uses and interprets basic algebraic conventions ...
- Recognises ... and uses patterns involving operations on whole ... numbers, and follows ... rules for how successive terms in a sequence ... can be linked by a single operations
- ... explains rules for linking successive terms in a sequence or paired quantities using on or two operations

- Uses a letter to represent a variable quantity in an oral or written expression involving one or two operations
- Generates and plots data in first-quadrant coordinate graphs, describing patterns in the resulting scatter of points
- Draws on mathematical knowledge to give reasons for conjectures ...
- Uses a letter to represent a variable quantity ...
- Generates and plots data in first-quadrant coordinate graphs ...

**Chapter 26:** Finding the missing number

- Adds & subtracts whole nos ... & multiplies & divides by one digit whole nos ...
- Understands the ... connections between the four operations on whole ... numbers, and uses this understanding to choose appropriate operations ...
- Generates numbers or number pairs which satisfy a single constraints which is stated in natural language
- Working towards: ... solve equations of the form  $ax + b = cx + d$  ... using “guess, check and improve” ... and solve linear equations using analytic methods
- Working towards: ... solve linear equations using analytic methods
- Checks, when prompted, that answers ... makes sense
- ... solves linear equations using analytic methods
- Uses and interprets basic algebraic conventions ...
- Adds and subtracts whole numbers ...
- Recognises ... and uses patterns involving operation on whole numbers
- Sets up equations to represent one constraints in a sit<sup>N</sup> ... solve linear eqns...
- Checks ... that answers fit specifications ...
- ... interprets basic algebraic conventions ...
- Makes generalizations ...

*Year 9*

**Chapter 8:** Using letters

- Uses and interprets basic algebraic conventions for representing situations involving a variable quantity and explain why two linear expressions are equivalent
- Uses & interprets basic algebraic conventions for representing situations involving a variable quantity
- Checks when prompted, that answers are roughly as expects ...
- Uses examples to support or refute mathematical conjectures ...
- Draws on mathematical knowledge to give reasons for conjectures ...
- ... uses problem solving strategies which include those based on developing systematic approaches

**Chapter 9:** Equations

- ... chooses appropriate operations ...
- Generates numbers or number pairs which satisfy a single constraints which is stated n natural language
- Uses & interprets basic algebraic conventions for representing situations involving a variable quantity ...
- Uses ... basic algebraic conventions ...
- ... solve equations ... using ‘guess, check & improve’ ... & solve linear equations using analytic methods
- Uses a letter to represent a variable quantity in an oral or written expression involving 1 or 2 operations
- Uses & interprets basic algebraic conventions for representing situations involving a variable quantity ...
- Sets up equations to represent one constraint in a situation, solve equations ... sing ‘guess, check & improve’ ... and solves linear equations using analytic methods

**Chapter 11:** Graphs

- ... interprets graphs which describe the relationship between two quantities in everyday situations
- Interprets tables and graphs showing a quantity changing over time

- ... describing patterns in the resulting scatter of points
- ... plots data in first-quadrant coordinate graphs ...
- Uses coordinates ...
- ... understands ... negative integers
- ... plots data in first-quadrant coordinate graphs, describing patterns in the resulting scatter of points
- ... interprets graphs which describe the relationship between two quantities in everyday situations
- Informally sketches and interprets graphs which describe the relationship between two quantities in everyday situations
- Describes how some familiar mathematical ideas are, or have been, used by people to represent, describe and explain their world

## Brunei Schools

### *Year 7*

#### **Chapter 6:** An introduction to algebra

- Explain algebraic terminology using an expression  $3x + 2y - 4xy + xy^2 - 5$ ,  $x$  and  $y$  are variables;  $3x$ ,  $+2y$ ,  $-4xy$ ,  $xy^2$ ,  $-5$  are terms;  $3$ ,  $2$ ,  $-4$  and  $1$  are the coefficient of  $x$ ,  $y$ ,  $xy$  and  $xy^2$  respectively;  $-5$  is the constant term
- The algebraic expression  $2ab + 5bc - 5ba + 1 - 3$ ,  $2ab$  and  $-5ba$  are like terms. So are  $1$  and  $-3$  which are constant terms
- When two algebraic equations have the same solution, they are equivalent.
- Adding and subtracting the same expression to and from both sides of an equation does not change the solution of the equation
- Multiplying or dividing both sides of an equation by the same non-zero expression does not change the solution of the equation
- To solve a linear equation in one variable, we can use a series of operations to find an equivalent equation such that : the variable with coefficient 1 is on the LHS of the equation, and the constant term is on the RHS of the equation
- A formula is an equation which expresses a rule relating two or more variables

### *Year 8*

#### **Chapter 3:** Algebraic manipulation and formulae

- Introduce technique on expanding and factorizing algebraic expressions. Factorisation can be performed by : finding common factors and by grouping
- Factorise  $Ax^2 + Bx + C$ , and  $Ax^2 + Bxy + Cy^2$
- Factorisation of expressions which are the difference of two squares
- Algebraic fractions are fractions involving algebraic expressions. Explain addition, subtraction, multiplication and division of algebraic fractions
- To add or subtract two algebraic fractions with different denominators, we first rewrite the fractions using the LCM of the denominators as the common denominator
- Changing the subject of a formula

#### **Chapter 5:** Simultaneous and fractional equations, and inequalities

- A solution of a pair of simultaneous equations is a pair of values which will satisfy both equations at the same time
- Two methods commonly used in solving simultaneous equations: elimination and substitution
- To solve a fractional equation, multiply the equation throughout by the LCM of the denominators then solve the resulting equation
- Using number line to show sets of real numbers with symbols  $\leq$ ,  $>$ ,  $\neq$
- Discuss the properties of inequalities

#### **Investigation:**

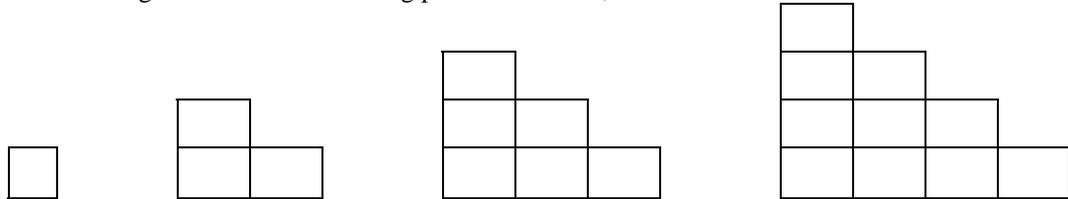
$x = 8$ ,  $y = 6$  is a pair of integer solutions of the equation  $3x + 4y = 48$ . Is this the only pair of integer solutions? If not, write down all other pairs of integer solutions in terms of the coefficients of  $x$  and  $y$  and the given solution.

**Chapter 6: Quadratic equations**

- Equations in one variable whose highest index is 2 are called quadratic equations on one variable
- Any quadratic equation in  $x$  can be expressed as  $ax^2 + bx + c = 0$  where  $b, c$  can be any number and  $a$  is any number except zero.
- A useful fact for solving quadratic equations: If  $A \times B = 0$ , then either  $A = 0$  or  $B = 0$

Investigation:

Tiles are arranged to form the following pattern as shown;



- (1) Find the number of tiles required to form a similar pattern with 10 rows
- (2) Find the number of tiles required to form a similar pattern with  $n$  rows
- (3) A similar pattern is formed with 210 tiles. Find the number of rows in this pattern.

**Chapter 7: Rectangular coordinates and graphs**

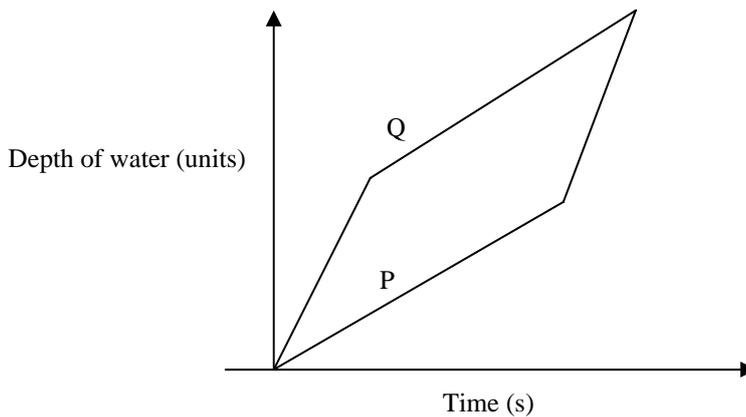
- Explain the  $x$ - and  $y$ - axis of the coordinate plane and the four quadrants
- The ordered pair  $(x, y)$  represents the coordinates of a point, then the first number is called the  $x$ -coordinate and the second number, the  $y$ -coordinate of the point
- Before plotting a graph on graph paper, appropriate scales need to be chosen
- Conversion graphs, distance-time graphs and other straight line graphs can be used to solve problems in practical situations

**Investigation:**

Part 1: Two empty cylindrical containers A and B of diameters 2 units and 1 unit respectively, are to be filled with water from a different tap each. Assume that water flows at the same constant rate from both taps and that the two taps are turned on at the same time.

Draw a graph each for A and B showing how the depth of water in each container varies with time from the moment the taps are turned on.

