

A Review of School Textbooks for Project Maths

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Published by the National Centre for Excellence in
Mathematics and Science Teaching and Learning (NCE-MSTL)

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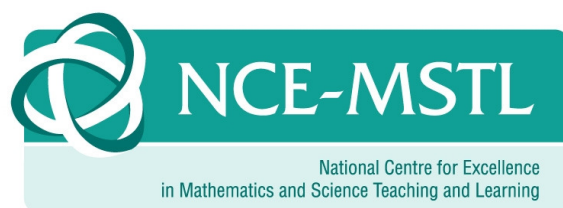
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The NCE-MSTL is a distributed centre established under the aegis of the Shannon Consortium and funded by the HEA through SIF Cycle 2. The University of Limerick is the lead institution and is supported by existing centres of expertise in the Shannon Consortium partners.



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July 2011

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Preface

We are charged under our brief at the National Centre to engage in evidence-based world class research in Science and Mathematics Teaching and Learning and to bring our findings to bear, *inter alia*, on advice offered to stakeholders in Irish education. This is the third report in the series following the NCE's ground-breaking report, *Out-of-field teaching in Post-Primary Mathematics Education: An analysis of the Irish context* (2009) and it presents a review of school textbooks published commercially for Project Maths.

Historically, mathematics teaching and classrooms in Ireland have been strongly influenced by commercially produced school textbooks and mathematics education has come to reflect the view of mathematics teaching and learning portrayed in these textbooks. This situation has not also worked in the best interests of mathematics education.

This report is timely as teachers, students, parents and publishers are working to come to grips with the new reality of Project Maths in our schools. A significant number of new textbooks are now available for Project Maths but anecdotal evidence suggests that they are not a good match for Project Maths. Given the central role of textbooks in curriculum development and change, it is prudent that care is taken at policy level to ensure new second level mathematics textbooks are aligned with the reform vision of the mathematics curriculum embodied in Project Maths, and are 'fit for purpose'. This report offers an objective evaluation of a selection of new textbooks available for Project Maths.

In this study the authors look to the Third International Mathematics and Science Study (1995) (TIMSS) for theoretical underpinnings and methodology. The TIMSS mathematics curriculum framework as it evolved is adapted by the authors (LO'K) and further refined for use in this report as TIMSS+. This present report, the first of its kind in Ireland, produced a wealth of interesting data recorded. These are recorded in the appendices and support the conclusion that this selection of textbooks is not well aligned with the intended Project Maths curriculum and expectations. Further, a careful reading of the report and data show where mismatches occur and potential avenues for improvement.

The Directors are pleased to discharge their brief to advise on matters related to Science and Mathematics teaching in this way and commend this report to all who have a stake in Irish education and particularly to those front-line agencies involved in improving matters in Mathematics and Science teaching at all levels.

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Summary

The Department of Education and Skills asked the National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL) to review the current mathematics textbooks available for schools for Project Maths, and evaluate them using a version of the TIMSS framework already in use, adapted for the purpose of this study.

This study is part funded by the NCCA and is undertaken by the National Centre as part of its brief to advise on matters related to Science and Mathematics teaching and learning.

A very tight reporting deadline and resource constraints precluded a more extensive study, however, the study as implemented and reported aspires to best practice standards within its frame.

Methodology

The study summarised here is based on analysis of data obtained by the application of TIMSS+ (a modified TIMSS instrument for mathematics textbook analysis) to a selection of published textbooks (Appendix A) that were available during the school year 2010/11. The TIMSS mathematics curriculum framework is applied to the Project Maths Syllabus documents and is used as a referent for analysis and comparison purposes.

Key Findings

- All textbooks included in the study fall short of the standard needed to support Project Maths (intended curriculum) effectively,
- These textbooks display a genuine attempt to match the intentions of Project Maths but no one textbook meets all the needs of Project Maths,
- The most significant overall finding is the mismatch between textbook expectations and Project Maths expectations,
- It is noteworthy that there are topic omissions in the reviewed textbooks when the Project Maths syllabus treats all topics as compulsory,
- A key topic omission is the integration of ICT throughout all textbooks,
- Structure and content analysis uncovers disparities between the textbooks in their approaches to teaching for understanding and problem solving.

Conclusions and Recommendations

If textbooks are to contribute to the success of Project Maths then more needs to be done. The obvious lack of attention to key Project Maths expectations needs careful consideration. While the developmental nature of Project Maths is on a strand by strand basis, this militates against topic integration, and, when the roll out is complete, a more integrated approach should feature in textbooks.

The report recommends that:

- An exemplar textbook series for Project Maths be produced by a specially selected and constituted writing team appointed and funded by the DES,
- All commercially produced textbooks for Project Maths be reviewed against this exemplar textbook series
- Such a review procedure leads to an approved list of mathematics textbooks for Project Maths

1. Introduction

1.1 The influence of mathematics textbooks on teaching and learning

It is accepted worldwide that mathematics textbooks have a major influence on classroom practice (Valverde et al., 2002). Textbooks are important vehicles for the promotion of specific types of mathematics curricula. They are organised in a purposeful way, and consequently their content and structure are very important for the promotion of a specific vision of mathematics curriculum such as Project Maths. Given the central role of textbooks in curriculum development and change it is prudent that care is taken at policy level to ensure new second level mathematics textbooks are aligned with the reform vision of mathematics curriculum embodied in Project Maths, and are ‘fit for purpose’.

Historically, mathematics teaching and classrooms in Ireland have been strongly influenced by commercially produced school textbooks that have promoted a view of mathematics concerned mainly with skills and instrumental learning (NCCA, 2005). This view of mathematics curriculum is not compatible with Project Maths, and if these emphases dominate through the new generation of mathematics textbooks then the success of Project Maths is likely to be severely compromised.

The aim of the report is to inform decision making at policy level through evidence-based research regarding school mathematics textbooks at second level.

1.2 Outline structure of report

The report is presented in eight sections. The first section of the report describes the context and the influence of mathematics textbooks on teaching and learning. Section 2 discusses the theoretical underpinnings of the report and the origins of the textbook analysis instrument used in the study. Section 3 is devoted exclusively to methodology and related issues. Data analysis and findings are developed in Section 4. Section 5 contains a summary of the report and the main conclusions. A short list of references is included in section 6. Section 7 contains a glossary of important terms and definitions used throughout the study. The appendices (section 8) contain all the tables, diagrams and figures developed from the primary data.

2. Theoretical framework for this study

2.1 The TIMSS curriculum frameworks

This study looks to the Third International Mathematics and Science Study (1995) (TIMSS) for its theoretical underpinnings. Curriculum is a central variable in TIMSS and is used to compare national systems of education. The conceptual framework for TIMSS is based on the now well known tripartite model of curriculum (Robitaille et al., 1997):

- intended curriculum
- implemented curriculum
- attained curriculum.

TIMSS devised a common framework to compare systems of education through analyses of curricula, related documents and artefacts. They are known as *curriculum frameworks*. Each framework is characterised by the same three elements that are further sub-divided (Robitaille et al., 1997):

- subject matter content
- performance expectations
- perspectives or context.

These frameworks are applied to the curriculum or any piece of the curriculum that is seen as promoting the intended, implemented or attained curriculum and includes artefacts such as textbooks, curriculum guides, standards documents etc. TIMSS employs two separate frameworks viz. the curriculum framework for mathematics, and curriculum framework for science. The TIMSS model was formulated to deal with evolving curricula and is appropriate for use with Project Maths. This model does not deal with language analysis or readability of mathematics textbooks which would require a separate study.

2.2 The mathematics framework as a tool for textbook analysis

The mathematics framework is a tool for studying curriculum or any piece of curriculum or artefact. Indeed the view supported by TIMSS is that 'A textbook is a surrogate curriculum...' (Robitaille et al., 1997: 50). In this study the mathematics framework is adapted for use as a tool for mathematics textbook analysis.

Thus we start with the TIMSS mathematics framework as a tool for textbook analysis. It has three dimensions:

- Structure
- Performance expectations
- Perspectives.

Subsequently, the mathematics framework was adapted and refined for use in TIMSS as an instrument for mathematics textbook analysis per se.

3. Methodology

3.1 TIMSS instrument for mathematics textbook analysis

In this study the TIMSS mathematics curriculum framework as it evolved is adapted and further refined as outlined below. The ‘perspectives’ dimension captures student data and is not used in this study. In any case it was not envisaged that all three dimensions would be applied to every piece of curriculum. The structure dimension encompasses issues concerning content and the structure of knowledge and information in the textbook and the make-up of the textbook. This line of reasoning led to an analytical tool with two dimensions and three elements as follows:

- Structure
 - Structure
 - Content
- Expectation.

3.2 The TIMSS+ instrument

Further refinements were added to this TIMSS instrument by O’Keeffe (2011) in order to allow for a finer-grained analysis. Refinements based on the work of River’s (1990) and Mikk (2000) that reinforce and add to the TIMSS model around content and expectation and structure analysis respectively, are included here. The evolved model is identified as the TIMSS+ instrument (Figure 3.1).

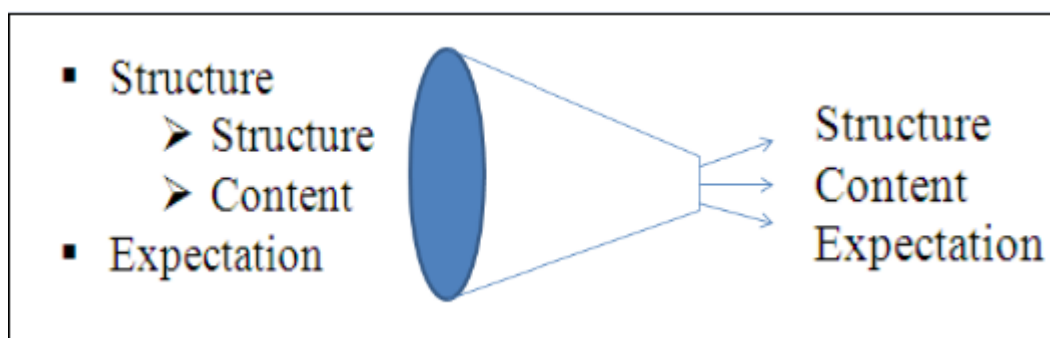


Figure 3.1: Development of the TIMSS+ Instrument

3.3 Exploiting the link between curriculum and textbooks for methodological purposes

TIMSS posits and develops a powerful link between curriculum and textbooks. Indeed the textbook is described as a ‘surrogate curriculum’. This point is expanded by Vanezky (cited in Robitaille et al., 1997: 50) when he points out that a single set of curriculum guidelines can spawn a myriad of textbook representations. In this context the bi-directional link between the textbook and curriculum is a powerful insight. This line of reasoning is

exploited to advance this study. The alignment of this study with TIMSS theory and methodology makes available the TIMSS superstructure as needed.

Each textbook analysed for the study is treated as a representation of the intended Project Maths curriculum, and may be treated as individual stand-alone representations or compared to the others in order to advance our understanding. A full list of textbooks and disaggregated textbooks is given in Appendix A.

3.4 Specially constructed curricula (SCC)

For the purposes of this study a further refinement is necessary. The TIMSS+ instrument is systematically applied to a number of mathematics textbooks or series of textbooks by disaggregating textbooks into chunks of curricula or strands identified as units called *specially constructed curricula*. This step is necessary because there are no complete textbooks for Project Maths (Strands 1-5) covering the entire curriculum from year 1 to year 5 at Higher and Ordinary levels; several of the textbooks comprise curriculum strands only, and consequently render analysis and comparison extremely difficult or impossible without some such device. A selection of several recently published mathematics textbooks are analysed and discussed in the context of their associated SCC and Project Maths.

Specially constructed curricula (SCC) are represented by a book or books or selected chapters from a book according to the information supplied by the publisher and are keyed to the Common Introductory Course (CIC), Junior Cycle and Senior Cycle as appropriate. In all, this study compares data from 10 selected textbooks and 6 specially constructed curricula as follows:

- 1 Common Introductory Course (CIC)
- 2 Junior cycle curricula
- 3 Senior cycle curricula.

Details of the SCC and their associated textbooks are given in Tables 3.1 and 3.2 together with their respective codes. For the purposes of this study a workbook is treated as part of the associated textbook.

Table 3.1: Junior Cycle Constructed Curricula

Constructed Curriculum:	Level:	Curriculum Material:
1. Strand 1 - 5	Ordinary Level	Textbook 1 Syllabus
2. CIC	All Levels	Textbook 2 Textbook 3 Syllabus
3. Strands 1 & 2	Ordinary Level	Textbook 4 Textbook 5 Textbook 6 Syllabus

Table 3.2: Senior Cycle Constructed Curricula

Constructed Curriculum:	Level:	Curriculum Material:
4. Strands 1 & 2	Ordinary Level	Textbook 7 Textbook 8 Textbook 9 Syllabus
5. Strands 1 & 2	Higher Level	Textbook 10 Textbook 11 Syllabus
6. Strand 2	Higher Level	Textbook 12 Textbook 13 Textbook 14 Syllabus

Also for the purposes of analysis the Project Maths Syllabus documents are disaggregated into constructed syllabi matching the 6 SCC in the above list. The TIMSS mathematics curriculum framework is applied to these constructed syllabi for use as a reference for comparative purposes. This gives an objective benchmark for the Project Maths 'intended curriculum'.

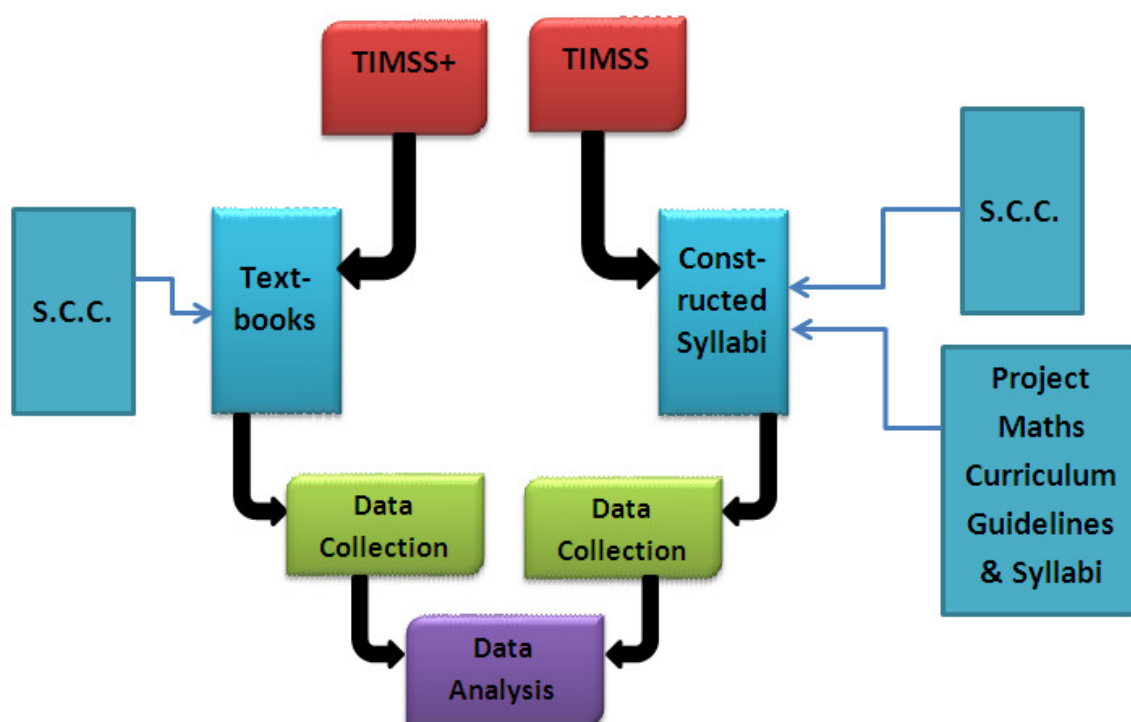


Figure 3.2: Overview of methodology

3.5 The process of analysing textbooks

The textbook analysis proceeds by dividing every textbook into blocks of 'text' and applying the three lenses from the TIMSS+ instrument to each block. This process involves every page and every chapter of each textbook. 'Text' may include ordinary literary text, exam items, graphs or charts, etc. An ordinary literary paragraph in a curriculum document may be taken as a block for the purposes of this analysis.

Generally, the data from each block is recorded as counts that in turn contribute to the production of various graphical displays. The TIMSS template for data collection was used systematically throughout (Appendix B). The data collected in this manner were entered into an Excel file and subsequently used for computer analysis.

4. Data analysis and findings

4.1 Structure Analysis

Table 4.1 Structure Analysis

Specially Constructed Curriculum and Associated Textbooks	Structure Analysis:
Constructed Curriculum 2: JC CIC Associated textbooks: TB 2; TB 3	Table D.1 and Figure D.1 show that textbook 2 displays lower levels of narration but higher levels of related narration in comparison to textbook 2. Also textbook 3 has a much higher rate of instructional narration throughout its text. Textbook 2 has three times as many definitions, seven times as many theorems and four times as many axioms highlighted from the text than textbook 3. Graphics are plentiful across both textbooks (Figure D.3) with textbook 2 using 171 of its graphics for problem solving and textbook 3 using 196. Textbook 2 has a much higher presence of photo-like graphics, 126 compared to 12. Textbook 3 boasts a greater number of exercises (1843 compared to 782), and problems (532 compared to 349) (Table D.4). Of the total number of problems and exercises present in these two textbooks, 32% of these in textbook 2 are devoted to problems while 22% are devoted to problems in textbook 3 (Table D.4a). Further analysis of problem solving showed that 20 of the 349 problems present in textbook 2 are non- routine problems and the ratio in textbook 3 is 89/532. Further classification of the routine problem types (Figure D.7) identifies that Real and Realistic problems are the most commonly found in textbook 2, whereas Realistic and Purely Mathematical problems are the most commonly found in textbook 3. Of the 20 non-routine problems in textbook 2, 16 of these are realistic type problems and in textbook 3 of the 89 non-routine problems 29 are realistic and 44 are purely mathematical (Figure D.8). Textbook 2 contains 162 worked examples, 56 of which represent real or realistic problems, giving a total of 1 worked example for every 7 exercises/problems. The corresponding ratio for textbook 3 is 21/108 giving a total of 1 worked example for every 22 exercises/problems.
Constructed Curriculum 3: JC S1&2/O	As can be seen from Table D.1 and Figure D.1, textbook 4 exhibits the lowest levels of narration but highest levels of related narration. Textbook 6 exhibits the highest rate of instructional narration throughout its text. Textbook 4 also has the greatest number of definitions, theorems and axioms highlighted from its text (Figure D.2). Graphics are plentiful across all three textbooks (Table & Figure D.3) with textbook 4 exhibiting the greatest number of graphics in total, the highest number of

Associated textbooks: TB 4; TB 5; TB 6	graphics used for problem solving and the greatest frequency of photo-like graphics. Textbook 4 has the highest frequency of exercises and problems present (Table & Figure D.4). 31% of the total number of problems and exercises in textbook 4 are devoted to problems; the corresponding figures for textbooks 5 and 6 are 32% and 21% respectively (Table D.4a). Further analysis of problem solving identified that the ratio of non-routine problems to problems is 16/280, 6/225 and 2/150 for textbooks 4, 5 and 6 respectively. A further classification of the routine and non-routine problem types (Figure D.7 & D.8) identifies that realistic problems are the most commonly found in all textbooks. Textbook 4 contains 110 worked examples, 45 of which represent real or realistic problems, giving a total of 1 worked example for every 8 exercises/problems. The corresponding data for textbooks 5 and 6 respectively are: 58 worked examples, 16 of which represent real or realistic problems, giving a total of 1 worked example for every 12 exercises/problems; 67 worked examples, 23 of which represent real or realistic problems, giving a total of 1 worked example for every 11 exercises/problems.
Constructed Curriculum 4: LC S1&2/O Associated textbooks: TB 7; TB 8; TB 9	As can be seen from Table E.1 and Figure E.1, textbook 8 exhibits the highest levels of narration while textbook 7 exhibits the highest presence of related narration. Textbook 7 also has the greatest number of definitions, theorems and axioms highlighted from its text (Table & Figure E.2). Graphics are plentiful across all three textbooks (Table & Figure E.3) with textbook 7 containing the greatest number of graphics and real life diagrams and photo-like graphics. However the highest number of graphics used for problem solving is found in textbook 8. On the other hand textbook 9 exhibits the highest frequency of exercises and textbook 7 has the highest frequency of problems present (Table E.4). The percentage of the total number of problems and exercises present in these three textbooks devoted to problems is 35 % , 49%, and 33% respectively for textbooks 7, 8 and 9 (Table E.4a). Further analysis of problems shows that 46 of 389 problems in textbook 7 are non- routine problems. This ratio for textbooks 8 and 9 is 51/380, and 118/288. A further classification of the routine and non-routine problem types (Tables E.10a and E.10b and Figures E.7 & E.8) identifies that realistic and purely mathematical problems are the most commonly found across all three textbooks. Textbook 7 contains 189 worked examples, 86 of which represent real or realistic problems, giving a total of 1 worked example for every 7 exercises/problems. The corresponding data for textbooks 8 and 9 are: 114 worked examples, 35 of which represent real or realistic problems, giving a total of 1 worked example for every 8 exercises/problems; 146 worked examples, 48 of which represent real or realistic problems, giving a total of 1 worked example for every 8 exercises/problems.
Constructed Curriculum 5: LC S1&2/H Associated textbooks:	Table F.1 and Figure F.1 show that textbook 10 displays higher levels of both narration and related narration in comparison to textbook 11. Textbook 10 has more than four times as many definitions and almost twice as many theorems. Textbook 11 fails to highlight any axioms or corollaries from the narration (Table and Figure F.2). Graphics are plentiful across both textbooks (Table & Figure F.3) with textbook 10 using 330 of its graphics for problem solving and textbook 11 using 290. Textbook 10 has a much higher incidence of photo-like graphics, 58 compared to 0. The difference in the number of exercises in both textbooks is

TB 10; TB 11	marginal (604 in textbook 10 compared with 615 in textbook 11) and textbook 11 exhibits a greater number of problems (689 compared to 656) (Table F.4 and Figure F.4), while textbook 10 boasts a higher presence of activities (29 compared with 3). Of the total number of problems and exercises present in each of these textbooks just over 52% (in each textbooks, see Table F.4a) are devoted to problems. Further analysis of problem solving demonstrated that 183 of the 656 problems present in textbook 10 are non- routine problems and the ratio in textbook 11 is 226/689. Further classification of the non-routine problem types (Figures F7 & F8) identifies that realistic and purely mathematical problems are the most commonly found in both textbooks. Textbook 10 contains 188 worked examples, 59 of which represent real or realistic problems, giving a total of 1 worked example for every 7 exercises/problems. The corresponding ratio for textbook 11 is 68/177 giving a total of 1 worked example for every 7 exercises/problems.
Constructed Curriculum 6: LC S2/H Associated textbooks: TB 12 TB 13; TB 14	Textbook 13 displays higher levels of narration (Table F.1 and Figure F.1) while textbook 12 has the highest levels of related narration. Textbook 12 has the greatest number definitions (94), theorems (41) and axioms (14) (Table F.2 and Figure F.2). Textbook 12 has considerably more graphics (943) than textbook 13 (525) or textbook 14 (494) (Table F.3). The distributions of graphics used for problem solving across all three textbooks are similar with 222 in textbook 12, 195 in textbook 13 and 212 in textbook 14. Textbook 12 has a higher incidence of real life diagrams and photo-like graphics, 108 and 25, compared to 32 and 0 in textbook 13 and 36 and 0 in textbook 14 (Table F.4 and Figure F.4). Textbook 13 has the lowest number of exercises (217) but the highest number of problems (442) compared with 420/351 in textbook 12 and 466/428 in textbook 14 (Table F.5). Of the total number of problems and exercises present in textbook 12, 46% are devoted to problems compared with 67% in textbook 13 and 48% in textbook 14 (Table F.4a) Further analysis of problem solving showed that 138 of the 351 problems present in textbook 12 are non- routine problems. The ratio in textbook 13 is 147/442 and in textbook 14 it is 188/428. Further classification of the non-routine problem types (Figures F7 & F8) identifies that realistic and purely mathematical problems are the most commonly found in all three textbooks. Textbook 12 contains 117 worked examples, 4 of which represent real or realistic problems, giving a total of 1 worked example for every 7 exercises/problems. The corresponding ratio for textbook 13 is 15/122 giving a total of 1 worked example for every 5 exercises/problems and for textbook 14 it is 1/96 with 1 worked example for every 9 exercises/problems.

4.2 Content Analysis

Table 4.2 Content Analysis

Specially Constructed Curriculum and Associated Textbooks	Content Analysis:
Constructed Curriculum 1: JC S1-5/O Associated textbook: TB 1	Content analysis identified two content topics that are outlined in the syllabus (Tables D.6a and D.6b) but omitted from this textbook. These topics are 'Domain and Range' and 'use of Computer Software'. While the River's Matrix (Table D.9) identified 12 references to 'Computer Software', all of these references are found in one chapter which forms part of Strand 1. The Project Maths syllabus also makes direct reference to use of the internet particularly for strand 3, and this textbook makes two references to the internet in two separate chapters, one of which is in Strand 1 and the other is in Strand 3. The River's Matrix also identifies the presence of motivational factors (Table D.7); this textbook contains 25 historical notes, 5 biographical facts and 9 notes of career information, while also including 6 instances of direct humour or quotes. There is consistent use of colour, with background colours placing text in context, for example all hints are in a purple box and all keywords are in a green box etc. (see Table D.8).
Constructed Curriculum 2: JC CIC Associated textbooks: TB 2; TB 3	Analysis of the content grids identified that 'Estimating Computations', a significant element of strand 1 is omitted from textbook 3 (Tables D.6c to D.6e). The River's Matrix (Table D.7) shows that textbook 2 has a greater number of historical notes, biographies, career information and humour/quotes. Both textbooks demonstrate consistent use of colour. While textbook 3 demonstrates consistent use of colour, the range of colours used is more limited (see Table D.8). The analysis of Technical Aids (Table D.9) identifies 12 references to 'Computer Software' and one reference to the 'Internet' in textbook 2 (all of these references are found in one chapter which forms part of Strand 1). Textbook 3 has no references to either type of technical aid.
Constructed Curriculum 3: JC S1&2/O Associated textbooks: TB 4; TB 5; TB 6	Content analysis of the three textbooks in this section identified one content topic that is outlined in the syllabus but omitted from the textbooks (Tables D.6f to D.6i). This topic is 'Computer Software'. While the River's Matrix (Table D.9) identified 12 references to 'Computer Software' and one reference to the 'Internet' in textbook 4 all of these references are found in one chapter that forms part of Strand 1. There are other omissions; 'Counting Principles' is omitted from textbook 5 and '2D Geometry – The Circle' is omitted from textbook 6. The River's Matrix (Table D.7) shows that textbook 4 has a greater presence of historical notes, biographies, career information and humour/quotes. Consistent use of colour is evident in textbook 4 as is the case for the other Junior Cycle textbooks from this publisher. While textbooks 5 and 6 also demonstrate consistent use of colour, the range of colours used across both is more limited, with textbook 5 making use of more colour and colour backgrounds from context (see Table D.8).

Constructed Curriculum 4: LC S1&2/O Associated textbooks: TB 7; TB 8; TB 9	Four content topics that are outlined in the syllabus (Tables E.6a to E.6d) are omitted from all three textbooks. These topics are 'Negative Numbers & their properties', 'Set Properties', 'Set Operations' and 'Linear Functions'. Also all textbooks omit the topic content 'Computer Software' and the 'Internet' (with the exception of Strand 1 in textbook 7, see Table E.9). Content analysis also shows that 'Percentages' and 'Exponents, roots and radicals' are not given a strong weighting in textbooks 8 and 9. The Rivers Matrix (Table E.7) indicates that textbook 7 has a greater number of historical notes, biographies, career information and humour/quotes than the others in the set. Textbook 7 demonstrates consistent use of colour in line with the same publisher's textbooks for Junior Cycle. While textbooks 8 and 9 also demonstrate consistent use of colour the range of colours used across both is more limited, with textbook 8 making use of more colour and colour backgrounds from context (see Table E.8).
Constructed Curriculum 5: LC S1&2/H Associated textbooks: TB 10; TB 11	Content analysis of textbooks 10 and 11 identified four content topics that are outlined in the Project Maths syllabus but omitted from both textbooks (Tables F.6a. to F.6c). These topic are 'Negative Numbers, Integers are their Properties', 'Set Properties', 'Set Operations'(all omitted from strand 1), and 'Linear Functions' (omitted from strand 2). The content analysis of textbook 10 also indicates that 'Proportionality Problems' are omitted from strand 2. Textbook 11 also exhibits a lack of emphasis to 'Randomisation' and 'Defining Probability' in strand 1. The River's Matrix (Table F.7) shows that textbook 10 has a marginally greater number of historical notes and a significantly greater number of references to career information. Both textbooks demonstrate consistent use of colour. While textbook 11 demonstrates consistent use of colour, the range of colours used is more limited (see Table F.8). The analysis of Technical Aids (Table F.9) identifies 14 references to 'Computer Software' and 12 references to the 'Internet' in textbook 10 in comparison to 17 and 2 references in textbook 11.
Constructed Curriculum 6: LC S2/H Associated textbooks: TB 12 TB 13; TB 14	The content analysis of textbook 12 indicates that 'Proportionality Problems' are omitted, while in textbook 13 an emphasis on 'Fractions' is omitted. The River's Matrix (Table F.7) shows that textbook 12 has a marginally greater number of historical notes and biographical information and a significantly greater incidence of career information. All three textbooks demonstrate consistent use of colour. While textbook 14 demonstrates consistent use of colour, the range of colours used is more limited (see Table F.8). The analysis of Technical Aids (Table F.9) identifies 1 reference to 'Computer Software' in textbook 12 and none in textbook 13 or 14. None of these textbooks make reference to the 'Internet'.