Part 2: The graphs show two containers P and Q, which are being filled with water under similar conditions. Draw diagrams to indicate possible shapes of P and Q.



**Chapter 8: Graphs of equations**

- Any ordered pair satisfying an equation is represented as a point on the graph of this equation
- If a point lies on a graph, its coordinates satisfy the equation of the graph. If a point does not lie on a graph, its coordinates do not satisfy the equation of the graph
- An equation that can be put in the form  $ax + by + c = 0$ , where  $a, b$  and  $c$  are constants, is a linear equation in two variables
- The graph of a linear equation is a straight line
- An equation of the form  $y = ax^2 + bx + c$ , where  $a, b$  and  $c$  are constants and  $a \neq 0$ , is a quadratic equation in two variables
- The graph of a quadratic equation of the form  $y = ax^2 + bx + c$  is a parabola

- The solution of a pair of simultaneous linear equations is given by the coordinates of the point of intersection of their graphs
- A pair of simultaneous linear equations may have one solution, no solution or an infinite number of solutions

**Investigation:**

For each of the following, use a scale of 1 cm to 1 unit on both axes.

- Plot the graphs of  $y = x^2$ ,  $y = x^2 + 5$  and  $y = x^2 - 3$  for  $-3 \leq x \leq 3$  in the same coordinate plane. Study the equations and their corresponding graphs. What can you say in general about the graph of  $y = x^2 + k$ , where  $k$  is a constant, with reference to the graph of  $y = x^2$ ?
- Plot a few graphs of the form  $y = (x + k)^2$  where  $k$  is a constant. What can you say in general about the graph of  $y = (x + k)^2$  with reference to the graph of  $y = x^2$ ?
- Plot a few graphs of the form  $y = -kx^2$  and  $y = kx^2$  where  $k$  is a constant. What can you say in general about the graph of  $y = -kx^2$  with reference to graph of  $y = kx^2$ ?

*Year 9*

**Chapter 4:** More on quadratic equations and linear inequalities

- A quadratic expression  $x^2 + bx + c$  is a perfect square if the constant term is the square of half

the coefficient of  $x$ , i.e.  $c = \left(\frac{b}{2}\right)^2$ . (Note that the coefficient of  $x^2$  is 1)

- To solve a quadratic equation by completing the square:
  - Check that the coefficient of  $x^2$  is 1. If it is not 1, divide the equation by the coefficient of  $x^2$
  - Rewrite the equation with the  $x^2$  and  $x$  terms on the LHS and the constant term on the RHS
  - Complete the square on the LHS by adding an appropriate constant to both sides of the

equations

- Take the square root of both sides

- The formula for solving the quadratic equation  $ax^2 + bx + c = 0$ , where  $a \neq 0$ , is

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- To solve a pair of linear inequalities:
  - First find the solution of each inequality
  - The use the number line to find the solution of the two inequalities

**Investigation:**

$p$  and  $q$  are the two roots of quadratic equation  $ax^2 + bx + c = 0$ , where  $a \neq 0$ . Express  $p + q$  and  $pq$  in terms of  $a$ ,  $b$  and  $c$ .

**Chapter 5:** More on algebraic fractions and fractional equations

- As for the year 8 (Form 2) summary

**Investigation:**

Yaming did the following sums this way:

$$\frac{-4}{2} + \frac{9}{3} = \frac{-4+9}{2+3} = \frac{5}{5} = 1$$

$$\frac{4}{2} + \frac{(-16)}{4} = \frac{4-16}{2+4} = \frac{-12}{6} = -2$$

$$\frac{36}{6} + \frac{(-25)}{5} = \frac{36-25}{6+5} = \frac{11}{11} = 1$$

$$\frac{-49}{7} + \frac{25}{5} = \frac{-49+25}{7+5} = \frac{-24}{12} = -2$$

Thus, he claims that  $\frac{a}{b} + \frac{c}{d} = \frac{a+c}{b+d}$ . The claim he made is definitely incorrect but why are his answers all correct?

### Chapter 9: Further graphs of equations

- Gradient of a curve at a point is given by the gradient of the tangent to the curve at that point
- Graphs of equations:  $y = x^3$ ,  $y = 1/x$ ,  $y = 1/x^2$

#### Investigation:

Answer questions I, II and III on a sheet of graph paper each. Use scales of 1 cm to 1 unit on the x-axis and 1 cm to 5 units on the y-axis

(I) Draw a few graphs of the form  $y = x^3 + k$  where  $k$  is a constant

What can you conclude about the graph of the form  $y = x^3 + k$  with reference to the graph of  $y = x^3$ ?

(II) Draw a few graphs of the form  $y = (x + k)^3$  where  $k$  is a constant

What can you conclude about the graph of the form  $y = (x + k)^3$  with reference to the graph of  $y = x^3$ ?

(III) (a) Draw a few graphs of the form  $y = kx^3$  where  $k$  is a constant

(b) Using the same values as in part (a) for  $k$ , draw graphs of the form  $y = -kx^3$

Compare the graph of  $y = kx^3$  with the graph of  $y = -kx^3$  for each value of  $k$ .

### Chapter 10: Variation

- Direct variation: if  $y$  varies directly as  $x$ , then  $y = kx$  where  $k$  is a constant
- Inverse variation: if  $y$  varies inversely as  $x$ , then  $y = k/x$  where  $k$  is a constant

#### Investigation:

If  $y = k/x$ ,  $y$  varies inversely as  $x$ . The following diagram shows part of the graph of  $y = 10/x$ .

AOBC is a rectangle with three vertices on the axes and one vertex on the curve. What is area of AOBC? What is the area of any rectangle with three vertices on the axes and one vertex on the curve?

For the graph of  $y = n/x$  where  $n$  is a positive number, that is the area of each rectangle with three vertices on the axes and one vertex on the curve?

## Singapore Schools

### Year 7

#### Chapter 7: Basic Algebra

- Use letters to represent numbers;
- Express basic arithmetical processes algebraically;
- Substitute numbers for letters in formulae and expressions;
- Manipulate simple algebraic expressions.

The content introduced and explained the terms polynomials, variables, coefficients and constant terms. A list of 4 problem-solving questions was added. Below is an example;

Q2 The average salary of  $m$  male employees and  $f$  female employees of a company is \$A. If the average salary of the male employees is \$B, find an expression for the average salary of the female employees.

1. Anecdotes / Notes: 7
2. Investigations: 0

#### Chapter 8: Algebraic Equations

- Solve simple algebraic equations
- Construct simple linear equations from given situations and solve these problems.

The content also includes fractional and decimal coefficients, formulae and algebraic expressions. There are 5 questions on additional problem solving list. Below is an example;

Q4 At a fast-food restaurant, for every three people who ordered a cheeseburger, there are five people who ordered an apple pie. The number of people who ordered the cheeseburger is 5 more than the people who ordered the apple pie. If the total number of people who ordered food is 1678, how many people ordered apple pie?

1. Anecdotes / Notes: 11
2. Investigations: 0

## Year 8

### Chapter 5: Expansion and factorization of algebraic expressions

- Expands products of simple algebraic expressions
- Factorise algebraic expressions

The content illustrated the distributive property of algebraic expressions geometrically leading to  $(a+b)^2$ ,  $(a-b)^2$  and  $(a+b)(a-b)$ . The various factorization techniques are introduced. Three questions with many smaller parts are included on the problem-solving list to consolidate learning. Below is an example;

Q1 Simplify  $(a - b + c)^2 - (b - c + a)^2$

1. Anecdotes / Notes: 8
2. Investigations: 3

Below is an investigation problem;

You can find out the age of your friend without being told by asking your friend to carry out the following instructions in the given order: 1. Write down your age 2. Add 5 to it 3. Double the result 4. Add 10 to it

5. Multiply the result by 5 6. Subtract 100 from it.

Ask your friend to give you the final result and cross out the last digit to obtain your friend's age. Try this mathematical game with different people. Do you always get their age right? If so, can you explain why?

### Chapter 6: Solving quadratic equations by factorization

- Solve quadratic equations by factorization
- Solve problems involving quadratic equations

The content included division of polynomials which is optional in the Singapore syllabus. There are 6 questions on the problem-solving list. Below is an example;

Q2 Given that  $(a + b)^2 = 24$  and  $ab = 3$ , find the value of  $(2a - 2b)^2$ .

1. Anecdotes / Notes: 5
2. Investigations: 2

### Chapter 7: Algebraic manipulation and formulae

- Manipulate algebraic fractions;
- Solve equations involving algebraic fractions;
- Transform simple formulae

The content includes the 4 basic operations as well as the LCM and HCF of the algebraic expressions. It also include changing the subject of a formula. There are 5 questions on the problem solving list. Below is an example;

Q4 The square of  $x$  is equal to the square root of  $y$ . Express  $y$  in terms of  $x$ .

1. Anecdotes / Notes: 13
2. Investigations: 1

Within four consecutive years, Mrs Li gave birth to four lovely children. Today,  $x$  years later, Mr. And Mrs Li find out that the product of their four children's ages is 3 024. How old is each child now, assuming all of them are of different ages?

### Chapter 8: Simultaneous linear equations

- Solve a pair of simultaneous linear equations by (a) elimination, (b) substitution;
- Apply the technique to solve some practical problems like the one mentioned below.