4.3 Expectation Analysis

Table 4.3 Expectation Analysis

Specially Constructed Curriculum and Associated Textbooks	Expectation Analysis:
Constructed Curriculum 1: JC S1-5/O Associated textbook: TB 1	The expectation analysis identified that two expectations are omitted from textbook 1, one of which the syllabus suggests should be evident in every strand (see Tables D.11a and D.11b). These expectations are ‘Developing Algorithms’ which the Project Maths syllabus suggest should be present in strand 3 and ‘Generalising’ which it suggests should be evident in all five strands. Other expectations which the syllabus suggests should have greater coverage across all strands are ‘Use of Vocabulary & Notation’, ‘Relating Representations’, ‘Critiquing’, ‘Inter subject Connections’ and ‘Across Subject Connections’. The S1-5 syllabus also places weight on the presence of ‘Instrumental and Relational Learning’, ‘Fostering Positive Attitudes’, ‘Inquiry Based Learning’, ‘Applications’ and making ‘Connections between Solutions and Questions’, problem solving in context and the use of graphics to assist with problem solving.
Constructed Curriculum 2: JC CIC Associated textbooks: TB 2; TB 3	The expectation ‘Generalising’ which the syllabus suggests should be evident in strands 3 and 4 is omitted from both textbooks (see Tables D.11c to D.11e). Textbook 2 has a number of expectations missing in various strands in comparison to the syllabus. ‘Performing more Complex Procedures’, ‘Formulating & Clarifying Problems’ and ‘Developing Strategies’ are omitted from strands 2 and 4. ‘Predicting’ is omitted from strand 4 and ‘Developing Algorithms’ is omitted from strand 3. A number of expectations are also omitted from textbook 3: ‘Recognising Equivalents’ is omitted from strand 2; ‘Developing Strategies’ is omitted from strands 2, 3 and 4 while ‘Predicting’ is omitted from strands 1 and 4. Both textbooks are missing a number of expectations that are outlined in the syllabus for strand 4, these are ‘Conjecturing’, ‘Justifying & Proving’, ‘Axiomatising’, ‘Using Vocabulary & Notation’, and ‘Describing/Discussing’. The syllabus also makes direct references to ‘Inquiry Based Learning’, ‘problem solving in context and the use of graphics to assist with problem solving.’
Constructed Curriculum 3: JC S1&2/O Associated textbooks: TB 4; TB 5; TB 6	A number of expectations are omitted from all three textbooks, (see Tables D.11f to D.11i). The first of these expectations is ‘Generalising’ which the syllabus suggests should be evident in all strands. The elements ‘Developing Strategies’ and ‘Across Subject Connections’ are omitted from strand 2 of each textbook while ‘Relating Representations’, ‘Inter Subject Connections’ and ‘Across Subject Connections’ are also omitted from strand 1 of each textbook. ‘Critiquing’ is also absent from strand 2 of textbook 4. Textbook 5 and 6 are both missing ‘Predicting’ from strand 1 and ‘Axiomatising’ from strand 2. ‘Using more Complex Procedures’ and ‘Conjecturing’, are also omitted from strand 2 of textbook 5 while textbook 6 is also missing ‘Using more Complex Procedures’ and ‘Critiquing’ from strand 1. The Project Maths S1&2 syllabus also places weight on the presence of ‘Instrumental and Relational Learning’, ‘Fostering Positive Attitudes’, ‘Inquiry Based Learning’ and ‘Applications’.

Constructed Curriculum 4: LC S1&2/O Associated textbooks: TB 7; TB 8; TB 9	The expectation analysis identified that a number expectations are omitted from all three textbooks, (see Tables E.11a to E.11d). The first of these expectations is 'Generalising' which the syllabus suggests should be evident in all strands. 'Developing Strategies' is omitted from strand 2 of each textbook. 'Relating Representations' is omitted from strand 1 in textbooks 7, 8 and 9 and in strand 2 for textbooks 8 and 9. 'Inter Subject Connections' is absent from both strands in textbooks 7, 8 and 9. 'Critiquing' is absent from strand 2 in both textbooks 7 and 8. The S1&2 Project Maths syllabus also places weight on the presence of 'Instrumental and Relational Learning', 'Fostering Positive Attitudes', 'Inquiry Based Learning', 'Applications' and making 'Connections between Solutions and Answers'.
Constructed Curriculum 5: LC S1&2/H Associated textbooks: TB 10; TB 11	The syllabus suggests that the expectation 'Generalising' should be evident in strand 1. This expectation is omitted from both textbooks (see Tables F.11a to F.11c). Both textbooks are also missing three further expectations from strand 2; 'Developing Strategies', 'Developing Algorithms', and 'Critiquing'. There are two further expectations omitted from textbook 10, 'Critiquing' is omitted from strand 1 and 'Across Subject Connections' is omitted from strand 2. For textbook 11 there are three expectations absent from strand 1, 'Using Equipment', 'Inter Subject Connections' and 'Across Subject Connections'. The Project Maths syllabus also makes direct references to a number of further expectations; 'Instrumental and Relational Learning', 'Fostering Positive Attitudes', 'Inquiry Based Learning', 'Applications' and making 'Connections between Solutions and Questions'.
Constructed Curriculum 6: LC S2/H Associated textbooks: TB 12 TB 13; TB 14	The expectation analysis of all three textbooks identified two expectations that are outlined in the Project Maths syllabus but omitted from all textbooks (Tables F.11d. to F.11g). These expectations are 'Developing Strategies' and 'Critiquing'. Textbook 12 is also missing 'Developing Algorithms' and 'Across Subject Connections'. 'Generalising' and 'Across Subject Connections' are omitted from textbook 13 while textbook 14 is missing 'Developing Algorithms' and 'Generalising'. The Project Maths syllabus also makes direct references to a number of further expectations 'Instrumental and Relational Learning', 'Fostering Positive Attitudes', 'Inquiry Based Learning' and 'Applications'.

5. Conclusion

5.1 Discussion and conclusions

Project Maths places particular emphasis on teaching for understanding, problem solving and real life applications promoted through active teaching methodologies including ICT and appropriate assessment strategies. Textbooks will be considered successful to the extent that they facilitate the needs of Project Maths. The data analysis and findings provide a perspective on the alignment between the textbooks and Project Maths.

Table: 5.1 Discussion and conclusion for each textbook

Textbook	
1	This Junior Cycle textbook has a high level of narration and a low level of instructional narration. This indicates a genuine concern for explanations and a move away from procedural-type materials. The definitions, axioms, theorems, etc are accentuated by printing devices such boxes and colour thus adding learning impact. The large number of graphics in this textbook adds little to the educational value of the text because a very small proportion of these graphics are related to problems as Project Maths stipulates. The ratio of exercises to problems is 3:1 and this balance is inconsistent with Project Maths particularly in the context of non-routine problems being 2% of the overall total of exercises and problems. An unusual feature in presentation occurs in strand 4 (Algebra) where problems are not integrated throughout the associated chapters (8). Content analysis shows gaps in textbook content compared to the corresponding Project Maths syllabus. One of these omissions viz. 'Use of Computer Software' has particular significance in light of the emphasis that Project Maths places on use of ICT. Consideration for motivational factors is evident and this is captured in the data on related narration. The gaps that are evident from the expectation analysis indicate a lack of focus on mathematical thinking e.g. 'Generalising', 'Inter and Across Subject Connections' and 'Relating Representations'. Problem solving in context is underrepresented despite being highlighted in Project Maths syllabus. These findings run counter to the general expectation of Project Maths.
TB 2	This textbook for the Common Introductory Course is a subset of textbook 1 (chapters 1-14; chapters 26, 27) previously discussed. The only concern here is whether this book is aligned with Project Maths in terms of content and expectation since it inherits the other characteristics. Despite some minor omissions from strand 3 and other omissions as identified for the previous

	textbook this book is reasonably well aligned with the CIC syllabus in content terms. In terms of expectations strand 4 (Algebra) seems to be far removed from Project Maths with key expectations omitted such as 'Conjecturing', 'Justifying and Proving', 'Using Vocabulary and Notation' and 'Describing/ Discussing'. Apart from strand 4 the main issues in relation expectations are in the area of problem solving, particularly in strands 2 and 4 that relate 'Performing more Complex Procedures', 'Formulating and Clarifying Problems', and 'Developing Strategies'.
TB 3	This Junior Cycle textbook exhibits high levels of narration and high levels of instructional narration compared to other CIC textbook. While a high level of narration is reflective of concern for explanations the level of instructional narration is not so high as to cause concern. An exceptionally high number of exercises in this book contributes to a poor ratio of exercises to problems (3.5:1). This ratio masks a good incidence of problems throughout the textbook. Of the two CIC textbooks this book has a much higher incidence of non- routine problems. However, this textbook has a special extra section for the problem solver. The only noteworthy content omission is 'Estimating Computations' from strand 1. Motivational factors such as historical references, biographies and career information are given little consideration which is reflective of the low levels of related narration found in the structure analysis. Again strand 4 (Algebra) seems to be far removed from Project Maths with key expectations omissions as identified previously. Other individual strands fail to target expectations such as 'Generalising', 'Recognising Equivalents', 'Developing Strategies' and 'Predicting'.
TB 4	Once again this textbook is a subset of another textbook, TB 1 (chapters 3, 7, 14, 11, 12, 13, 18, 24-28). As previously, the only concern here is with syllabus alignment as regards content and expectation. The only content gap evident is 'Use of Computer Software' which was addressed previously. Issues similar to those in textbook TB 1 related to mathematical thinking were identified in the expectation analysis.
TB 5	This Junior Cycle textbook exhibits a high level of narration and instructional narration combined with low levels of related narration. The levels of instructional narration are not so high as to cause concern. As previously outlined high narration identifies a concern for explanations. The number of graphics present in this textbook is plentiful and 20% are concerned with problems which is a step towards the Project Maths expectation of graphic use. A surprising finding is the reduction in the number of exercises in comparison to its counterpart CIC textbook. This reduction improves the proportion of exercises and problems that are problems but there is no objective measure to judge whether this

	improves the efficacy of the text for the learner. The content of this textbook aligns well with the Project Maths syllabus apart from the 'Use of Computer Software' content topic. The only minor omission is 'Counting Principles'. In conjunction with the ICT deficiency noted in the content analysis, further analysis identified that references to computer software and the internet are minimal. While colour is consistent across this textbook the use of other motivational factors is minimal. The gaps that are evident from the expectation analysis indicate a lack of general focus on mathematical thinking e.g. 'Generalising' and strand-specific omissions, 'Inter and Across Subject Connections' and 'Relating Representations'. Problem solving is an issue for strand 2 where 'Developing Strategies' 'Using more Complex Procedures' and 'Conjecturing' do not feature. These findings run counter to the general expectation of Project Maths.
TB 6	High narration, instructional narration and low related narration are features of this textbook and these features are similar to previous textbook discussed. Similar findings for graphics are evident in both textbooks with 19% of graphics used for problem solving. However, this textbook exhibits a much lower incidence of problems in relation to the comparable textbooks for this syllabus. An important content gap evident is 'Use of Computer Software' which was addressed for previous textbooks. In conjunction with this ICT deficit noted in the content analysis, further analysis identified that references to computer software and the internet are absent. The use of colour is more limited in this textbook than the previous books and also the incidence of motivational factors is almost non-existent with just one reference to career information. Issues similar to those identified for the previous textbook related to mathematical thinking and problem solving were again evident in the expectation analysis.
TB 7	This Senior Cycle Ordinary level textbook is characterised by high levels of narration and related narration. There are a large number of definitions, theorems and axioms highlighted in comparison to comparable textbooks. The learning impact of definitions, axioms, theorems, etc is accentuated by printing devices such boxes and colour. The large number of graphics in this textbook adds little to the educational value of the text because only a small proportion of these graphics are related to problems counter to what Project Maths stipulates. The ratio of exercises to problems (2:1) is a better alignment with Project Maths expectations. The content topic 'Use of Computer Software' is an issue of concern for this textbook particularly in strand 2. However, strand 1 includes 6 references to computer software and 6 references to the internet. This book exhibits the highest incidence of motivational factors compared to the other Senior Cycle Ordinary level textbooks which is consistent with a high level of related

	narration. There is also a wide variety and consistent use of colour which contributes to student comprehension. The gaps that are evident from the expectation analysis indicate a lack of focus on mathematical thinking e.g. 'Generalising' and 'Inter and Across Subject Connections'. 'Developing Strategies' is omitted from strand 2.
TB 8	This Senior Cycle Ordinary level textbook exhibits a high level of narration and instructional narration combined with low levels of related narration. As previously outlined high narration identifies a concern for explanations, the levels of instructional narration are not so high as to cause concern. The number of graphics present in this textbook is plentiful and almost 40% are concerned with problems which is a step towards the Project Maths expectation of graphic use. The ratio of exercises to problems is almost 1:1 and is again a good alignment with the Project Maths expectations. As outlined in previous textbooks an important content gap evident is 'Use of Computer Software', further analysis also noted an omission of 'Exponents, Roots and Radicals' from strand 2. The use of colour is consistent throughout the textbook, however, there is a very low incidence of other motivational factors. The gaps evident from the expectation analysis indicate a lack of focus on mathematical thinking e.g. 'Generalising' and 'Across Subject Connections'. 'Developing Strategies' and 'Critiquing are also omitted from strand 2.
TB 9	High narration, high instructional narration and low related narration are features of this textbook and these features are similar to previous textbooks discussed. Similar findings for graphics are evident in both textbooks with 35% of graphics used for problem solving here. This textbook also makes use of printing devices to improve the learning impact of definitions e.g. colour and boxes. While the ratio of exercises to problems is almost 3:1, this textbook does present the highest number of non-routine problems (118) compared with the comparable textbooks for this syllabus. Similar content findings are evident for this textbook and the one previously discussed. The main areas of content concern are the omission of 'Use of Computer Software' from both strands and the absence of an emphasis on the use of 'Exponents, Roots and Radicals' from strand 2. Further analysis with regard to ICT identified that this textbook makes only 2 references to the internet; minor reference to motivational factors, and a limited use of colour. The gaps evident from the expectation analysis again indicate a lack of focus on mathematical thinking e.g. 'Generalising' and 'Across Subject Connections'. 'Inter Subject Connections' is omitted from strand 1 while 'Developing Strategies' is also omitted from strand 2.

TB 10	This Senior Cycle Higher level textbook contains high levels of narration and related narration. However, it is important to note that the levels of instructional narration in this textbook are much higher than in the previous textbooks from this series. This textbook also demonstrates a concern for explanations with the large number of definitions, theorems and axioms highlighted in comparison to comparable textbooks for this syllabus. It has a much higher number of graphics than comparable textbooks, however, only a small proportion of this number is related to problem solving. The balance between problems and exercise is improved from the ordinary level counterpart textbook by a ratio of 0.9:1 exercises to problems, and by the presence of 183 non-routine problems and 29 activities. This is a much better reflection of the Project Maths intentions. Again, lack of emphasis on ‘Use of Computer Software’ is evident from the content analysis of this textbook. There is one other omission; ‘Proportionality Problems’ which is absent from strand 2. Further analysis of the content shows that this textbook includes 14 references to computer software and 12 internet references. These findings in conjunction with the higher incidence of motivational factors, and variety and consistent use of colour suggest a concern for the Project Maths intentions. Once again gaps evident from the expectation analysis indicate a lack of focus on mathematical thinking e.g. ‘Generalising’ omitted from strand 1, and ‘Developing Algorithms’, ‘Developing Strategies’ & ‘Across Subject Connections’ from strand 2. ‘Critiquing’ is also absent from both strands.
TB 11	This Senior Cycle Higher level textbook exhibits a high level of narration and instructional narration combined with low levels of related narration. As previously outlined, high narration identifies a concern for explanations, the level of instructional narration is not so high as to cause concern. The number of graphics present in this textbook is generous and almost 40% are concerned with problems which is a step towards the Project Maths expectation of graphic use. The ratio of exercises to problems is 0.9:1, and combined with the high number of non-routine problems (226) this is a good alignment with the Project Maths expectations. Again the main area of concern with regard content is the omission of ‘Use of Computer Software’; further analysis identified 17 references to computer software and 2 internet references. A weak attempt is made to include motivational factors in this textbook while the use of colour is also limited. The gaps evident from strand 1 of the expectation analysis indicate a lack of focus on mathematical thinking e.g. ‘Generalising’ and ‘Inter & Across Subject Connections’. Problem solving is a lesser issue for strand 2 where ‘Developing Strategies’ and ‘Critiquing’ do not feature.

TB 12	This Senior Cycle Higher level textbook is a subset of textbook TB 10 (chapters 4-6 and 8-11). As previously, the only concern here is with syllabus alignment as regards content and expectation. The only content gap evident is 'Use of Computer Software' which was addressed previously. The main expectation concerns are evident in the omission of 'Developing Algorithms', 'Developing Strategies' & 'Across Subject Connections' and 'Critiquing' from strands 2. These expectations are of concern for mathematical thinking and problem solving as espoused by Project Maths.
TB 13	This Senior Cycle Higher level textbook exhibits a high level of narration and combined with low levels of instructional narration and related narration. The number of graphics present in this textbook is plentiful and 37% are concerned with problems. Again, this is in line with Project Maths expectations of graphic use. The ratio of exercises to problems (0.5:1) combined with the high number of non-routine problems (147) signals a good alignment with the Project Maths expectations in this regard. The content topic 'Use of Computer Software' is again omitted. Further analysis identified no references to computer software or the internet, and few incidences of motivational factors. The gaps evident from the expectation analysis indicate a lack of focus on mathematical thinking e.g. 'Generalising', 'Developing Algorithms' and 'Critiquing'.
TB 14	This Higher level textbook is a subset of textbook TB 11 (chapters 3-6) which was previously discussed. As previously, the structural concerns include a low level of related narration. The main issues with this textbook are with syllabus alignment as regards content and expectation. The only content gap evident is 'Use of Computer Software' which was addressed previously and expectation gaps are again evident in terms of mathematical thinking; 'Developing Algorithms', 'Developing Strategies' & 'Critiquing' and 'Across Subject Connections'.

5.2 Summary

All textbooks included in the study fall short of the standard needed to support Project Maths (intended curriculum) effectively, as envisaged in the Project Maths Syllabus documents for Junior Cycle, including the Common Introductory Course (CIC), and Senior Cycle. However, some of the new textbooks are better aligned to Project Maths expectations than others. The individual profiles of textbooks as developed in this study are not always consistent with each other across their associated curricula.

A number of issues stand out when these profiles are considered together. It is noteworthy that there should be any topic omissions when the Project Maths syllabus treats all topics as compulsory. For example, Project Maths stresses the integration of ICT into the curriculum and despite this emphasis 'Use of Computer Software' repeatedly emerged as a content omission. Project Maths expectations in relation to teaching for understanding, problem solving and using real life applications, and integration of ICT are addressed to variable degrees within the new textbooks. All these textbooks display a genuine attempt to match Project Maths expectations but no one textbook meets all the Project Maths expectations as identified above.

The textbook analysis captures elements that contribute to all the expectations. Structure and content analysis uncovers disparities between the textbooks in their approaches to teaching for understanding and problem solving. This is evident in features such as the distribution of narration, narration types, and abundance of non-routine problems and problems in context. Some textbooks show greater consideration for teaching for understanding in terms of narration and related narration, and the use of printing devices to aid comprehension. The treatment of problem solving is variable across all textbook series and no one textbook series deals with this aspect satisfactorily. However, some individual Senior Cycle textbooks are better in this regard. Another contribution to teaching for understanding is the inclusion of motivational factors that help to place mathematics in context.

The most significant overall finding is the mismatch between textbook expectations and Project Maths expectations. The lack of obvious attention to key Project Maths expectations must be attended to successfully if textbooks are to fulfil their role in the success of Project Maths. While the developmental nature of Project Maths is on a strand by strand basis, this militates against topic integration, and, when the roll out is complete, a more integrated approach should feature in textbooks.

5.3 Recommendations

These considerations lead to a single integrated recommendation:

- An exemplar textbook series for Project Maths should be produced by a specially selected and constituted writing team appointed and funded by the DES,
- All commercially produced textbooks for Project Maths should then be reviewed against this exemplar textbook series
- Such a review procedure should lead to an approved list of mathematics textbooks for Project Maths.

6. References

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7. Glossary of terms

Narration:

this refers to all text and information presented in the textbook outside of exercises and examples. Narration was counted in blocks, sentence by sentence.

Related Narration:

this refers to all text and information devoted to providing additional information such as historical significance, biographical and career information.

Instructional Narration:

this refers to all commands and instruction which are outside the exercise and example context. High levels of instructional narration indicate an emphasis on the procedural nature of mathematics.

Definitions:

this refers to all definitions which are bolded and highlighted from the narration. Embedded definitions were not counted.

Routine Problem:

this refers to all problems which are 'dressed up exercises'.

Non- Routine Problem:

this refers to all problems which cannot be answered by a routine procedure or problems in which it is not immediately obvious what one must do.

Real Context Problem:

this refers to the type of problems which are created in a real environment and which involve or engage the student.

Realistic Context Problem:

this refers to the type of problems which have the possibility of being reproduced, involves a simulation of reality.

Fantasy Context Problem:

this refers to the type of problems which are not based on reality and are the product of imagination.

Purely Mathematical Context Problem:

this refers to the type of problems which are exclusively mathematical and relate only to mathematical objects.

Project Math Syllabus Strands:

Strand 1 (S1): Probability and Statistics

Strand 2 (S2): Geometry and Trigonometry

Strand 3 (S3): Number

Strand 4 (S4): Algebra

Strand 5 (S5): Functions

8. Appendices

Appendix A

Table A.1: List of Junior Cycle reviewed textbooks

Constructed Curriculum:	Publisher	Level:	Code	Textbooks
1. Strand 1 - 5	A	Ordinary Level	JC TB 1 S1-5/O	Textbook 1
			JC SY S1-5/O	Syllabus
2. CIC	A	All Levels	JC TB 1 CIC	Textbook 2
			JC TB 2 CIC	Textbook 3
			JC SY CIC	Syllabus
3. Strands 1 & 2	A	Ordinary Level	JC TB 1 S1&2/O	Textbook 4
			JC TB 2 S1&2/O	Textbook 5
			JC TB 3 S1&2/O	Textbook 6
			JC SY S1&2/O	Syllabus

Table A.2: List of Senior Cycle Ordinary level reviewed textbooks

Constructed Curriculum:	Publisher	Level:	Code	Textbooks
4. Strands 1 & 2	A	Ordinary Level	LC TB 1 S1&2/O	Textbook 7
			LC TB 2 S1&2/O	Textbook 8
			LC TB 3 S1&2/O	Textbook 9
			LC SY S1&2/O	Syllabus

Table A.3: List of Senior Cycle Higher level reviewed textbooks

Constructed Curriculum:	Publisher	Level:	Code	Textbooks
5. Strands 1 & 2	A	Higher Level	LC TB 1 S1&2/H	Textbook 10
	C	Higher Level	LC TB 2 S1&2/H	Textbook 11
			LC SY S1&2/H	Syllabus
6. Strand 2	A	Higher Level	LC TB 1 S2/H	Textbook 12
	B	Higher Level	LC TB 2 S2/H	Textbook 13
	C	Higher Level	LC TB 3 S2/H	Textbook 13
			LC SY S2/H	Syllabus

Appendix B

Document Analysis Form

Date:	Document ID Code:					Unit ID Number:				No.		of	
Page No.													
Block ID													
Structure (Block Type)													
Content													
Expectation													
Notes:													

Appendix C

A further refinement of the curriculum material analysis tool in TIMSS identified a number of textbook content topics. This topic list which is intended for content analysis was further refined for this study. The TIMSS content list originally had ten key elements:

- 1.1 Numbers
- 1.2 Measurement
- 1.3 Geometry: position, visualisation and shape
- 1.4 Geometry: symmetry, congruence and similarity
- 1.5 Proportionality
- 1.6 Functions, relations and equations
- 1.7 Data representation, probability and statistics
- 1.8 Elementary analysis
- 1.9 Validation and structure
- 1.10 Other

TIMSS then further categorised each of these ten categories into subdivisions of content topics. For the purpose of this analysis six additional explicit categories were included. These are:

- The use of Computer Software
- Measurement (as a content topic as opposed to a section as outlined in TIMSS)
- Factorisation
- Trigonometry (as a separate section from Geometry)
- Definition of Function
- Irrational Numbers
- Use of the Internet

The above topics and the TIMSS content topics combine to give the following list of content topics:

Content Data List:

- | | |
|--|--|
| 1. Meaning | 40. Linear interpolation & extrapolation |
| 2. Operations | 76. Trig |
| 3. Properties of Operations | 41. Area |
| 4. Common Fractions | 42. Trig Ratios |
| 5. Decimals | 43. Patterns, Relations & Analysis |
| 6. Relationships with common & decimal | 44. Equations & formulae |
| 7. Percentages | 77. Definition of Function |
| 8. Properties of common & Decimal | 45. Domain & range |
| 9. Negative Numbers & their properties | 46. Function classification |
| 10. Rational Numbers and their properties | 47. Linear Functions |
| 11. Real numbers, their subsets & properties | 48. Quadratics Functions |
| 12. Binary Arithmetic | 49. Cubic Functions |
| 13. Exponents, roots and radicals | 50. Exponential Functions |
| 14. Complex numbers and their properties | 51. Logarithmic Functions |
| 15. Number Theory | 52. Trigonometric Functions |
| 16. Counting | 53. Inequalities |
| 17. Estimation & Number Sense | 75. Factorisation |
| 18. Estimating quantity & size | 54. Approximating Values |
| 19. Rounding & significant figures | 55. Maximum & Minimum Values |
| 20. Estimating computations | 56. Data Representation & Analysis |
| 21. Exponents & orders of magnitude | 57. Classification of Data |
| 22. Set properties | 58. Classification of Studies (including |
| 23. Set operations | 59. Summary Statistics |
| 24. Venn Diagrams | 60. Randomisation (including Bias) |
| 25. Units | 61. Inferential Statistics |
| 26. Perimeter, Area & Volume | 62. Counting principles |
| 27. Estimation & Errors | 63. Permutations & Combinations |
| 74. Measure | 64. Defining Probability |
| 28. 2D Geometry: Coordinate Geometry – | 65. Measuring Probability |
| 29. 2D Geometry: Coordinate Geometry – | 66. Laws of Probability |
| 30. 2D Geometry: Basics – angles & lines | 67. Probability Experiments |
| 31. 2D Geometry: Basics – shapes & | 68. Infinite Processes |
| 32. 2D Geometry: Circles | 69. Change |
| 33. 3D Geometry/problems | 70. Motion |
| 34. Transformations | 71. Validation & Justification |
| 35. Congruence & Similarity | 72. Structuring & Abstracting |
| 36. Constructions using straightedge & | 73. Software |
| 37. Proof & Theorems | 78. Irrational Numbers |
| 38. Proportionality Concepts | 79. Internet |
| 39. Proportionality Problems | |

Appendix D

Junior Cycle Data

TIMSS+ Analysis – Structure, Content & Expectation

Appendix D1

Narration

Table D.1: Distribution of Narration and Narration type throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Narration	Related Narration	Instructional Narration
1 (JC S1-5 O)	1	1107	99	25
	SY	-	-	-
2 (JC CIC)	2	631	76	10
	3	884	14	45
	SY	-	-	-
3 (JC S1&2 O)	4	505	74	10
	5	703	16	32
	6	579	7	47
	SY	-	-	-

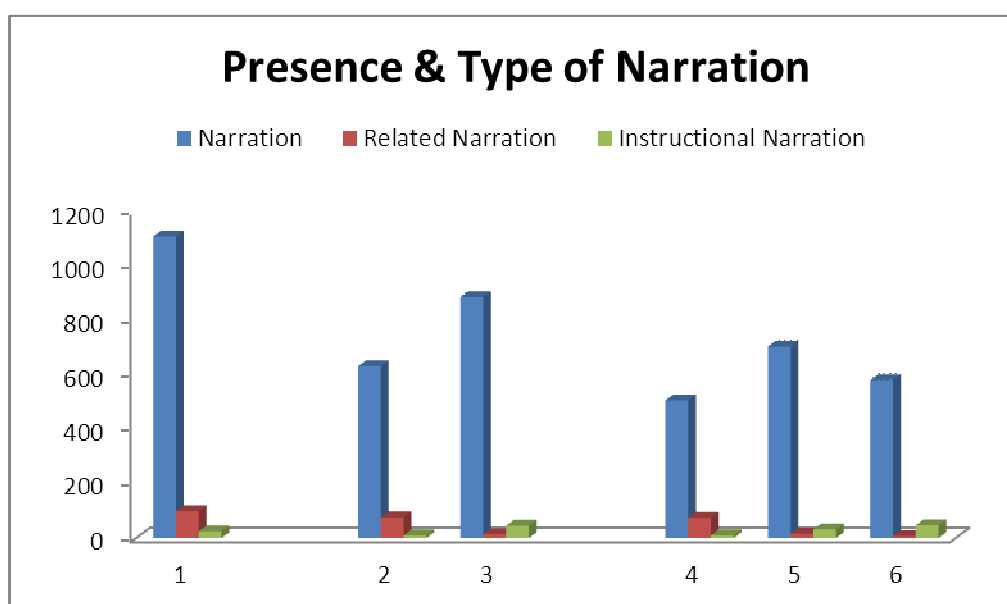


Figure D.1: Distribution of Narration and Narration type throughout the Junior Cycle Mathematics Textbooks

Appendix D2

Definitions

Table D.2: Distribution of Definitions, Theorems & Axioms throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Definitions	Theorems	Axioms & Corollaries
1 (JC S1-5 O)	1	152	11	7
	SY	-	-	-
2 (JC CIC)	2	99	7	4
	3	33	1	1
	SY	-	-	-
3 (JC S1&2 O)	4	74	11	7
	5	19	2	1
	6	32	1	0
	SY	-	-	-

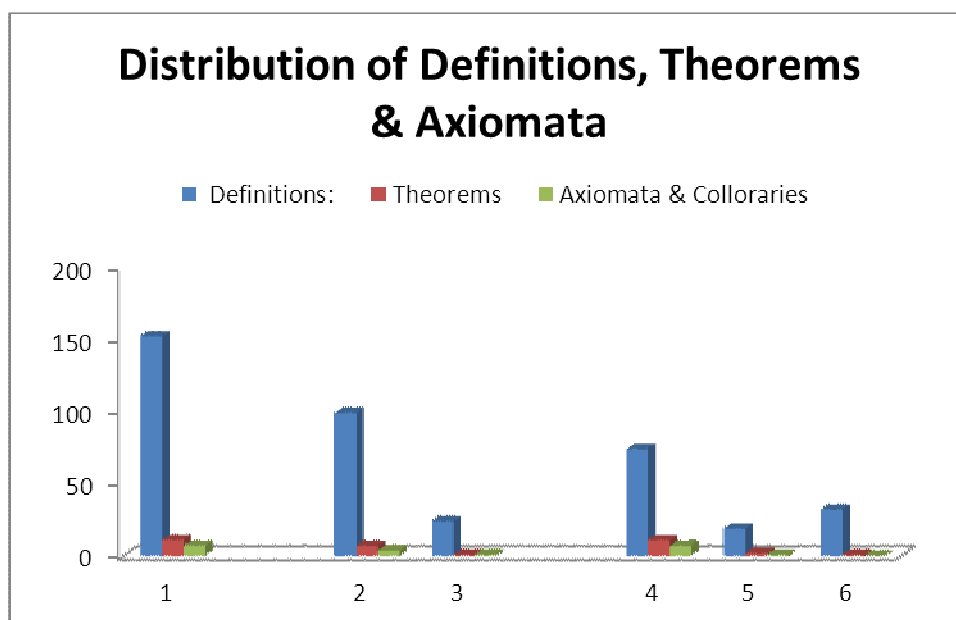


Figure D.2: Distribution of Definitions, Theorems & Axioms throughout the Junior Cycle Mathematics Textbooks

Appendix D3

Graphics

Table D.3: Distribution and Purpose of Graphics throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Graphics	Graphics for Problem Solving	Realistic Diagrams	Photos
1 (JC S1-5 O)	1	1616	334	193	204
	SY	-	-	-	
2 (JC CIC)	2	853	171	103	126
	3	949	196	150	12
	SY	-	-	-	
3 (JC S1&2 O)	4	1096	211	164	125
	5	822	177	112	10
	6	720	139	83	0
	SY	-	-	-	