There are 3 questions on problem solving, with Q1 consists of 6 sub-questions to consolidate skills in solving simultaneous equations. Below is an example;

Q1 (d)  $2^x x 32^y = 2^{13}$ ,  
 $8^x x 2^{2y} = 1$

1. Anecdotes / Notes: 6
2. Investigations: 2

(Below is one of the investigation problems)

Consider the following simultaneous equations:

$$2x + y = 6 \dots (1)$$

$$x = 1 - \frac{1}{2}y \dots (2)$$

Substitute(2)in(1);

$$2\left(1 - \frac{1}{2}y\right) + y = 6$$

$$2 - y + y = 6$$

$$\therefore 2 = 6!$$

Do you know where the problem lies?

### Chapter 9: Linear graphs and their applications

- Plot coordinate points on a graph;
- Plot straight line graphs;
- Solve simultaneous linear equations graphically;
- Interpret and use graphs in practical situations;
- Draw graphs using data from practical situations

Conversion graphs and travel graphs are part of the practical application of graphs. The worked example includes strategies for problem solving using equation and graphical method. There are 5 and 4 questions included in the problem-solving and exploration list respectively. Below is an example;

(From the problem-solving list)

Q5 Towns A and B are 220 km apart. A bus leaves Town A at 08 30 for Town B at a speed of 30 Km/h. It arrives at Town B after stopping for 40 minutes at Town C which is 120 km from Town A. A motorist starts from Town B at 09 00 and travels towards Town A at a speed of 40 km/h. Find graphically when and at what distance from Town A they will meet.

(From the exploration list)

Q3 The monthly cost of running a kindergarten consists of a fixed amount and a variable amount which depends on the number of children attending the kindergarten classes. It costs \$3 750 to run classes for 50 children and \$4 500 to run classes for 80 children. Find graphically the fixed cost for running the kindergarten and the cost per child.

1. Anecdotes / Notes: 10
2. Investigations: 0

### Chapter 10: Graphs of quadratic functions

- Plot quadratic graphs;
- Solve quadratic equations graphically.

The range of the quadratic graph is included in the content. 2 questions are included in the problem-solving list.

Q2 Draw the graphs of  $y = -x^2$  and  $y = 2x - 3$  on the same axes, taking 2 m to represent 1 unit on the x – axis and 1 cm to represent 1 unit on the y – axis, for  $-5 \leq x \leq 3$ .

Use your graphs to find  $4.8^2$  and  $\sqrt{6}$ .

Write down the values of x at the points of intersection of the two graphs and find the equation for which these values of x are the solution.

1. Anecdotes / Notes: 2
2. Investigations: 1

Mr. Lin wants to pour 12 litres of water equally into two containers. However, he has only two measuring cans of capacity 9 litres and 5 litres with him. How is he to obtain the two equal amounts of water accurately by using the measuring cans?

### Year 9

#### Chapter 1: Solutions to quadratic equations

- Quadratic equations by factorization;
- Quadratic equations by using completing the square" method;
- Quadratic equations by using formulae;
- Problems that can be reduced to quadratic equations

The term discriminant and its implication on the roots is discussed. The significance of the coefficient of  $x^2$  on the shape of the graphs (maximum or minimum curve) is also explained. There are 10 exploration questions. Below is one such question;

Q6 The line  $y = 2x + k$  is a tangent to the curve  $x^2 + y^2 = 5$ . Find the possible values of  $k$  (hint: the tangent meets the curve at a point)

1. Anecdotes / Notes: 20
2. Investigations: 0

#### Chapter 2: Indices and algebraic manipulation

- About the laws of indices;
- To manipulate formulae;
- How to simplify algebraic expressions
- To solve equations involving algebraic expressions

There are 12 problem-solving questions. Below are some examples;

Q10 Given that today is Sunday, what day of the week will it be  $14^{101}$  days from today?

Q14 If  $10^x = 3$ , find the value of  $10^{2x+1}$

1. Anecdotes / Notes: 19
2. Investigations: 0

#### Chapter 3: Linear inequalities

- Simple laws of linear inequalities;
- Simple methods for solving linear inequalities.

The content also differentiates between  $\leq$  and  $<$  and the use of circle-dot and circle to indicate the range on the number line. The questions are mainly those of linear inequalities in one variable. There are 10 problem-solving questions. Below are two such questions;

Q4  $|2x - 7| \leq 3$

Q6 Find the range of values of  $x$  for which  $\frac{3x-5}{(x-7)^2} > 0, x \neq 7$

1. Anecdotes / Notes: 10
2. Investigations: 1

Find the number of points,  $(x, y)$ , where  $x$  and  $y$  are positive integers lying on the line  $3x + 4y = 29$

#### Chapter 7: Variations

- Write an equation connecting the two quantities involved in a variation;
- Solve problems involving simple direct and inverse variation.

There are 5 exploration problems. Below is an example;

Q4 A developer estimates that he needs 96 men to build a house in 14 days. If he is asked to complete the building in 12 days, how many more men must he hire, assuming that the men work at the same rate?

1. Anecdotes / Notes: 9
2. Investigations: 0

**Chapter 8:** Graphical solution of equations

- Solve simultaneous linear equations graphically;
- Solve quadratic, cubic, hyperbolic and exponential equations graphically.

Some of the review questions included have practical applications. Below is part (a) of one such questions;

Q12 A stone is thrown from the top of a vertical cliff. Its position during its flight is represented by the equation

$$y = 56 + 10x - x^2, \text{ where } y \text{ metres is the height of the stone above the sea and } x \text{ metres is its horizontal distance from the cliff.}$$

- (a) (i) Solve the equation  $0 = 56 + 10x - x^2$ .  
(ii) Explain briefly what the positive solution of this equation represents.

There are 2 exploration questions. Below is one of the questions;

Q1 Draw the graphs of the equations  $y = \sin 2x$  and  $y = \cos x$  for  $0^\circ \leq x \leq 90^\circ$ . Hence, find the solution of the equation  $\sin 2x = \cos x$  in this range.

1. Anecdotes / Notes: 23
2. Investigations: 0

**Chapter 9:** Further graphs and graphs applied to kinematics

- Draw distance-time and speed time graphs;
- Solve problems involving distance-time and speed-time graphs;
- Find the distance covered by a particle using the speed-time graph.

The content discussed the significance of the gradient of a distance-time graph and the speed-time graph, as well as the area under the speed-time graphs. There are 5 problem-solving questions. Below is an example;

Q2 A particle is projected vertically upwards from the ground with a speed of 80 m/s. Sketch the speed-time graph and find the total time of flight. (Take the acceleration due to gravity to be  $10 \text{ m/s}^2$ .)

1. Anecdotes / Notes: 9
2. Investigations: 0

China Shanghai Schools

*Year 7*

**Chapter 1:** Linear equations in one variable

- Solving strategies clearly tabulated
- Modulus equations  $|x| = a$  ( $a > 0$ )
- Application of linear eqn in one variable in word problems including interest calculations

**Chapter 2:** System of linear eqns in 2 variables:

- Linear eqns in 2 variables & the solutions
- Position & coordinates of points in a plane
- Graphical representation of linear eqns in 2 variables
- Systems of linear eqns in 2 variables :
- Solving linear eqns in 2 variables
- Graphical solutions to linear eqns in 2 variables
- System of linear eqns in 3 variables
- Application of systems of linear eqns
- Anecdote: ancient arithmetics

**Chapter 3: Linear inequality in one variable**

- Inequality & the properties
- Inequality and the representation using dot, circle and lines
- Properties of inequality
- Solution set to inequality
- Linear inequality in one variables
- Solution set
- System of linear inequalities in one variable
- Solving system of linear inequalities in one variable

$$4 - 2(2x - 1) \geq x - 3(1 - x)$$

Exercise: solve  $\frac{x}{4} - \frac{2x-1}{3} < \frac{1}{2} - \frac{x}{6}$

**Chapter 6: Multiplication & division of polynomials :**

- Multiplication and division of mono-nomials: illustrate with worked examples
- Multiplication and division of indices with same base, x of powers of index, x of powers of products: : derive indices rules
- Multiplication and division of monomials and polynomials: derive rules
- Multiplication of polynomial expressions
- Formula of product of binomial expression: using the area of rectangle for illustration leading to multiplication of binomial expressions and a quadratic expression:  $(a + b)(a^2 - ab + b^2) = a^3 + b^3$ ;  
 $(a - b)(a^2 + ab + b^2) = a^3 - b^3$
- Division of polynomials by a polynomial
- Binomial theorem
- Anecdote

**Chapter 7: Factorisation of polynomials**

- Common factor method
- Common group method
- Formula method: using the expansion of terms by formulae to look for same terms for factorisation
- Cross factorization method: for trinomial expressions
- Simple application of Binomial theorem (remainder theorem) as for finding a divisor in the factorization process,

**Chapter 8: Algebraic fractional expressions**

- Definition & property of fraction expressions
- Definition of fraction expression
- Indices with integer as power
- Basic property of fraction expressions
- Multiplication and division of fraction expressions
- Multiplying powers of fraction expressions

$$\frac{x^{-1} - y^{-1}}{x^{-1} + y^{-1}}$$

- Complex fraction: e.g.:

$$\frac{xy^{-1}}{x^{-1}y - xy^{-1}}$$

*Year 8***Chapter 3: Directly & indirectly proportional functions**

- Ratio: the meaning & property of ratio, the rule of ratio: explain the terminology and illustrate with worked examples.
- Directly & inversely proportional function, graphical representation & properties: The graphical illustrations involved linear and non-linear proportionalities for both types of function.
- Function, representation of a function: explain “function”

**Chapter 5:** Linear functions

- Linear functions
- Graphical representation & property of linear functions: translation of graphs and its implication in writing the equation; positive and negative gradients.