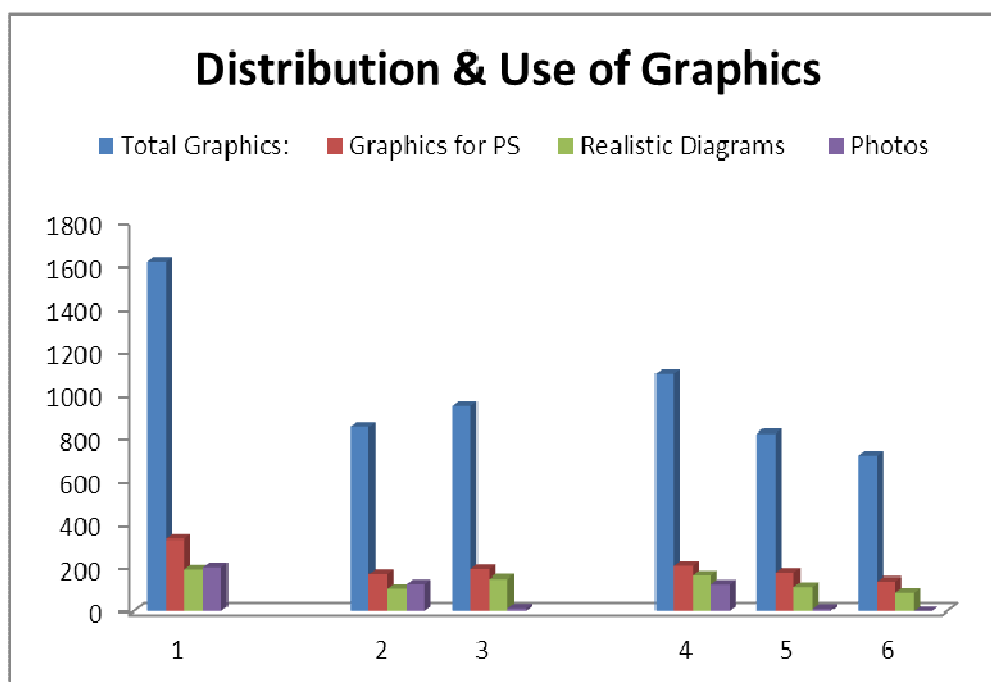


Figure D.3: Distribution and Purpose of Graphics throughout the Junior Cycle Mathematics Textbooks

Appendix D4

Exercises

Table D.4: Distribution of Exercises, Problems and Activities throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Exercise Blocks	Problem Blocks	Exercises	Problems	Activities
1 (JC S1-5 O)	1	343	100	2025	690	16
	SY	-	-	-		
2 (JC CIC)	2	189	55	782	349	13
	3	150	89	1843	532	8
	SY	-	-	-		
3 (JC S1&2 O)	4	176	45	612	280	16
	5	58	35	482	225	5
	6	46	27	556	152	1
	SY	-	-	-		

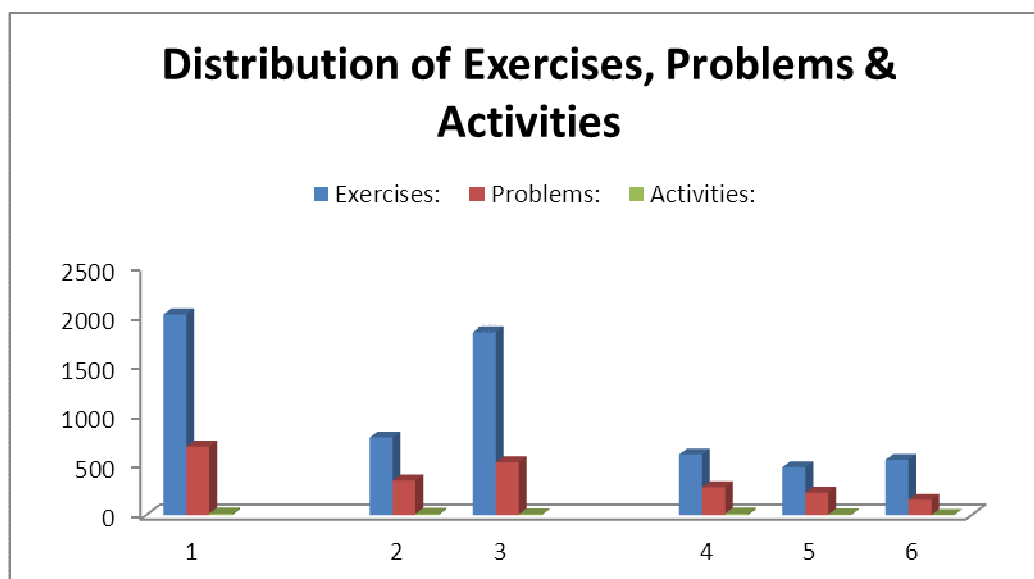


Figure D.4: Distribution of Exercises, Problems and Activities throughout the Junior Cycle Mathematics Textbooks

Table D.4a: Percentage Breakdown of Exercises and Problems throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Total Exercises + Problems	% of which are Problems
1 (JC S1-5 O)	1	2715	25.41%
	SY	-	-
2 (JC CIC)	2	1081	32.28%
	3	2375	22.4%
	SY	-	-
3 (JC S1&2 O)	4	892	31.39%
	5	707	31.83%
	6	708	21.47%
	SY	-	-

Appendix D5

Examples

Table D.5: Distribution of Worked Examples throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Total No. of Worked Examples	Real/Realistic	Mathematical
1 (JC S1-5 O)	1	309	102	207
	SY	-	-	-
2 (JC CIC)	2	162	56	106
	3	108	21	87
	SY	-	-	-
3 (JC S1&2 O)	4	110	45	65
	5	58	16	42
	6	67	23	44
	SY	-	-	-

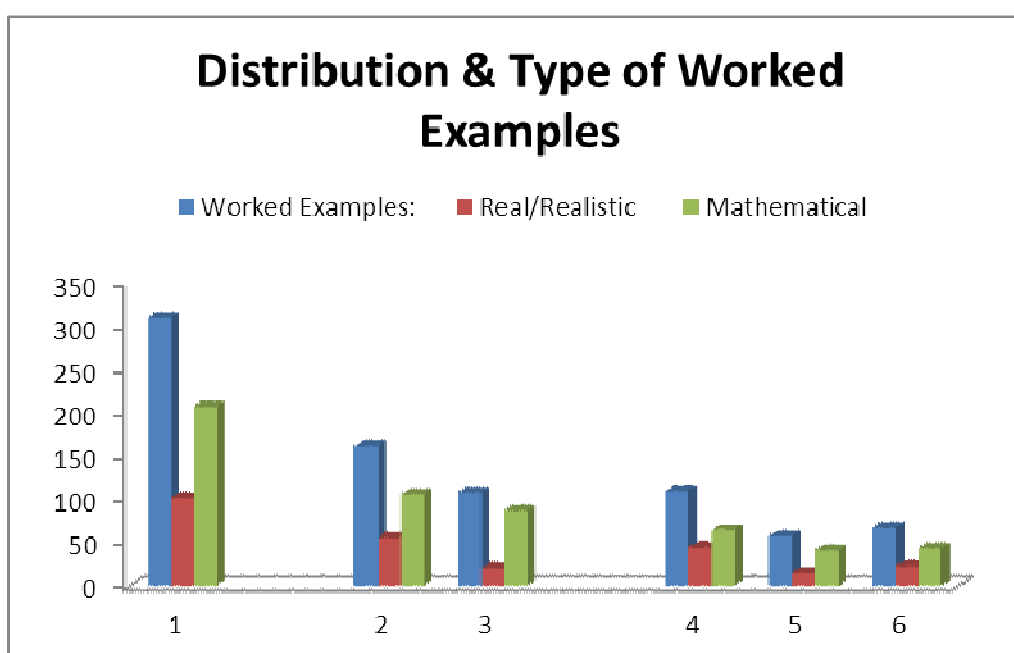


Figure D.5: Distribution of Worked Examples throughout the Junior Cycle Mathematics Textbooks

Table D.5a: Ratio of Worked Examples to Exercises, Problems & Activities throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Total Worked Examples	Ratio Examples: Exercises
1 (JC S1-5 O)	1	309	1:08.79
	SY	-	-
2 (JC CIC)	2	162	1:06.67
	3	108	1:21.99
	SY	-	-
3 (JC S1&2 O)	4	110	1:08.11
	5	58	1:12.19
	6	67	1:10.57
	SY	-	-

Appendix D6

Junior Cycle Mathematics Textbook Content Analysis

The following tables (Table D.6a to D.6i) represent the content data from the Junior Cycle Mathematics Textbooks. Each column in the following grids represents a strand of content from the Project Maths Curriculum and each row represents a specific content topic as derived from TIMSS. A list of 79 content topics was originally devised (see Appendix C), non-applicable content topics were removed after data collection hence the numbering is not continuous.

Content Data List:

- | | |
|--|--|
| 1. Meaning | 37. Proof & Theorems |
| 2. Operations | 38. Proportionality Concepts |
| 3. Properties of Operations | 39. Proportionality Problems |
| 4. Common Fractions | 76. Trig |
| 5. Decimals | 41. Area |
| 6. Relationships with common & decimal | 42. Trig Ratios |
| 7. Percentages | 43. Patterns, Relations & Analysis |
| 8. Properties of common & Decimal | 44. Equations & formulae |
| 9. Negative Numbers & their properties | 77. Definition of Function |
| 10. Rational Numbers and their properties | 45. Domain & range |
| 11. Real numbers, their subsets & properties | 47. Linear Functions |
| 13. Exponents, roots and radicals | 48. Quadratics Functions |
| 16. Counting | 49. Cubic Functions |
| 17. Estimation & Number Sense | 50. Exponential Functions |
| 18. Estimating quantity & size | 53. Inequalities |
| 19. Rounding & significant figures | 75. Factorisation |
| 20. Estimating computations | 54. Approximating Values |
| 21. Exponents & orders of magnitude | 56. Data Representation & Analysis |
| 22. Set properties | 57. Classification of Data |
| 23. Set operations | 58. Classification of Studies (including |
| 24. Venn Diagrams | 59. Summary Statistics |
| 25. Units | 60. Randomisation (including Bias) |
| 26. Perimeter, Area & Volume | 62. Counting principles |
| 27. Estimation & Errors | 63. Permutations & Combinations |
| 74. Measure | 64. Defining Probability |
| 28. 2D Geometry: Coordinate Geometry – | 65. Measuring Probability |
| 30. 2D Geometry: Basics – angles & lines | 66. Laws of Probability |
| 31. 2D Geometry: Basics – shapes & | 67. Probability Experiments |
| 32. 2D Geometry: Circles | 69. Change |
| 33. 3D Geometry/problems | 70. Motion |
| 34. Transformations | 73. Use of Computer Software |
| 35. Congruence & Similarity | 79. Internet |
| 36. Constructions using straightedge & | |

Table D.6a: TB 1

S. 1	S. 2	S. 3	S. 4	S. 5	Content
					1
					2
					3
					4
					5
					6
					7
					8
					9
					10
					11
					13
					16
					17
					18
					19
					20
					21
					22
					23
					24
					25
					26
					27
					74
					28
					30
					31
					32
					33
					34
					35
					36
					37
					38
					39
					76
					41
					42
					43
					44
					77
					45
					47
					48
					49
					50
					53
					75
					54
					56
					57
					58
					59
					60
					62
					63
					64
					65
					66
					67
					69
					70
					73

Table D.6b: JC SY S1-5

S. 1	S. 2	S. 3	S. 4	S. 5	Content
					1
					2
					3
					4
					5
					6
					7
					8
					9
					10
					11
					13
					16
					17
					18
					19
					20
					21
					22
					23
					24
					25
					26
					27
					74
					28
					30
					31
					32
					33
					34
					35
					36
					37
					38
					39
					76
					41
					42
					43
					44
					77
					45
					47
					48
					49
					50
					53
					75
					54
					56
					57
					58
					59
					60
					62
					63
					64
					65
					66
					67
					69
					70
					73
					79

Table D.6c: TB 2

S. 1	S. 2	S. 3	S. 4	Cont.
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				13
				16
				17
				18
				19
				20
				21
				22
				23
				24
				25
				26
				27
				74
				28
				30
				31
				32
				33
				34
				35
				36
				37
				38
				39
				76
				41
				42
				43
				44
				77
				45
				47
				48
				49
				50
				53
				75
				54
				53
				56
				57
				58
				59
				60
				62
				63
				64
				65
				66
				67
				69
				70
				73

Table D.6d: TB 3

S. 1	S. 2	S. 3	S. 4	Cont.
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				13
				16
				17
				18
				19
				20
				21
				22
				23
				24
				25
				26
				27
				74
				28
				30
				31
				32
				33
				34
				35
				36
				37
				38
				39
				76
				41
				42
				43
				44
				77
				45
				47
				48
				49
				50
				53
				75
				54
				56
				57
				58
				59
				60
				62
				63
				64
				65
				66
				67
				69
				70
				73

Table D.6e: JC SY CIC

S. 1	S. 2	S. 3	S. 4	Cont.
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				13
				16
				17
				18
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				22
				23
				24
				25
				26
				27
				74
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				30
				31
				32
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				36
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				38
				39
				76
				41
				42
				43
				44
				77
				45
				47
				48
				49
				50
				53
				75
				54
				56
				57
				58
				59
				60
				62
				63
				64
				65
				66
				67
				69
				70
				73

Table D.6f:
TB 4

S. 1	S. 2	Cont.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		13
		16
		17
		18
		19
		20
		21
		22
		23
		24
		25
		26
		27
		74
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		39
		76
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		53
		75
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		56
		57
		58
		59
		60
		62
		63
		64
		65
		66
		67
		69
		70
		73

Table D.6g:
TB 5

S. 1	S. 2	Cont.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		13
		16
		17
		18
		19
		20
		21
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		26
		27
		74
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		76
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		75
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		56
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		58
		59
		60
		62
		63
		64
		65
		66
		67
		69
		70
		73

Table D.6h:
TB 6

S. 1	S. 2	Cont.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		13
		16
		17
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		20
		21
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		23
		24
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		74
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		75
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		56
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		60
		62
		63
		64
		65
		66
		67
		69
		70
		73

Table D.6i:
JC SY S1&2/O

S. 1	S. 2	Cont.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		13
		16
		17
		18
		19
		20
		21
		22
		23
		24
		25
		26
		27
		74
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		31
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		75
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		62
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		67
		69
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		73

Appendix D7

Motivational factors (Rivers Matrix)

Table D.7: Distribution of Motivational Factors throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Historical Notes	Bio-graphies	Career Information	Problem Solving	Photos	Humour/ Quotes
1 (JC S1-5 O)	1	25	5	9	690	204	6
	SY	-	-	-	-	-	-
2 (JC CIC)	2	21	4	4	349	126	5
	3	6	0	0	532	12	0
	SY	-	-	-	-	-	-
3 (JC S1&2 O)	4	15	5	7	280	125	3
	5	4	1	1	225	10	0
	6	0	0	1	150	0	0
	SY	-	-	-	-	-	-

Appendix D8

Comprehension Cues (Rivers Matrix)

Table D.8: Summary of colour use throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Page Background Colour	Font Colour	Graph-line Colour
1 (JC S1-5 O)	1	Hints: Purple Formula: Blue Exercises: blue Examples: green Definitions: Green Keywords: green Theorems/Axioms: Orange Reminders: Change per chapter (Blue, Pink, Green, Orange)	White, Black, Blue, Green, Pink	Red, Blue, Black, Green, Purple, Navy
	SY	-	-	-
2 (JC CIC)	2	Hints: Purple Formula: Blue Exercises: blue Examples: green Definitions: Green Keywords: green Theorems/Axioms: Orange Reminders: Change per chapter (Blue, Pink, Green, Orange)	White, Black, Blue, Green	Red, Blue, Black,
	3	Hints/Def/Formulae: Yellow Keywords: Blue Examples: Green	Red, Black, Blue, Green	Black, Red
	SY	-	-	-
3 (JC S1&2 O)	4	Hints: Purple Formula: Blue Exercises: Blue Examples: Green Definitions: Green Keywords: Green Theorems/Axioms: Orange Reminders: Change per chapter (Blue, Pink, Green, Orange)	White, Black, Blue, Green, Pink	Red, Blue, Black, Green, Purple, Navy