**Chapter 6:** Quadratic eqns with 1 unknown & quadratic functions

- Quadratic eqns with 1 unknown, solution, (using completing the square, formulae, etc)
- Determine the roots of quad eqns with 1 unknown
- Relationship between roots & coefficient of quad equations
- Quadratic functions (continuous and otherwise) and the solutions (including graphical solutions)
- Graphical representation & properties of quadratic functions, graphs analysis,

Piecewise functions

*Year 9*

**Chapter 1:** Application of quadratic equations

- Examples using quadratic eqn to solve word problems, illustrated with worked examples
- Factorisations of quadratic trinomials
- Fractional equations & irrational equations
- Fractional equations
- Anecdote: golden section & Fibonacci number
- Irrational equations
- Simple expressions with power greater than 2
- System of quadratic equations in two variables

Example: solve 
$$\begin{cases} 6x^2 - 5xy + y^2 = 0 \\ x^2 + xy + y^2 = 7 \end{cases}$$

## **Appendix D: Questionnaire for Teacher Interview**

(All information will be confidential as outlined in the university code of practice for the research.)

### **Teacher's background**

Level undertaken: \_\_\_\_\_ Age: \_\_\_\_\_ Sex: \_\_\_\_\_

Qualifications: \_\_\_\_\_ Number of years in teaching: \_\_\_\_\_

Position in present school: \_\_\_\_\_

Present duties and responsibilities:

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Commonly used mathematics-teaching tools/technique:

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### **Teacher's view on the textbooks content**

(Comment on the following statements)

- Text content is well presented and easy to use

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- Every chapter contains interesting anecdotes to illustrate the topic

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- Content width and depth is adequate and appropriate to the specified level

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- Content width and depth is adequate and appropriate to the specified learning duration

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- Worked examples are interesting and adequate for the topic introduced

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- Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging

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- Exercises cover problems of varying degrees of difficulties ranging from easy to challenging

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- Revision exercises help consolidation of the lessons

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- Any other comments

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**Teacher's view on the textbook as a teaching tool**

(Short answers)

- Do you rely totally on the textbook for your lesson?

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- Do you follow the topic sequence at given in the textbook? If not, please state the variation.

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- Do you select only certain problems from the exercise in the text as classwork or homework?

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- In general, how many problems are given from the exercise?

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- In your opinion, which topic/s is/are presented exceptionally well in the textbook?

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- Are there any exemplary examples / exercises in the textbook? If yes, please list them.

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- Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?

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- Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?

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- Do you have enough curriculum time to complete the text content?

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- Any other comments

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**Teacher's view on the textbook as a learning tool**

(Comment on the following statements)

- An average student is able to do most of the problems given in the text.

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- An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.

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- There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.

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- Students find some of the topics rather difficult. Please list the topics / strands.

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- Any other comments

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**Teacher's comment on international students / migrant children joining the class**

(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)

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***Your effort is highly appreciated. All information will be kept confidential.***

***Thank you very much for participating in this textbook study.***

## Appendix DA: PLC7's interview transcript

In this interview transcript of PLC7 the bold print is the question and the ordinary print is the teacher's response.

### Teacher's background

- **Present duties and responsibilities:**

Teach at years 7 & 11; Plan and coordinate the year 7 program and lead the year 7 team of teachers; coordinate math week; convenor senior math committee

- **Commonly used mathematics-teaching tools/technique:**

Textbooks; worksheets; games; puzzles; math relays; PEEL activities; stories; calculators; computers; groups; pairs; students as teachers.

### Teacher's view on the textbooks content

(Comment on the following statements)

- **Text content is well presented and easy to use**

Very well presented. Concepts are presented clearly, with all examples worked fully and supporting written explanations, included where necessary.

- **Every chapter contains interesting anecdotes to illustrate the topic**

This text uses an historical and a contemporary statement to illustrate the focus of the chapter and this falls at the beginning of each chapter.

- **Content width and depth is adequate and appropriate to the specified level**

Most adequately.

- **Content width and depth is adequate and appropriate to the specified learning duration**

In our learning duration of 50 minutes, again most adequately.

- **Worked examples are interesting and adequate for the topic introduced**

Very much so. (mentioned earlier)

- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**

Where necessary, yes they do; example: Adding fractions uses ex:

$$\frac{1}{7} + \frac{3}{7} \quad ; \quad \frac{5}{9} + \frac{7}{9} \quad ; \quad 2\frac{1}{8} + 1\frac{3}{8} \quad ; \quad \frac{1}{4} + \frac{2}{3} \quad ; \quad 2\frac{4}{5} + 3\frac{5}{7}$$

- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**

Yes, as appropriate for year 7 level.

- **Revision exercises help consolidation of the lessons**

Very adequate set of Revision Questions at the end of each chapter.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

Never!

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

No – Our year 7 course runs as follows: Ch. 1; Some of Ch. 10; Ch. 2; Ch. 3; Ch. 11; Ch. 12; Ch. 8; Ch. 4; SETS (not in text), Ch. 4; Ch. 5, 6, 7; Ch. 13; Ch. 10; Ch. 14.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Most definitely - always a thoughtful selection are chosen to cover the width and depth of any exercise.

- **In general, how many problems are given from the exercise?**

Across topics, this can vary immensely. For each exercise, somewhere between 25% to 90%, dependent on groups need, knowledge of and ability with the particular exercise focus.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

I am very happy with all topics which are presented in this textbook and further to this, the book has been well received by students.

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

Again, I was very impressed with the textbook when viewing it 2 years ago (only published in 2003) I think the whole text is exemplary.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

It would appear chapter topics are grouped in strands: from Number, Measurement, Space, Algebra, to Chance and Data in that order.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

I prepare additional resources because of my methods of teaching and learning not because of any significant inadequacy of the textbook.

- **Do you have enough curriculum time to complete the text content?**

Some years, yes; some years NO. This can depend on the number of interruptions in any year and the mix of student abilities in any one year.

- **Any other comments**  
(Blank)

**Teacher's view on the textbook as a learning tool**  
(Comment on the following statements)

- **An average student is able to do most of the problems given in the text.**  
Certainly.
- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**  
Generally, they should be able to do so.
- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**  
Mainly Algebra (factorization; solving equations)
- **Students find some of the topics rather difficult. Please list the topics / strands.**  
At year 7, fractions can still cause problems.
- **Any other comments**  
(Blank)

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

My experience has been that whilst students may have trouble reading, writing and /or speaking the English language – if a concept is demonstrated well, mathematical ideas and processes can be communicated without language; mathematics seems to transcend language barriers.

## **Appendix DB: PLC8's interview transcript**

In this interview transcript of PLC8 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**  
Teach at years 8, 9, 10 & 12; Provide technology support to mathematics, Religious Education.
- **Commonly used mathematics-teaching tools/technique:**  
Chalk & talk. Technology based (calculator & computer). Discovery lessons. Minor project work.

### **Teacher's view on the textbooks content** **(Comment on the following statements)**

- **Text content is well presented and easy to use**  
Clear, good page contrast and good font size.
- **Every chapter contains interesting anecdotes to illustrate the topic**  
Presentation is the "driest" of many text reviewed. Some texts (long since discarded) went overboard in this regard.
- **Content width and depth is adequate and appropriate to the specified level**  
The current text is the best for our syllabus, available in this state.
- **Content width and depth is adequate and appropriate to the specified learning duration**  
Best width and depth – exercises well graded.
- **Worked examples are interesting and adequate for the topic introduced**  
Simple "dry" presentation with key points highlighted.
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Sometimes examples move too quickly from easy to hard and need supplementing. Range well covered.
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
Exercises well graded CONSISTENTLY!  
(A major weakness of many other texts – inconsistent grading of exercises)
- **Revision exercises help consolidation of the lessons**

Exercises quite comprehensible in own right. Revision for topic as a whole provided in separate section along with special interest material.

- **Any other comments**

For many years we put up with “The least worst” text available, but our current text, while not totally comprehensible, does the best we’ve seen in a long time!

**Teacher’s view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

Yes as a style of example. No extra examples/work provided by me.

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

NO We follow our own syllabus which has us jumping around the text quite a bit.  
Chapter order: 2, 5, 11, 10, 3, 4, 7, 12, 8, 9, 12, 5, 7, 13, 9, 14

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Where I think particular problems are better than others I will specify them. Otherwise I will set “any number” from an exercise or part thereof and allow students to choose which one. There usually encompass  $\frac{1}{4} - \frac{1}{3}$  of the whole exercise.

- **In general, how many problems are given from the exercise?**

It depends on the topic. In Algebra or Number quite a few, in Geometry only a small number. In a class 10 – 20.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

Basic Numerical, Algebraic and Geometric concepts

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

(Blank)

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Ratio, 3D Geometry, Factors, Significant Figures.

- **Do you have enough curriculum time to complete the text content?**

We don’t use the full text, and teach from outside it. There’s never enough time to complete a syllabus!!

- **Any other comments**

Many new texts are pitched to lower ability groups than our students, and finding a suitable text has been hard.

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

The language is sometimes difficult for ESL students, and some notation seems "archaic" but good intentions prevail.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

The later years are getting harder as the Algebra work is being shifted there. Generally yes, but work is always required.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

Since we all teach a variety of levels, we are mostly aware of the higher requirement, and interesting debates continue as to how best meet them.

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Algebra, Factors, 3D geometry, Indices

- **Any other comments**

The textbook is a useful resource but is not slavishly adhered to. The order of the chapters and often content within chapters is often not in the text order.

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

We have high achieving / striving students – many from ESL / ESL – like backgrounds. We like to strongly ground the fundamentals in the early secondary years before moving "out" higher up. Consequently many new arrivals have a lot of catching up to do, even if they have covered some material previously.

## **Appendix DC: PLC9's interview transcript**

In this interview transcript of PLC9 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**  
Teach at years 8, 9, 10 & 12; Provide technology support to mathematics, Religious Education.
- **Commonly used mathematics-teaching tools/technique:**  
Chalk & talk. Technology based (calculator & computer) in discovery lessons. Minor project work.

### **Teacher's view on the textbooks content** (Comment on the following statements)

- **Text content is well presented and easy to use**  
Clear good page layout, but font size a little small for my liking.
- **Every chapter contains interesting anecdotes to illustrate the topic**  
Presentation quite "dry" and straightforward.
- **Content width and depth is adequate and appropriate to the specified level**  
The current text is the best for our syllabus available in this state.
- **Content width and depth is adequate and appropriate to the specified learning duration**  
Yes!
- **Worked examples are interesting and adequate for the topic introduced**  
Straightforward examples, but need supplementing to reinforce key points.
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Good grading!
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
CONSISTENTLY well graded – better than other texts, and far more available!
- **Revision exercises help consolidation of the lessons**  
Exercises comprehensible in own right. Revision for topic as a whole provided in separate section.
- **Any other comments**

As a bare text for our syllabus, this text takes a lot of beating. No serious challenges encountered for a while.

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

• **Do you rely totally on the textbook for your lesson?**

Yes for style of example as lead to exercises. No extra examples/work provided as required.

• **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

No, we follow our own syllabus.

Chapter order: 2, 3, 4, 6, 4, 12, 14, 7, 7, 10, 9, 9, 15, 4, 6, 13, 16.

• **Do you select only certain problems from the exercise in the text as classwork or homework?**

Specific problems are chosen when they are the best. Otherwise students choose their own from a range set by me. There usually encompass  $\frac{1}{4} - \frac{1}{3}$  of the whole exercise.

• **In general, how many problems are given from the exercise?**

Topic dependent. Algebra, Measurement – a lot. Geometry, simultaneous equation on a smaller number. In a class 6 – 20.

• **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

Linear graphs, quadratic and other factors.

• **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

(Blank)

• **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No.

• **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Simultaneous equation – due to the way I teach this topic.

Sketching and plotting the parameters - due to the way I teach this topic.

Statistics \_ we prefer a different way but can use many of the exercises.

• **Do you have enough curriculum time to complete the text content?**

Don't plan to! Never enough time to teach our syllabus!!

• **Any other comments**

This text has been around in its current form for quite a while, and we believe has no peers. We incorporate more technology ideas from newer texts into our use of this text.

**Teacher's view on the textbook as a learning tool**  
(Comment on the following statements)

- **An average student is able to do most of the problems given in the text.**  
ESL students have some difficulties, particularly with some of the older jargon.
- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**  
Yes.
- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

We all teach a wide variety of secondary level, the debate is ongoing!

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Factorisation, Indices, Simultaneous equation

- **Any other comments**

The text is the guide and is supplemented from many sources in small / large ways. No single competitor could replace it yet.

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

ESL students have difficulties particularly with the jargon of mathematics. Students from other schools often lack the Algebra skills we expect. Some students are "ahead" when they start but need to fill their gaps as they go.

## **Appendix DD: BGS7's interview transcript**

In this interview transcript of BGS7 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**

- |   |                                  |   |                                   |
|---|----------------------------------|---|-----------------------------------|
| 1 | Checking teacher's attendance;   | 2 | Students' Welfare committee       |
| 3 | Staff Welfare committee          | 4 | School health promotion committee |
| 5 | Teacher-in-charge of girl guides |   |                                   |

- **Commonly used mathematics-teaching tools/technique:**

Yes

### **Teacher's view on the textbooks content**

(Comment on the following statements)

- **Text content is well presented and easy to use**

Yes. But some subtopics have few examples. Need to put in more.

- **Every chapter contains interesting anecdotes to illustrate the topic**

Yes.

- **Content width and depth is adequate and appropriate to the specified level**

Yes.

- **Content width and depth is adequate and appropriate to the specified learning duration**

Not all.

- **Worked examples are interesting and adequate for the topic introduced**

Not all.

- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**

Only on some topics. Make students very confused especially class of 1E and 1F

- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**

Yes, so that student could apply the problems.

- **Revision exercises help consolidation of the lessons**

It worked very well

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

Not really.

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

Yes.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

From 6 – 10 problems.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

From whole number to decimals (which they had learned from primary school).

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

Not sure.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

Not sure.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes, starting from Algebra.

- **Do you have enough curriculum time to complete the text content?**

No.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Ratio: 70% - 30%.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Yes, if with hardworking and understanding the contents.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

Yes, recalling.

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Yes. Algebra, geometry, polygons and volume.

- **Any other comments**

(Blank)

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

(Blank)

## **Appendix DE: BGS7's interview transcript**

In this interview transcript of BGS7 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**
  - 1 Co-form teacher of 1C2, 3G;
  - 2 Assistant Teacher-in-charge of textbooks;
  - 3 House-mistress,
  - 4 Checking absentee file
  
- **Commonly used mathematics-teaching tools/technique:**  
Classroom teaching

### **Teacher's view on the textbooks content** (Comment on the following statements)

- **Text content is well presented and easy to use**  
Yes.
  
- **Every chapter contains interesting anecdotes to illustrate the topic**  
Yes.
  
- **Content width and depth is adequate and appropriate to the specified level**  
Agree.
  
- **Content width and depth is adequate and appropriate to the specified learning duration**  
Agree.
  
- **Worked examples are interesting and adequate for the topic introduced**  
Agree.
  
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Agree.
  
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
Yes.
  
- **Revision exercises help consolidation of the lessons**  
Yes.
  
- **Any other comments**  
(Blank)

**Teacher's view on the textbook as a teaching tool**  
**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No.

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

No. Refer to the scheme of work provided by curricular department.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

Good and above average students do all the exercises. Weaker students do less.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

Pythagoras Theorem

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

No.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes, most of them.

- **Do you have enough curriculum time to complete the text content?**

Yes.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**  
**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Agree.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Agree.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

(Blank)

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Integer, mensuration, trigonometry, algebraic expression, transformation.

- **Any other comments**

(Blank)

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

N. A.

## **Appendix DF: BGS8's interview transcript**

In this interview transcript of BGS8 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**
  - 1 Class teacher;
  - 2 Staff Welfare committee;
  - 3 Teacher in charge for police cadet, tanan kebudayaan & baling.
  
- **Commonly used mathematics-teaching tools/technique:**  
Notes , quiz, games

### **Teacher's view on the textbooks content** (Comment on the following statements)

- **Text content is well presented and easy to use**  
Yes, very helpful and students easy to understand.
  
- **Every chapter contains interesting anecdotes to illustrate the topic**  
Yes.
  
- **Content width and depth is adequate and appropriate to the specified level**  
Yes.
  
- **Content width and depth is adequate and appropriate to the specified learning duration**  
Yes.
  
- **Worked examples are interesting and adequate for the topic introduced**  
Yes, but not adequate for some topics.
  
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Yes.
  
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
Yes.
  
- **Revision exercises help consolidation of the lessons**  
Yes.
  
- **Any other comments**  
(Blank)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

Not totally. Used other resources too.

- **Do you follow the topic sequence as given in the textbook? If not, please state the variation.**

I follow the scheme of work given, which some topics are not in sequence as in the textbook.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

No, I select all for classwork. But for homework, I select certain problems only.

- **In general, how many problems are given from the exercise?**

(Blank)

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

Mostly all topics

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

(Blank)

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

(Blank)

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes to most of the topics.

- **Do you have enough curriculum time to complete the text content?**

Yes.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Yes.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Depends if they remember the basic.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

(Blank)

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Algebra; Volume; Rate, Ratio and Proportion.

- **Any other comments**

(Blank)

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

It depends on the students themselves, whether they come from the town school or the rural school.

## **Appendix DG: BGS8's interview transcript**

In this interview transcript of BGS8 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**  
Mathematics teacher;
- **Commonly used mathematics-teaching tools/technique:**  
Chalk & talk.