	5	Hints/Definitions/Formulae: Yellow Keywords, Examples & Definitions: Interchange dependant on chapter colour (Purple (pink), Blue, Green, Red (orange))	Black & dependant on chapter colour. For example chapter 1 heading is Purple and writing is black & purple	Blue, Black, Red, Green
	6	Hints/Definitions/Formulae: Blue Examples & exercises: Yellow	Red, Black, Blue,	Blue, Red, Black
	SY	-	-	-

Appendix D9

Technical Aids (Rivers Matrix)

Table D.9: Distribution of Technical Aids throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Computer Software	Calculator	Internet
1 (JC S1-5 O)	1	12	56 (22)	2
	SY	-	-	-
2 (JC CIC)	2	12	14 (16)	1
	3	0	19 (12)	0
	SY	-	-	-
3 (JC S1&2 O)	4	12	22	1
	5	0	11	0
	6	0	7	0
	SY	-	-	-

*The figure in brackets represents instances where the calculator is referred to in the context of 'Do not use your calculator'

Appendix D10

Problem Solving

Table D.10: Distribution of Routine & Non- Routine Problems throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Routine Problems	Non-Routine Problems
1 (JC S1-5 O)	1	645	45
	SY	-	-
2 (JC CIC)	2	329	20
	3	443	89
	SY	-	-
3 (JC S1&2 O)	4	264	16
	5	219	6
	6	150	2
	SY	-	-

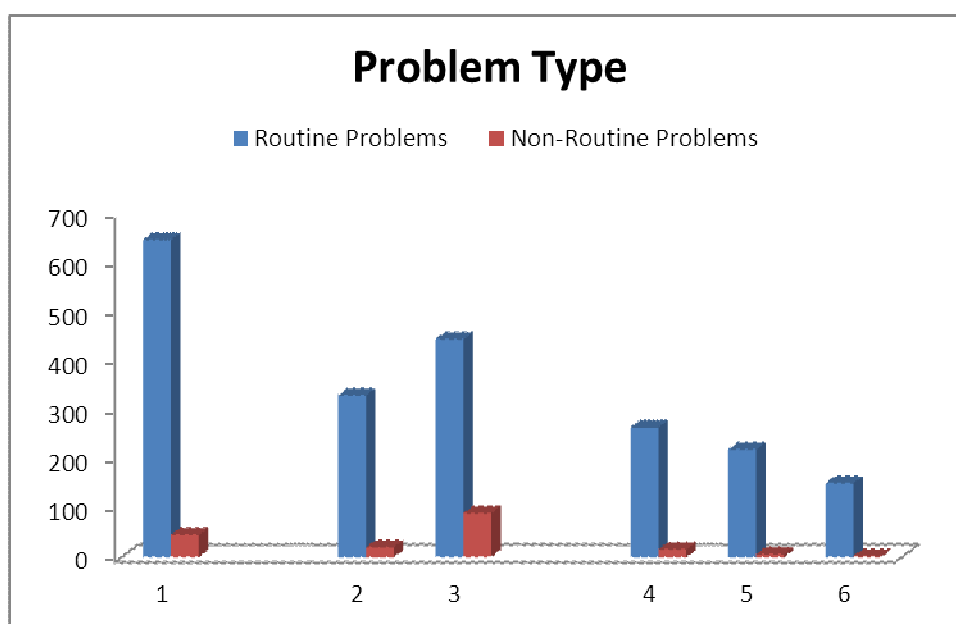


Figure D.6: Distribution of Routine & Non- Routine Problems throughout the Junior Cycle Mathematics Textbooks

Table D.10a: Breakdown of Routine Problem Type throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Real	Realistic	Fantasy	Purely Mathematical
1 (JC S1-5 O)	1	90	447	29	79
	SY	-	-		
2 (JC CIC)	2	65	235	4	25
	3	49	239	12	60
	SY	-	-		
3 (JC S1&2 O)	4	43	190	20	11
	5	29	163	5	22
	6	19	97	3	29
	SY	-	-		

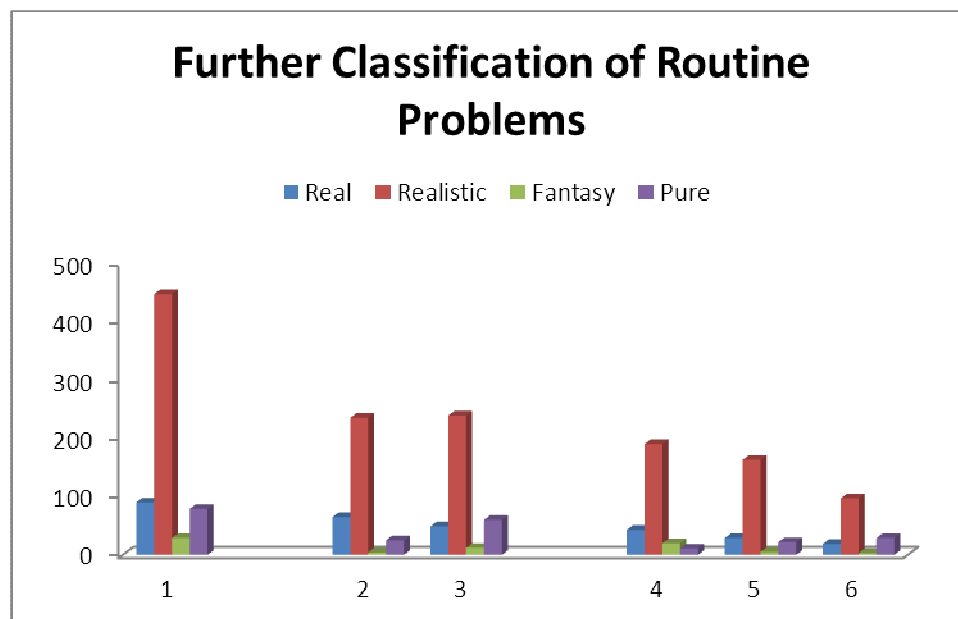


Figure D.7: Breakdown of Routine Problems throughout the Junior Cycle Mathematics Textbooks

Table D.10b: Breakdown of Non-Routine Problem Type throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Real	Realistic	Fantasy	Purely Mathematical
1 (JC S1-5 O)	1	4	32	2	7
	SY	-	-		
2 (JC CIC)	2	3	16	0	1
	3	0	29	16	44
	SY	-	-		
3 (JC S1&2 O)	4	0	12	0	4
	5	0	6	0	0
	6	0	2	0	0
	SY	-	-		

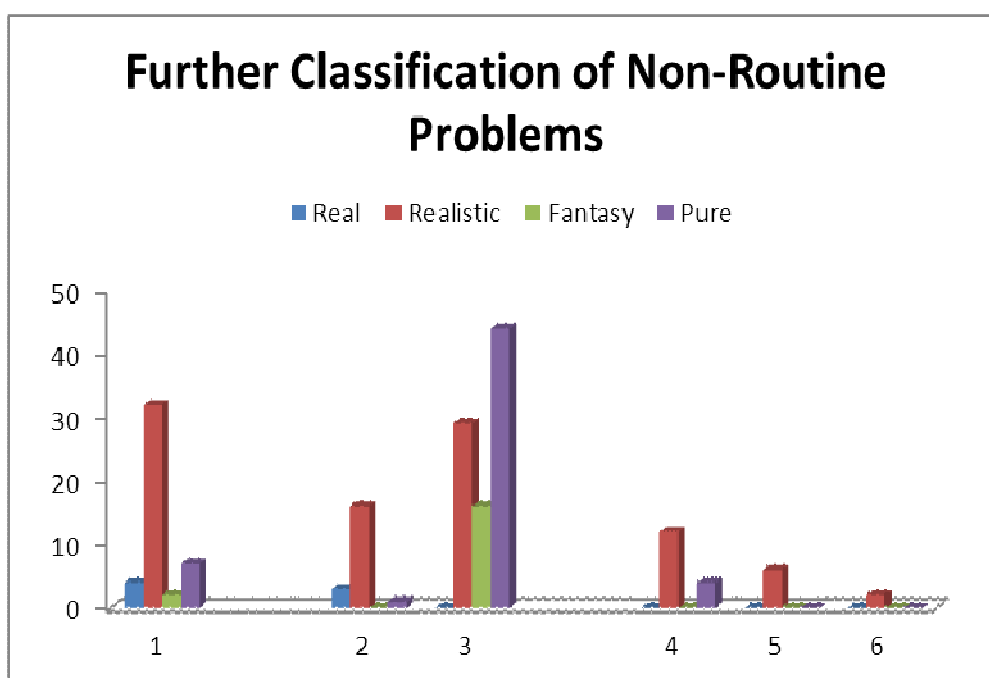


Figure D.8: Breakdown of Non-Routine Problems throughout the Junior Cycle Mathematics Textbooks

Appendix D11

Junior Cycle Mathematics Textbook Expectation Analysis

The following tables (Table D.11a to D.11i) represent the expectation data from the Junior Cycle Mathematics Textbooks. Each column in the following grids represents a strand of content from the Project Maths Curriculum and each row represents a specific expectation as derived from TIMSS. A list of 24 expectations was originally devised, an additional 6 project Maths specific expectations are noted in the syllabi analysis.

Expectation Data List:

Knowing

1. Representing
2. Recognising Equivalents
3. Recalling Mathematical Objects & Properties

Using Routine Procedures

4. Using Equipment
5. Performing Routine Procedures
6. Using More Complex Procedures

Investigating & Problem Solving

7. Formulating & Clarifying Problems &
8. Developing strategies (Designing)
9. Solving
10. Predicting
11. Verifying

Mathematical Reasoning

12. Developing Notation & Vocabulary
13. Developing algorithms
14. Generalising
15. Conjecturing
16. Justifying & proving
17. Axiomatising

Communicating

18. Using Vocabulary & Notation
19. Relating Representations
20. Describing/Discussing
21. Critiquing

Making Communications

22. Inter Subject Connections
23. Across Subject Connections
24. Give Real Life Examples
25. Instrumental Learning
26. Relational Learning
27. Fostering Positive Attitudes
28. Inquiry Based Learning
29. Applications
30. Connecting Solutions & Questions

Table D.11a: TB 1

S. 1	S. 2	S. 3	S. 4	S. 5	Exp.
					1
					2
					3
					4
					5
					6
					7
					8
					9
					10
					11
					12
					13
					14
					15
					16
					17
					18
					19
					20
					21
					22
					23
					24

Table D.11b: JC SY S1-5

S. 1	S. 2	S. 3	S. 4	S. 5	Exp.
					1
					2
					3
					4
					5
					6
					7
					8
		*	*	*	9
					10
					11
					12
					13
					14
					15
					16
					17
					18
					19
					20
					21
					22
					23
					24

					25
					26
					27
					28
					29
					30

*The red box identifies the expectation that problem solving should be in context and should make use of graphics.

Table D.11c: TB 2

S. 1	S. 2	S. 3	S. 4	Exp.
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				12
				13
				14
				15
				16
				17
				18
				19
				20
				21
				22
				23
				24

Table D.11d: TB 3

S. 1	S. 2	S. 3	S. 4	Exp.
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				12
				13
				14
				15
				16
				17
				18
				19
				20
				21
				22
				23
				24

Table D.11e: JC SY CIC

S. 1	S. 2	S. 3	S. 4	Exp.
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				12
				13
				14
				15
				16
				17
				18
				19
				20
				21
				22
				23
				24

				25
				26
				27
				28
				29
				30

*The red box identifies the expectation that problem solving should be in context and should make use of graphics.

Table D.11f:
TB 4

S. 1	S. 2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

Table D.11g:
TB 5

S. 1	S. 2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

Table D.11h:
TB 6

S. 1	S. 2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

Table D.11i:
JC SY S1&2/O

S. 1	S. 2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
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Appendix E

Senior Cycle Ordinary Level Data

TIMSS+ Analysis – Structure, Content & Expectation

Appendix E1

Narration

Table E.1: Distribution of Narration and Narration type throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Narration	Related Narration	Instructional Narration
4. (LC S1&2/O)	7	689	75	15
	8	891	5	39
	9	665	6	67
	SY	-	-	-

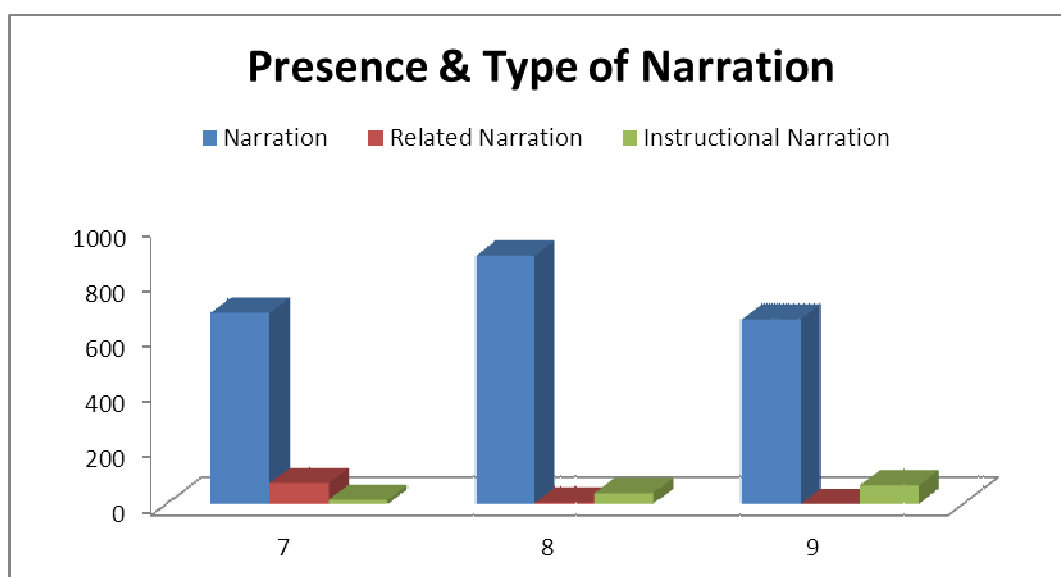


Figure E.1: Distribution of Narration and Narration type throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Appendix E2

Definitions

Table E.2: Distribution of Definitions, Theorems & Axioms throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Definitions	Theorems	Axioms & Corollaries
4. (LC S1&2/O)	7	119	22	9
	8	44	13	1
	9	71	1	0
	SY	-	-	-

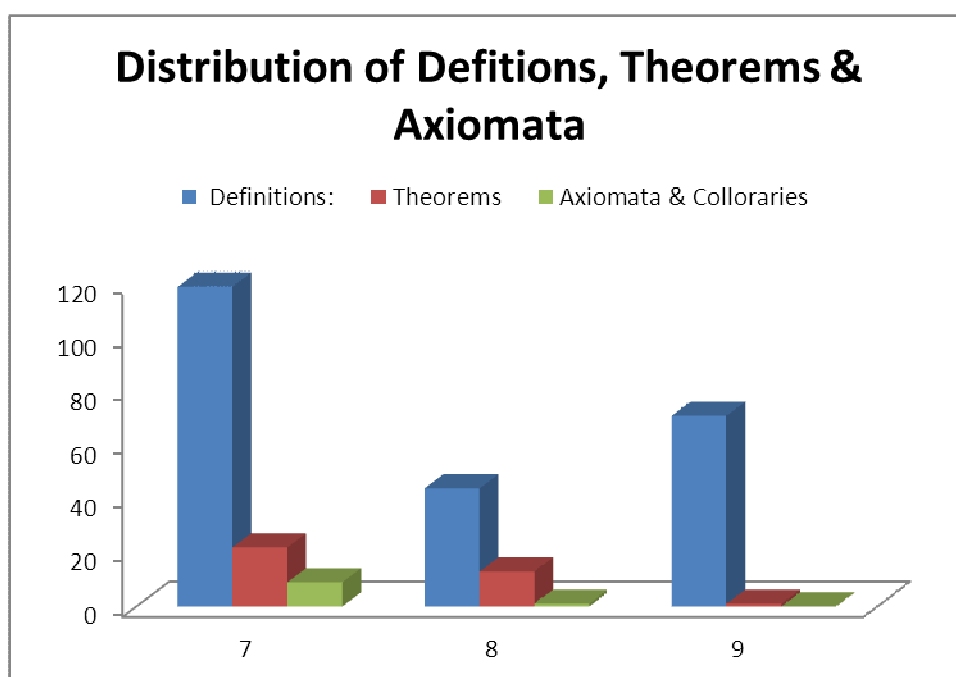


Figure E.2: Distribution of Definitions, Theorems & Axioms throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Appendix E3