### **Teacher's view on the textbooks content** (Comment on the following statements)

- **Text content is well presented and easy to use**  
Not all text can be used for teaching. Few of the contents are too advance to students.
- **Every chapter contains interesting anecdotes to illustrate the topic**  
(Blank)
- **Content width and depth is adequate and appropriate to the specified level**  
(Blank)
- **Content width and depth is adequate and appropriate to the specified learning duration**  
(Blank)
- **Worked examples are interesting and adequate for the topic introduced**  
(Blank)
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Depends on the textbook we are looking for.
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
Yes.
- **Revision exercises help consolidation of the lessons**  
(Blank)
- **Any other comments**  
(Blank)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

Yes.

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

No. The lesson follow the scheme of work given.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

Depends; minimum 5 for homework and minimum 15 for classwork.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

(Blank)

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

No.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

Not sure.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

No.

- **Do you have enough curriculum time to complete the text content?**

Yes.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Only a few of the students are able to do most of the problems

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Students tend to forget what they have learned in the previous lesson.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

(Blank)

- **Students find some of the topics rather difficult. Please list the topics / strands.**

(Blank)

- **Any other comments**

(Blank)

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

Never experience.

## **Appendix DH: BGS9's interview transcript**

In this interview transcript of BGS9 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**

Class teacher, math teacher; Website committee  
School environment and cleanliness committee; Checking teacher's attendance (relief)  
KKC committee; Synergy project committee Teacher on block duties

- **Commonly used mathematics-teaching tools/technique:**

Mind capturing, brainstorming, relate to everyday examples.

### **Teacher's view on the textbooks content**

**(Comment on the following statements)**

- **Text content is well presented and easy to use**

OK.

- **Every chapter contains interesting anecdotes to illustrate the topic**

Not really.

- **Content width and depth is adequate and appropriate to the specified level**

Only certain chapters.

- **Content width and depth is adequate and appropriate to the specified learning duration**

No.

- **Worked examples are interesting and adequate for the topic introduced**

Sometimes only.

- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**

Too general.

- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**

I agree.

- **Revision exercises help consolidation of the lessons**

Not really.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No. Extract questions from PMB past year papers.

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

No. Follow the syllabus.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

About 3 – 4 questions.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

(Blank)

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

No.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes.

- **Do you have enough curriculum time to complete the text content?**

I don't think so (since I am new).

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

No.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

No.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

(Blank)

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Rate, ratio and proportion in Sec. Maths 2A textbook, Pg 26 – 30 (especially example 8.2 and 8.3)

- **Any other comments**

The questions on the textbook should be designed similar to the (PMB syllabus).

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

(Blank)

## **Appendix DI: BGS9's interview transcript**

In this interview transcript of BGS9 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**  
Teaching Form 3 (Level 1) mathematics.
- **Commonly used mathematics-teaching tools/technique:**  
Chalk, models, straws, assessment books.

### **Teacher's view on the textbooks content** (Comment on the following statements)

- **Text content is well presented and easy to use**  
Yes.
- **Every chapter contains interesting anecdotes to illustrate the topic**  
Not all chapters.
- **Content width and depth is adequate and appropriate to the specified level**  
Yes, for most of the chapter.
- **Content width and depth is adequate and appropriate to the specified learning duration**  
Yes.
- **Worked examples are interesting and adequate for the topic introduced**  
Some examples are not as interesting as others.
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Yes for most of the topics.
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
Not all.
- **Revision exercises help consolidation of the lessons**  
No revision exercises given in the textbook used.
- **Any other comments**  
(Blank)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No.

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

No. We used the syllabus given and change the sequence of the topics. We do transformation before properties of circle.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

Depends on the class.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

Unit 1 of 3A

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

(Blank)

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

(Blank)

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes. Unit II Book 3B Transformations.

- **Do you have enough curriculum time to complete the text content?**

Yes.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Yes.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Yes.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

1 Estimate, rounding off

2 Use of scientific calculator

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Fraction, directed numbers, circle

- **Any other comments**

(Blank)

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

(Blank)

## **Appendix DJ: BPS7's interview transcript**

In this interview transcript of BGS7 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**

Mathematics teacher;  
Staff development coordinator.

- **Commonly used mathematics-teaching tools/technique:**

Tools: manipulative materials, calculators / computer (when appropriate), OHP, textbooks, workbooks, worksheets.  
Techniques: Cooperative work, Discussion, Questioning and making conjectures, problem solving approach.

### **Teacher's view on the textbooks content**

**(Comment on the following statements)**

- **Text content is well presented and easy to use**

Content is presented in a non-threatening, familiar format. Topics are sequenced in much the same way that they were in the texts used in the primary level.

- **Every chapter contains interesting anecdotes to illustrate the topic**

No notes / anecdotes, historical or otherwise, are provided to give the topics context or real life relevance. Introductory activities (provided in the accompanying workbooks) are offered but the majority of the activities are too contrived.

- **Content width and depth is adequate and appropriate to the specified level**

Both width and depth of content are inadequate. There is very little difference between this text & texts used in Primary 4 – Primary 5 levels.

- **Content width and depth is adequate and appropriate to the specified learning duration**

With regards to content depth, specific learning duration is way too long. More than 50% of the work only require repeated calculations of the kind students were subjected to throughout the year prior to sitting for their primary leaving exams.

- **Worked examples are interesting and adequate for the topic introduced**

Very few of the worked examples are interesting. Considering the content width & depth of topics introduced (see above comment) the example are fairly adequate.

- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**

Most of the worked examples are fairly easy. Very straightforward solutions / direct application of formulae are needed to solve the illustrated problems.

- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**

In general about 5% or less of given problems are of the challenging kind.

- **Revision exercises help consolidation of the lessons**

Revision exercises fairly well do that – consolidate the lessons (also lacking in depth).

- **Any other comments**

The inclusion of (i) vocabulary lists (“words you need to know”) at the beginning of each unit (topic); (ii) enrichment activity (suggested work for investigation or research); and (iii) summary of salient points in the unit (“do you remember”?) are the best features of the text. More than the repetitive exercises, they help consolidate the lesson (that is, if presented by an able teacher).

**Teacher’s view on the textbook as a teaching tool**  
(Short answers)

- **Do you rely totally on the textbook for your lesson?**

No, I don’t.

- **Do you follow the topic sequence as given in the textbook? If not, please state the variation.**

Yes, I do.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes, I do.

- **In general, how many problems are given from the exercise?**

About 60%.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

No exceptional presentation. Pretty much the ordinary, overly used presentations.

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

None than I can remember.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No mathematics strand is given any emphasis.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes, I use supplementary material for all the topics.

- **Do you have enough curriculum time to complete the text content?**

No, I don't have. But not on account of text content. It's mainly because of student factor.

- **Any other comments**

Text used is nothing but a rehost of Pri 4 – Pri 6 texts. My impression is that the authors were writing from the point of view that Form 1 work is simple straightforward revision of Pri 4 – Pri 6 work. And they may well be right considering the very low standard of teaching & learning going on in the primary levels. However, such treatment only re-enforces among students (esp the average & above average ones) the belief that maths is a boring repetition of endless calculations with no relevance to real life at all.

**Teacher's view on the textbook as a learning tool**  
**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

I agree with this statement, based on content quality wherein the problems are hardly of the challenging sort.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Not so if the teacher were to depend solely on the texts in use. Rote memory learning by the student would allow (the average student) to breeze through lower secondary mathematics course (using this text) but would hardly prepared the student for the critical thinking & problem solving skills needed in the higher level maths.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

Proportional reasoning, multiple representation, generalizations, modeling.

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Number and Operation sense; Fractions, Decimals Percent; Measurement, Spatial sense; Algebraic: Problems solved by linear equations.

- **Any other comments**

Text should be problem-solving oriented, need to emphasise critical thinking and reasoning over rote learning procedural drill, need to decrease emphasis on review of elementary topics such as whole number computation.

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

Most of the migrant children joining the class have better mathematical background even if their mathematical ability is not necessarily stronger. After a certain period of adjustment, they are able to catch up with the class on the content and to adjust to the instructional method.

## **Appendix DK: BPS8's interview transcript**

In this interview transcript of BGS8 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**

Mathematics teacher;  
Staff development coordinator.

- **Commonly used mathematics-teaching tools/technique:**

Tools: manipulative materials, calculators / computer (when appropriate), OHP, textbooks, workbooks, worksheets.  
Techniques: Cooperative work, Discussion, Questioning and making conjectures, problem solving approach.

### **Teacher's view on the textbooks content**

**(Comment on the following statements)**

- **Text content is well presented and easy to use**

Content is presented in a simple straightforward style. However, justification for sequencing is hard to decipher.

- **Every chapter contains interesting anecdotes to illustrate the topic**

No notes / anecdotes, historical or otherwise, are provided to give the topics context or real life relevance. Introductory activities (provided in the accompanying workbooks) are offered but the majority of the activities are too contrived.

- **Content width and depth is adequate and appropriate to the specified level**

For most of the topics, width & depth of content are adequate & appropriate to the specific level.

- **Content width and depth is adequate and appropriate to the specified learning duration**

Some topics (congruency, similarity, symmetry in solids) need longer learning time than specified.

- **Worked examples are interesting and adequate for the topic introduced**

Nearly all the worked examples are the routine type of questions that only require tedious paper and pencil computations

- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**

Worked examples only illustrated problems of average difficulty.

- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**

Too few challenging questions are offered for students to work on. Most problems are the routine, one-step problems aimed at developing skills but out of context.

- **Revision exercises help consolidation of the lessons**

To a limited extent, revision exercises do help to consolidate the lessons. Said exercises are mostly of the genre.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No, I don't.

- **Do you follow the topic sequence as given in the textbook? If not, please state the variation.**

Yes, I do.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes, I do.

- **In general, how many problems are given from the exercise?**

About 60%.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

No exceptional presentation. Pretty much the ordinary, overly used presentations.

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

None than I can remember.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No mathematics strand is given any emphasis.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes, I use supplementary material for all the topics.

- **Do you have enough curriculum time to complete the text content?**

No, I don't have. But not on account of text content. It's mainly because of student factor.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**  
**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**  
An average student is able to do most of the problems since they are mostly the routine, one-step problems wherein they can get-by by memorizing procedures and drilling.
- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**  
Not so if the teacher were to depend solely on the texts in use. Rote memory learning by the student would allow (the average student) to breeze through lower secondary mathematics course (using this text) but would hardly prepared the student for the critical thinking & problem solving skills needed in the higher level maths.
- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**  
Proportional reasoning; multiple representations; generalizations; modeling.
- **Students find some of the topics rather difficult. Please list the topics / strands.**  
Algebra: Indices, problems (solved by / leading to) quadratic equations.  
Geometry: Congruency, similarity
- **Any other comments**  
Text is unsatisfactory with respect to promoting student thinking.

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

Most of the migrant children joining the class have better mathematical background even if their mathematical ability is not necessarily stronger. After a certain period of adjustment, they are able to catch up with the class on the content and to adjust to the instructional method.

## **Appendix DL: BPS9's interview transcript**

In this interview transcript of BGS9 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**

Mathematics teacher;  
Staff development coordinator.

- **Commonly used mathematics-teaching tools/technique:**

Tools: manipulative materials, calculators / computer (when appropriate), OHP, textbooks, workbooks, worksheets.  
Techniques: Cooperative work, Discussion, Questioning and making conjectures, problem solving approach.

### **Teacher's view on the textbooks content**

**(Comment on the following statements)**

- **Text content is well presented and easy to use**

Content is presented in a simple straightforward style. However, justification for sequencing is hard to decipher.

- **Every chapter contains interesting anecdotes to illustrate the topic**

No notes / anecdotes, historical or otherwise, are provided to give the topics context or real life relevance. Introductory activities (provided in the accompanying workbooks) are offered but the majority of the activities are too contrived.

- **Content width and depth is adequate and appropriate to the specified level**

For most of the topics, width & depth of content are adequate & appropriate to the specific level.

- **Content width and depth is adequate and appropriate to the specified learning duration**

Longer learning duration is needed to for the following topics:  
Application of trigonometry; problems leading to algebraic fractions & fractional equations; variation; transformations; grouped data.

- **Worked examples are interesting and adequate for the topic introduced**

Hardly interesting. Examples hardly show relevance of topics to real life situations.

- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**

Worked examples only illustrated problems of average difficulty.

- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**

Too few challenging questions are offered for students to work on. Most problems are the routine, one-step problems aimed at developing skills but out of context.

- **Revision exercises help consolidation of the lessons**

To a limited extent, revision exercises do help to consolidate the lessons. Said exercises are mostly of the genre.

- **Any other comments**

Except for the 1<sup>st</sup> two units (topics), the rest of the topics are presented in isolated segments. (there is no natural flow of concepts learned from one topic to the next)

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No, I don't.

- **Do you follow the topic sequence as given in the textbook? If not, please state the variation.**

Yes, I do.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes, I do.

- **In general, how many problems are given from the exercise?**

About 60%.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

No exceptional presentation. Pretty much the ordinary, overly used presentations.

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

None.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No mathematics strand is given any emphasis.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes, I use supplementary material for all the topics.

- **Do you have enough curriculum time to complete the text content?**

No, I don't have. But not on account of text content. It's mainly because of student factor.

- **Any other comments**  
(Blank)

**Teacher's view on the textbook as a learning tool**  
(Comment on the following statements)

- **An average student is able to do most of the problems given in the text.**  
An average student is able to do most of the problems since they are mostly the routine, one-step problems wherein they can get-by by memorizing procedures and drilling.
- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**  
Not so if the teacher were to depend solely on the texts in use. Rote memory learning by the student would allow (the average student) to breeze through lower secondary mathematics course (using this text) but would hardly prepared the student for the critical thinking & problem solving skills needed in the higher level maths.
- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**  
Proportional reasoning; multiple representations; generalizations; modeling.
- **Students find some of the topics rather difficult. Please list the topics / strands.**  
Algebra.
- **Any other comments**  
As in the 1<sup>st</sup> and 2<sup>nd</sup> text (of the series), emphasis is on rote, drill and practice for basic skill mastery.

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

Most of the migrant children joining the class have better mathematical background even if their mathematical ability is not necessarily stronger. After a certain period of adjustment, they are able to catch up with the class on the content and to adjust to the instructional method.

## **Appendix DM: SRG7's interview transcript**

In this interview transcript of SRG7 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**  
Teaching, monitoring of beginning teachers, developmental supervision of teachers.
- **Commonly used mathematics-teaching tools/technique:**  
Textbook, GSP, Graphmatica, Internet resources.

### **Teacher's view on the textbooks content** (Comment on the following statements)

- **Text content is well presented and easy to use**  
Yes.
- **Every chapter contains interesting anecdotes to illustrate the topic**  
Depends on the type of textbooks, some do, some don't.
- **Content width and depth is adequate and appropriate to the specified level**  
Basic content for core curriculum. Not many challenging questions
- **Content width and depth is adequate and appropriate to the specified learning duration**  
Need to supplement with more challenging questions.
- **Worked examples are interesting and adequate for the topic introduced**  
Boring.
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Not much differentiation.
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
Not really.
- **Revision exercises help consolidation of the lessons**  
OK.
- **Any other comments**  
Nil

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No.

- **Do you follow the topic sequence as given in the textbook? If not, please state the variation.**

No, covers algebra before number patterns so that pupils can generalize patterns observed.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

Plenty for algebra, mensuration and geometry. Number varies according to topics.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

None.

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

None.

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

No.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes, all topics.

- **Do you have enough curriculum time to complete the text content?**

Yes.

- **Any other comments**

Nil

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Yes.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Yes.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

Yes, Algebra, geometry, mensuration.

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Algebra.

- **Any other comments**

Nil.

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

Pupils from PRC (People's Republic of China) find the text too easy.

## **Appendix DN: SRG8's interview transcript**

In this interview transcript of SRG8 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**

Level coordinator (Sec 2).

- **Commonly used mathematics-teaching tools/technique:**

Internet, resource books other than the textbooks.

### **Teacher's view on the textbooks content**

**(Comment on the following statements)**

- **Text content is well presented and easy to use**

Generally yes.

- **Every chapter contains interesting anecdotes to illustrate the topic**

Not necessarily. There could be more illustrations on real-life applications.

- **Content width and depth is adequate and appropriate to the specified level**

The level of difficulty for most textbooks are centered for the average pupil. In most topics, there could be little depth.

- **Content width and depth is adequate and appropriate to the specified learning duration**

Yes.

- **Worked examples are interesting and adequate for the topic introduced**

Yes – in most cases.

- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**

Nor really – few examples are challenging.

- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**

Yes.

- **Revision exercises help consolidation of the lessons**

It would be better if graded revision exercises are given after each chapter.

- **Any other comments**

Nil

**Teacher's view on the textbook as a teaching tool**

**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No.

- **Do you follow the topic sequence as given in the textbook? If not, please state the variation.**

No.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

Depends on topics. Sometimes, exercises are taken from sources outside the textbook.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

Algebra.

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

Nil

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

Nil

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Yes, I do so for all topics.

- **Do you have enough curriculum time to complete the text content?**

Yes.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**

**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Yes.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Yes. ( The teacher commented on the word completed : to mean learning assumed to have taken place)

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

Algebra, Graphs – drawing and interpretation.

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Algebra – manipulation and Indices.

Similarity and congruency – especially on congruency test.

- **Any other comments**

(Blank)

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

I do not have international students.

## **Appendix DO: SRG9's interview transcript**

In this interview transcript of SRG9 the bold print is the question and the ordinary print is the teacher's response.

### **Teacher's background**

- **Present duties and responsibilities:**  
Teaching twp classes of Sec 3 students.
- **Commonly used mathematics-teaching tools/technique:**  
Chalk and Talk, Transparency; students' discussions etc.

### **Teacher's view on the textbooks content** (Comment on the following statements)

- **Text content is well presented and easy to use**  
Agree.
- **Every chapter contains interesting anecdotes to illustrate the topic**  
Agree.
- **Content width and depth is adequate and appropriate to the specified level**  
With reference to 'O' Level exam, agree.
- **Content width and depth is adequate and appropriate to the specified learning duration**  
Agree.
- **Worked examples are interesting and adequate for the topic introduced**  
Agree.
- **Worked examples illustrated problems of varying degrees of difficulties ranging from easy to challenging**  
Agree.
- **Exercises cover problems of varying degrees of difficulties ranging from easy to challenging**  
Agree.
- **Revision exercises help consolidation of the lessons**  
Agree.
- **Any other comments**  
General a very well planned textbook. Easy to read and understand. Occasionally there are mistakes / printing error.