Graphics

Table E.3: Distribution and Purpose of Graphics throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Graphics	Graphics for Problem Solving	Realistic Diagrams	Photos
4. (LC S1&2/O)	7	1218	230	151	96
	8	736	290	78	5
	9	641	227	78	2
	SY	-	-	-	

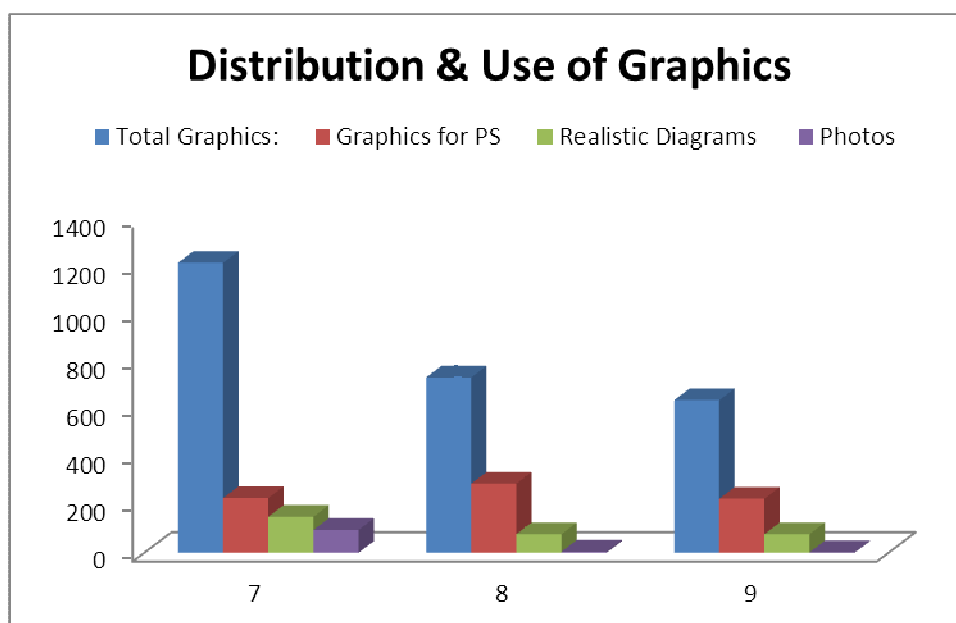


Figure E.3: Distribution and Purpose of Graphics throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Appendix E4

Exercises

Table E.4: Distribution of Exercises, Problems and Activities throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Exercise Blocks	Problem Blocks	Exercises	Problems	Activities
4. (LC S1&2/O)	7	207	81	806	435	15
	8	54	54	448	431	1
	9	67	61	828	404	9
	SY	-	-	-		

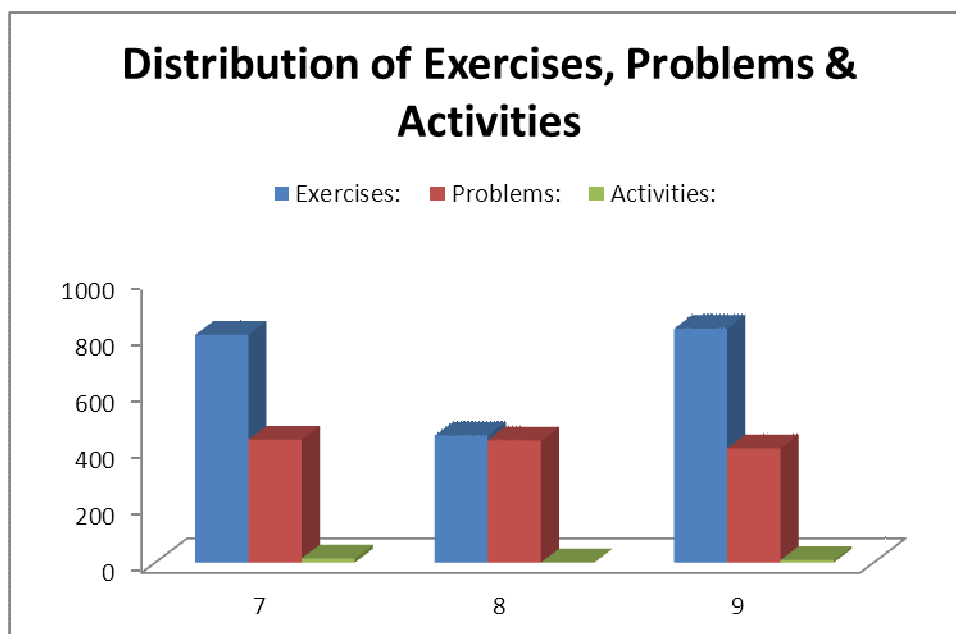


Figure E.4: Distribution of Exercises, Problems and Activities throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Table E.4a: Percentage Breakdown of Exercises and Problems throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Total Exercises + Problems	% of which are Problems
4. (LC S1&2/O)	7	1241	35.05%
	8	879	49.03%
	9	1232	32.79%
	SY	-	-

Appendix E5

Examples

Table E.5: Distribution of Worked Examples throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Total No. of Worked Examples	Real/Realistic	Mathematical
4. (LC S1&2/O)	7	189	86	103
	8	114	35	79
	9	146	48	98
	SY	-	-	-

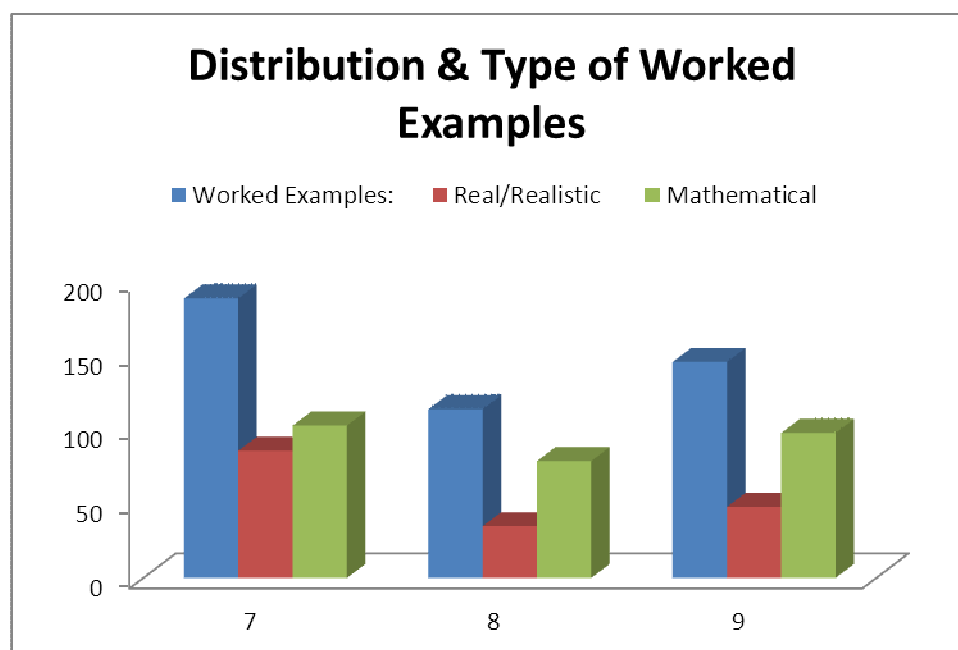


Figure E.5: Distribution of Worked Examples throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Table E.5a: Ratio of Worked Examples to Exercises, Problems & Activities throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Total Worked Examples	Ratio Examples: Exercises
4. (LC S1&2/O)	7	189	1:6.57
	8	114	1:7.71
	9	146	1:8.44
	SY	-	-

Appendix E6

Senior Cycle Mathematics Textbook Content Analysis

The following tables (Table E.6a to E.6d) represent the content data from the Senior Cycle Ordinary Level Mathematics Textbooks. Each column in the following grids represents a strand of content from the Project maths Curriculum and each row represents a specific content topic as derived from TIMSS. A list of 79 content topics was originally devised, irrelevant content topics were removed after data collection hence the numbering is not continuous.

Content Data List:

4. Common Fractions	38. Proportionality Concepts
5. Decimals	39. Proportionality Problems
7. Percentages	76. Trig
9. Negative Numbers & their properties	41. Area
13. Exponents, roots and radicals	42. Trig ratios
17. Estimation & Number Sense	43. Patterns, Relations & Analysis
19. Rounding & significant figures	44. Equations & formulae
20. Estimating computations	47. Linear Functions
22. Set Properties	53. Inequalities
23. Set Operations	54. Approximating Values
24. Venn Diagrams	56. Data Representation & Analysis
26. Perimeter, Area & Volume	57. Classification of Data
74. Measure	58. Classification of Studies (including limitations, statistical processes & presentation of results)
28. 2D Geometry: Coordinate Geometry – Line	59. Summary Statistics
29. 2D Geometry: Coordinate Geometry - Circle	60. Randomisation (including Bias)
30. 2D Geometry: Basics – angles	62. Counting principles
31. 2D Geometry: Basics – shapes	63. Permutations & Combinations
32. 2D Geometry: Polygons & Circles	64. Defining Probability
34. Transformations	65. Measuring Probability
35. Congruence & Similarity	66. Laws of Probability
36. Constructions using straightedge & Compass	67. Probability Experiments
37. Proof & Theorems	73. Software
	79. Internet

Table E.6a:
TB 7

S.1	S. 2	Cont.
		4
		5
		7
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		19
		20
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		23
		24
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		74
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		65
		66
		67
		73

Table E.6b:
TB 8

S.1	S. 2	Cont.
		4
		5
		7
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		20
		22
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		26
		74
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		65
		66
		67
		73

Table E.6c:
TB 9

S.1	S. 2	Cont.
		4
		5
		7
		9
		13
		17
		19
		20
		22
		23
		24
		26
		74
		28
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		67
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Table E.6d:
LC SY S1&2/O

S.1	S. 2	Cont.
		4
		5
		7
		9
		13
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		19
		20
		22
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		24
		26
		74
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Appendix E7

Motivational factors (Rivers Matrix)

**Table E.7: Distribution of Motivational Factors throughout the Senior Cycle Ordinary Level
Mathematics Textbooks**

Curriculum:	Text - book:	Historical Notes	Bio- graphies	Career Information	Problem Solving	Photos	Humour/ Quotes
4. (LC S1&2/O)	7	19	6	15	435	96	2
	8	4	2	3	431	5	0
	9	1	0	3	404	2	0
	SY	-	-	-	-	-	-

Appendix E8

Comprehension Cues (Rivers Matrix)

Table E.8: Summary of the use of colour throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Curriculum:	Text - book:	Page Background Colour	Font Colour	Graph-line Colour
4. (LC S1&2/O)	7	Hints: Purple Formula: Blue Exercises: blue Examples: green Definitions: Green Keywords: green Theorems/Axioms: Orange Reminders: Change per chapter (Blue, Pink, Green, Orange)	White, Black, Blue, Green, Pink	Red, Blue, Black, Green, Purple, Brown, Orange
	8	Hints/Formulae: Yellow Keywords, Examples & Definitions: Interchange dependant on chapter colour (Purple (pink), Blue, Green, Red (orange))	Black & dependant on chapter colour. For example chapter 1 is Purple and writing is black & purple	Blue, Black, Red,
	9	Hints/Definitions/Formulae: Blue Examples & exercises: Yellow	Red, Black, Blue, White	Blue, Red, Black
	SY	-	-	-

Appendix E9

Technical Aids (Rivers Matrix)

**Table E.9: Distribution of Technical Aids throughout the Senior Cycle Ordinary Level
Mathematics Textbooks**

Curriculum:	Text - book:	Computer Software	Calculator	Internet
4. (LC S1&2/O)	7	6	9	6
	8	0	48	0
	9	0	25(5)*	2
	SY	-	-	-

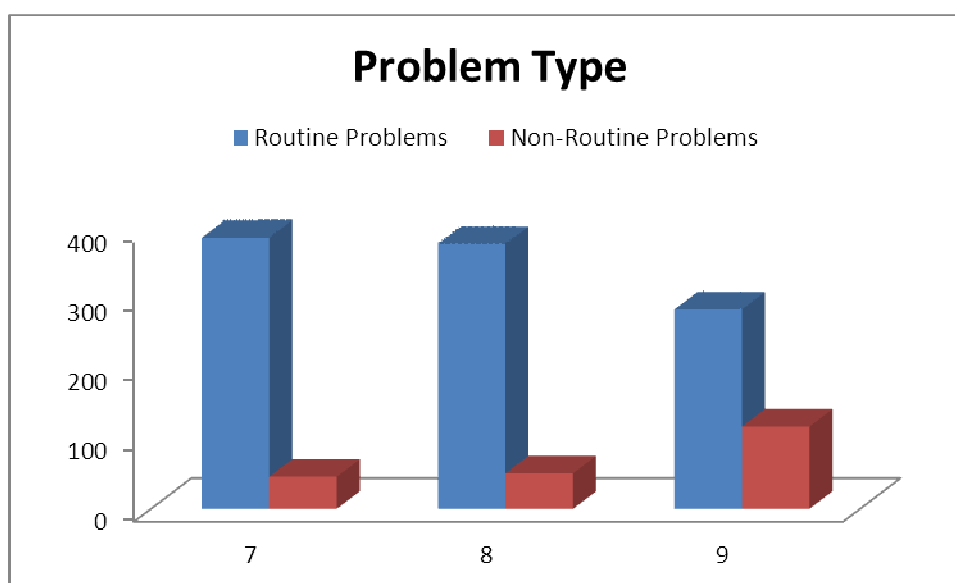
*The figure in brackets represents instances where the calculator is referred to in the context of 'Do not use your calculator'

Appendix E10

Problem Solving

**Table E.10: Distribution of Routine & Non- Routine Problems throughout the Senior Cycle
Ordinary Level Mathematics Textbooks**

Curriculum:	Text - book:	Routine Problems	Non-Routine Problems
4. (LC S1&2/O)	7	389	46
	8	380	51
	9	286	118
	SY	-	-



**Figure E.6: Distribution of Routine & Non- Routine Problems throughout the Senior Cycle
Ordinary Level Mathematics Textbooks**

Table E.10a: Breakdown of Routine Problem Type throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Real	Realistic	Fantasy	Purely Mathematical
4 (LC S1&2 0)	7	45	243	1	100
	8	31	180	1	168
	9	19	131	1	135
	SY	-	-		