**Teacher's view on the textbook as a teaching tool**  
**(Short answers)**

- **Do you rely totally on the textbook for your lesson?**

No, textbook is used more as a supplement.

- **Do you follow the topic sequence at given in the textbook? If not, please state the variation.**

No, the department decide on the sequence of the topics to be taught.

- **Do you select only certain problems from the exercise in the text as classwork or homework?**

Yes.

- **In general, how many problems are given from the exercise?**

Depends on topics and spread in each exercise.

- **In your opinion, which topic/s is/are presented exceptionally well in the textbook?**

No exception, generally good.

- **Are there any exemplary examples / exercises in the textbook? If yes, please list them.**

Nil

- **Do you notice any trend in the textbooks, which emphasizes certain mathematics strand? If yes, what are they?**

-The book focuses more on thinking / providing more guiding on thinking.

- **Do you need to prepare additional resources to supplement the content? If yes, what topic / strand needs supplementing?**

Sometimes.

- **Do you have enough curriculum time to complete the text content?**

Yes.

- **Any other comments**

(Blank)

**Teacher's view on the textbook as a learning tool**  
**(Comment on the following statements)**

- **An average student is able to do most of the problems given in the text.**

Agree.

- **An average student who completed the lower secondary mathematics course is able to proceed to the next level mathematics with ease and confidence.**

Agree.

- **There are reflections / feedbacks from teachers teaching higher-level mathematics the needs to consolidate certain mathematics skills or technique as pre-requisite before entering to the higher level. List the skills / strands involved.**

Algebra manipulation skills and graphing.

- **Students find some of the topics rather difficult. Please list the topics / strands.**

Graphs.

- **Any other comments**

Nil

**Teacher's comment on international students / migrant children joining the class**

**(On student's ability to cope with the mathematics content, their background, strength and weakness of their mathematics ability)**

It is difficult to comment because it depends on their education background and the country they were residing.

# Appendix E: Australian International School Singapore Newsletter – Student population information



## THE AUSTRALIAN INTERNATIONAL SCHOOL SINGAPORE NEWSLETTER

**Volume 13: No. 1** Printer: MITA (P) No 009/12/2004  
**Term 1 Week 1**

**Thursday January 20, 2005**

1 Lorong Chuan, Singapore 556818  
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DATES FOR YOUR DIARY	
Mon, 24 January	Schools photos will commence today until February 3. Parents meet Primary Teachers Evening
Wed, 26 January	<b>Australia Day</b> <b>AISS CARES</b> – Australia Day Celebration and Tsunami fundraising
27 – 29 January	MYP Conference at AISS
Wednesday, 2 February	9:30am AISSPA Newcomers' Morning Tea Parents meet Secondary Teachers Evening
Thursday, 3 February	Parents meet Preschool Teachers Evening
Friday, 4 February	Australia Day Ball
5-13 February	Switzerland Ski Trip
7-11 February	School & Chinese New Year Holidays

### From the Principal.....

Welcome to all students, parents and staff to the 2005 school year. Special welcome to all new students and families. We have around 240 new students starting this week and our overall enrolment is 1350. Our cultural diversity remains strong with students coming from 40 different countries. Our student nationality mix is 62% Australian, 8% New Zealand, 20% from Asian countries (main ones are Malaysia, Indonesia, Japan, Singapore, Korea, and China) and 10% from other countries (main ones are Great Britain and South Africa).

Our return to school is saddened by the Tsunami disaster that struck the Indian Ocean on Boxing Day. Our condolences go to all those who have lost loved ones and whose lives have been affected. With more than 175,000 dead, more than 1 million injured and more than 5 million left homeless and without sufficient food, water and medical supplies, the Boxing Day Tsunami represents the largest natural disaster in our living memory. A minute's silence has been observed in assemblies this week. Next week on Australia Day we begin our fundraising efforts to support those most in need. Details of the Australia Day program and activities will be provided to students. At this stage, cash is the best help we can give, and our efforts will be directed towards this in the immediate future. Longer term we can work towards support programs for the Tsunami victims. As an international school we have a leading role to play in community service programs within our region.

On Wednesday, 2 February 9.30 am, AISSPA (Australian International School Singapore Parents' Association) will host a coffee morning for parents new to the School. This will be a good opportunity to begin your involvement in school community activities and find out more about life at AISS and in Singapore.

The first parent teacher gatherings for 2005 will take place over the next two weeks with the "Meet The Teacher" programs. These are evening cocktail style events, sponsored by AISSPA, where all staff will be introduced to you and where you will be able to chat informally with teachers, executive and fellow parents. Dates are: Primary-Monday, 24 January, Secondary-Wednesday, 2 February, Preschool-Thursday, 3 February.

## Appendix F: Channelnewsasia.com article, titled “Australia wrongly cancels visas of up to 8,000 international students”

Channelnewsasia.com

Page 1 of 1

This story was printed from channelnewsasia.com



channelnewsasia.com

**Title** : Australia wrongly cancels visas of up to 8,000 international students  
**By** :  
**Date** : 16 September 2005 1825 hrs (SST)  
**URL** : [http://www.channelnewsasia.com/stories/afp\\_asiapacific/view/168619/1.html](http://www.channelnewsasia.com/stories/afp_asiapacific/view/168619/1.html)

SYDNEY : Australia's immigration department said on Friday it had wrongly cancelled the visas of up to 8,000 international students and asked diplomatic posts around the world to tell the wronged pupils they can resume their courses.

In a major hitch for Australia's stated goal of becoming Asia's education hub, a court found the immigration department had been using incorrect paperwork from May 2001 to August 2005.

The ruling forced the government to reinstate the revoked visas of 700 foreign students in Australia and more than 7,000 who left the country after being told they could not complete their courses.

The immigration department said it had asked its overseas offices to inform students, education bodies and other relevant organisations of the decision.

"The department is working to notify all potentially affected people through a range of methods, including an advertising campaign, letters to clients and website information," it said in a statement.

The case arose after a student launched a legal challenge after his visa was cancelled because he had not attended sufficient classes in his cookery course.

The court found that the standard warning notice sent to the student was incorrectly worded.

Australia's schools and universities earn about A\$7.5 billion (US\$5.8 billion) a year from foreign students, representing the country's fourth largest export earner worth more than the traditional exports of wool and wheat combined.

The vast majority of the students come from Asia, with China the fastest growing market.

The immigration department is already under fire for a series of bungles arising from the country's hardline border protection policies.

The department has admitted wrongfully detaining more than 200 people who were in the country legally, including a German-born woman who was locked up for 10 months and a Philippines-born woman who was wrongfully deported. - AFP/de

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## Appendix G: An overview of the textbook content-break-down

Level of textbooks	Textbooks					
	BH	PLC	RH	BS	SS	CSS
<b>Year 7 Text</b>	421	390	~	351	332	200
<b>Year 8 Text</b>	407	673	450	309	282	172
<b>Year 9 Text</b>	451	628	192	271	296	160
<b>Total no of pages</b>	1279	1691	642	931	910	532
<b>Number Strand</b>						
<b>Number Strand</b>	<b>Number of Pages</b>					
<b>Year 7</b>	89	110	N/A	189	194	0
<b>Year 8</b>	90	216	162	51	25	33
<b>Year 9</b>	84	123	70	0	0	0
<b>Total Pages</b>	263	449	232	240	219	33
<b>Weighting %age</b>	20.6	26.6	36.1	25.8	24.1	6.2
<b>Measure Strand</b>						
<b>Measure Strand</b>	<b>Number of Pages</b>					
<b>Year 7</b>	70	92	N/A	85	43	0
<b>Year 8</b>	58	113	84	29	76	0
<b>Year 9</b>	106	144	40	65	52	20
<b>Total Pages</b>	234	349	124	179	171	20
<b>Weighting %age</b>	18.3	20.6	19.3	19.2	18.8	3.8
<b>Space Strand</b>						
<b>Space Strand</b>	<b>Number of Pages</b>					
<b>Year 7</b>	117	78	N/A	50	35	67
<b>Year 8</b>	94	83	90	51	57	71
<b>Year 9</b>	47	93	32	101	84	67
<b>Total Pages</b>	258	254	122	202	176	205
<b>Weighting %age</b>	20.2	15.0	19.0	21.7	19.3	38.5
<b>Chance &amp; Data</b>						
<b>Chance &amp; Data</b>	<b>Number of Pages</b>					
<b>Year 7</b>	51	64	N/A	0	28	0
<b>Year 8</b>	77	55	38	55	14	0
<b>Year 9</b>	72	63	8	24	34	30
<b>Total Pages</b>	200	182	46	79	76	30
<b>Weighting %age</b>	15.6	10.8	7.2	8.5	8.4	5.6
<b>Algebra Strand</b>						
<b>Algebra Strand</b>	<b>Number of Pages</b>					
<b>Year 7</b>	94	46	N/A	27	32	133
<b>Year 8</b>	88	206	76	123	110	68
<b>Year 9</b>	142	205	42	81	126	43
<b>Total Pages</b>	324	457	118	231	268	244
<b>Weighting %age</b>	25.3	27.0	18.4	24.8	29.5	45.9