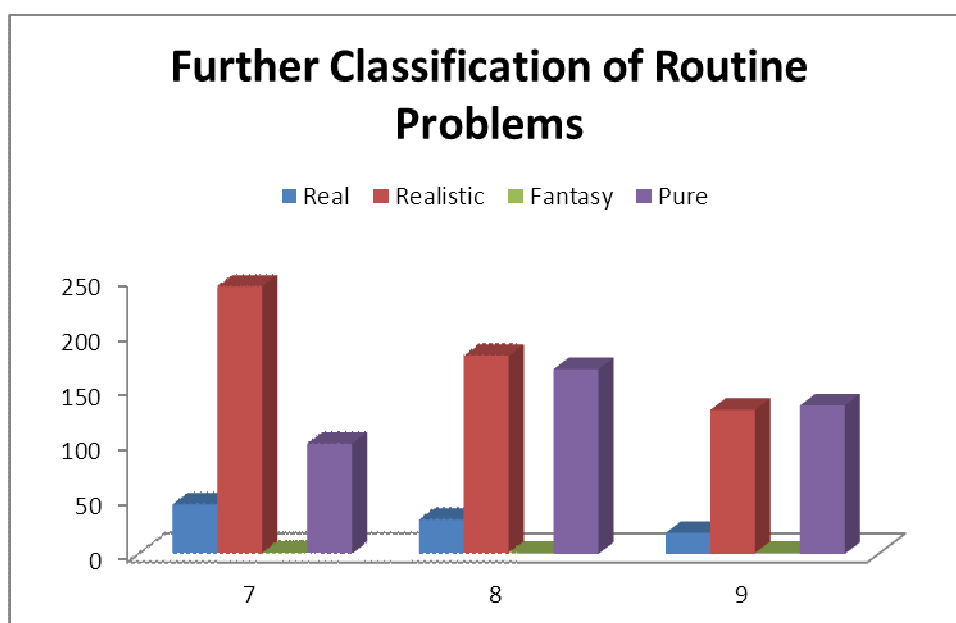


Figure E.7: Breakdown of Routine Problems throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Table E.10b: Breakdown of Non-Routine Problem Type throughout the Junior Cycle Mathematics Textbooks

Curriculum:	Text - book:	Real	Realistic	Fantasy	Purely Mathematical
4 (LC S1&2 0)	7	7	21	0	18
	8	2	18	0	31
	9	2	60	0	54
	SY	-	-		

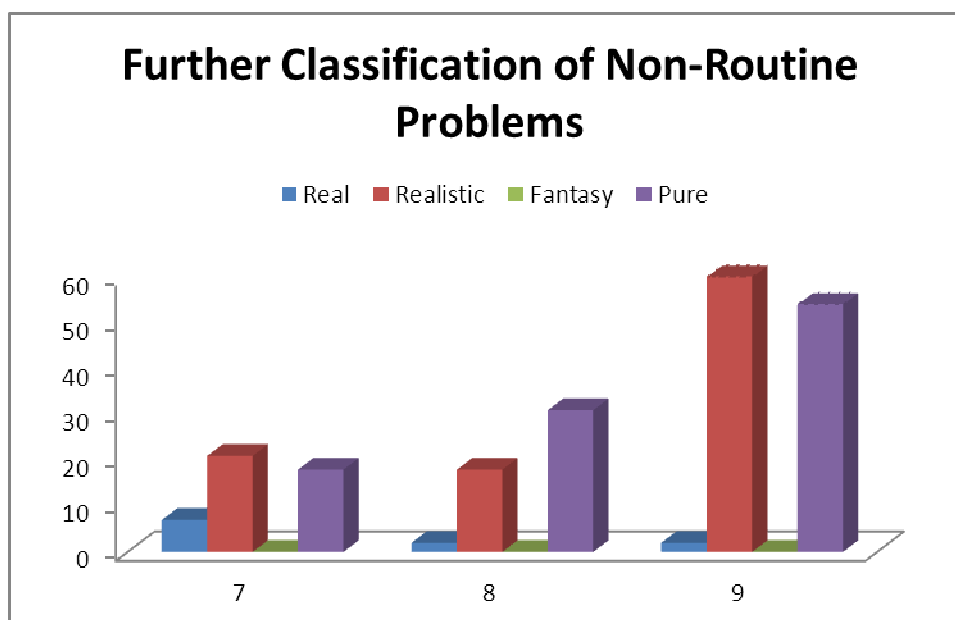


Figure E.8: Breakdown of Non-Routine Problems throughout the Senior Cycle Ordinary Level Mathematics Textbooks

Appendix E11

Senior Cycle Mathematics Textbook Expectation Analysis

The following tables (Table E.11a to E.11d) represent the expectation data from the Senior Cycle Ordinary Level Mathematics Textbooks. Each column in the following grids represents a strand of content from the Project Maths Curriculum and each row represents a specific expectation as derived from TIMSS. A list of 24 expectations was originally devised, an additional 6 Project Maths specific expectations are noted in the syllabi analysis.

Expectation Data List:

Knowing

1. Representing
2. Recognising Equivalents
3. Recalling Mathematical Objects & Properties

Using Routine Procedures

4. Using Equipment
5. Performing Routine Procedures
6. Using More Complex Procedures

Investigating & Problem Solving

7. Formulating & Clarifying Problems &
8. Developing strategies (Designing)
9. Solving
10. Predicting
11. Verifying

Mathematical Reasoning

12. Developing Notation & Vocabulary
13. Developing algorithms
14. Generalising
15. Conjecturing
16. Justifying & proving
17. Axiomatising

Communicating

18. Using Vocabulary & Notation
19. Relating Representations
20. Describing/Discussing
21. Critiquing

Making Communications

22. Inter Subject Connections
23. Across Subject Connections
24. Give Real Life Examples
25. Instrumental Learning
26. Relational Learning
27. Fostering Positive Attitudes
28. Inquiry Based Learning
29. Applications
30. Connecting Solutions & Questions

Table E.11a:
TB 7

S.1	S. 2	Exp.
		1
		2
		3
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		6
		7
		8
		9
		10
		11
		12
		13
		14
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		16
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		18
		19
		20
		21
		22
		23
		24

Table E.11b:
TB 8

S.1	S. 2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
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		16
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		19
		20
		21
		22
		23
		24

Table E.11c:
TB 9

S.1	S. 2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

Table E.11d:
LC SY S1&2/O

S.1	S. 2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
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Appendix F

Senior Cycle Higher Level Data

TIMSS+ Analysis – Structure, Content & Expectation

Appendix F1

Narration

Table F.1: Distribution of Narration and Narration type throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Narration	Related Narration	Instructional Narration
5. (LC S1&2/H)	10	973	55	32
	11	938	4	87
	SY	-	-	-
6. (LC HS2)	12	434	44	17
	13	529	7	20
	14	315	3	69
	SY	-	-	-

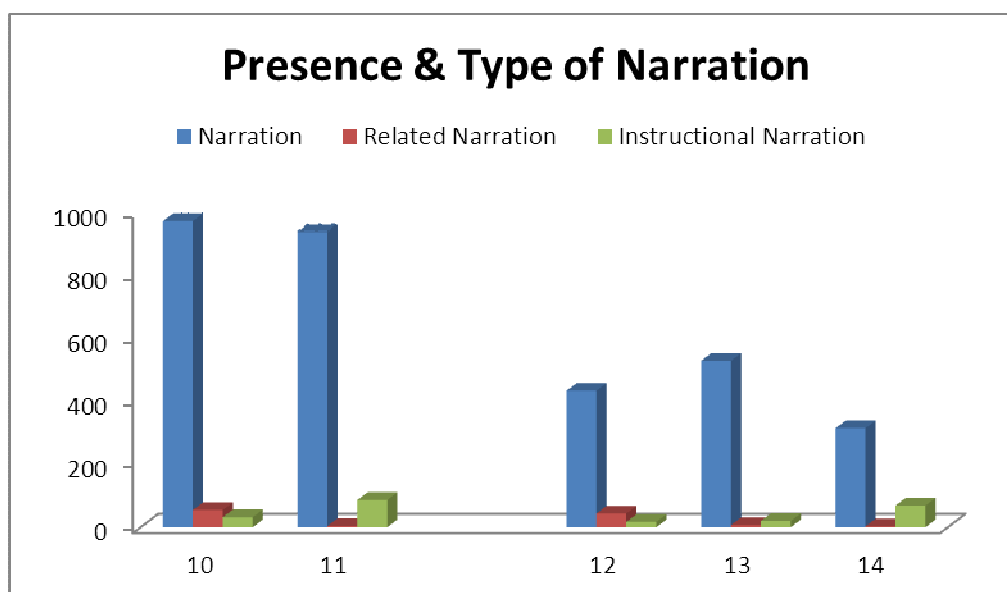


Figure F.1: Distribution of Narration and Narration type throughout the Senior Cycle Higher Level Mathematics Textbooks

Appendix F2

Definitions

Table F.2: Distribution of Definitions, Theorems & Axioms throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Definitions	Theorems	Axioms & Corollaries
5. (LC S1&2/H)	10	136	41	14
	11	32	21	0
	SY	-	-	-
6. (LC S2/H)	12	94	41	14
	13	36	12	3
	14	17	21	0
	SY	-	-	-

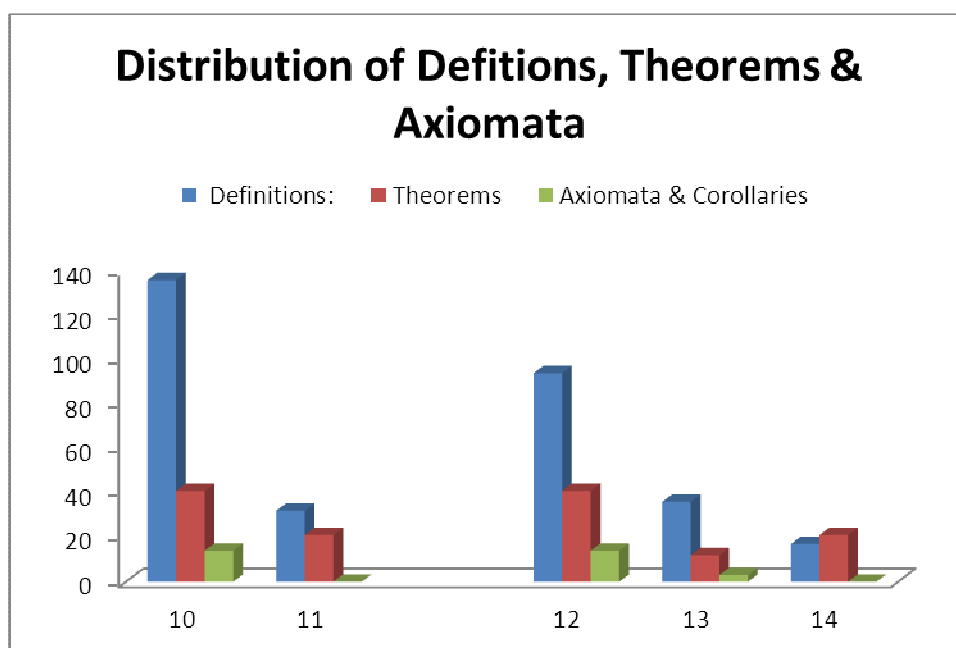


Figure F.2: Distribution of Definitions, Theorems & Axioms throughout the Senior Cycle Higher Level Mathematics Textbooks

Appendix F3

Graphics

Table F.3: Distribution and Purpose of Graphics throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Graphics	Graphics for Problem Solving	Realistic Diagrams	Photos
5. (LC S1&2/H)	10	1305	330	122	58
	11	744	290	56	0
	SY	-	-	-	
6. (LC S2/H)	12	943	222	108	25
	13	525	195	32	0
	14	494	212	36	0
	SY	-	-	-	

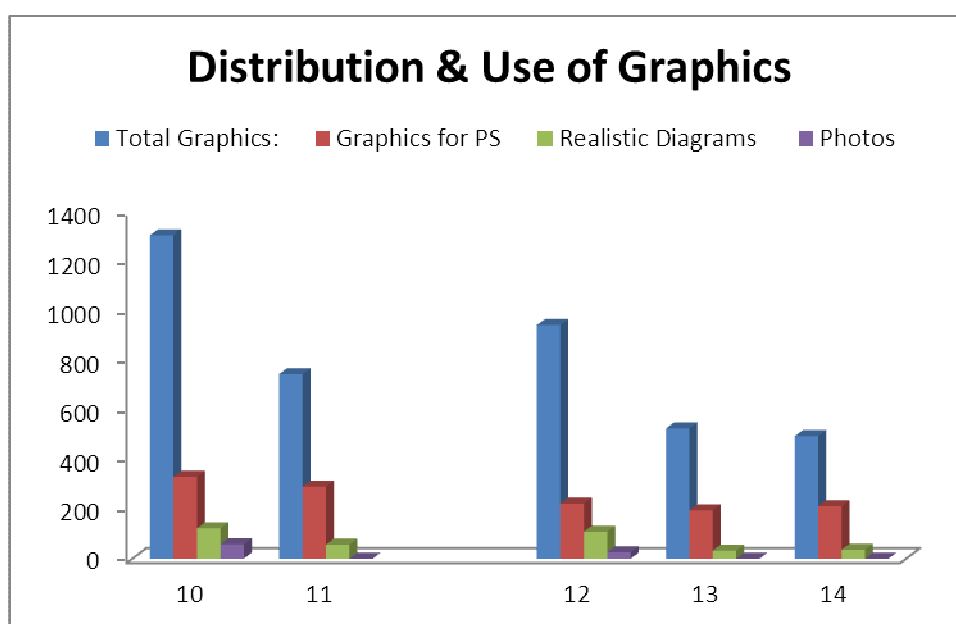


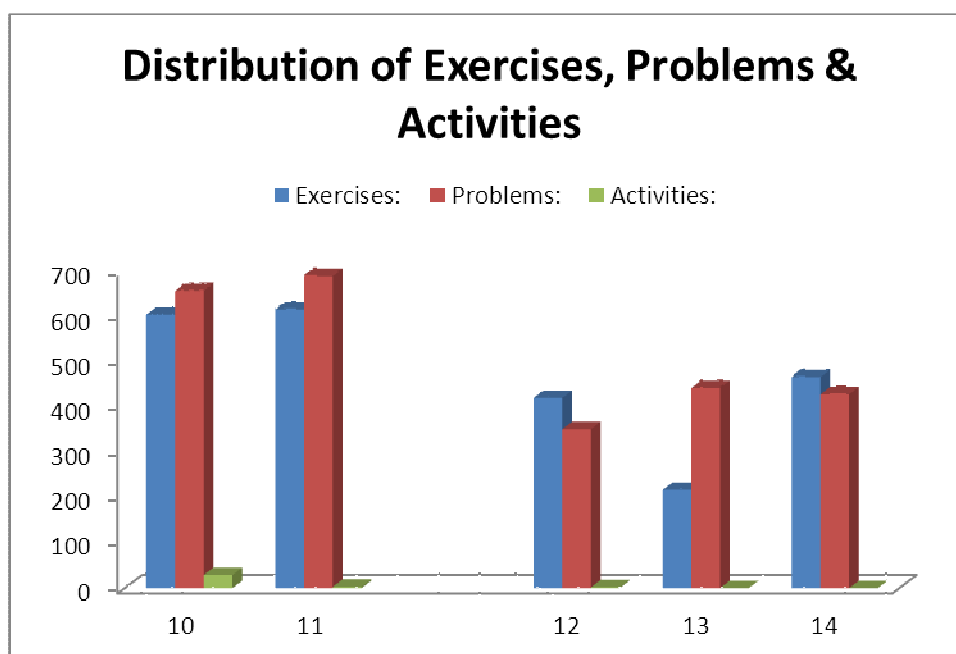
Figure F.3: Distribution and Purpose of Graphics throughout the Senior Cycle Higher Level Mathematics Textbooks

Appendix F4

Exercises

**Table F.4: Distribution of Exercises, Problems and Activities throughout the Senior Cycle
Higher Level Mathematics Textbooks**

Curriculum:	Text - book:	Exercise Blocks	Problem Blocks	Exercises	Problems	Activities
5. (LC S1&2/H)	10	155	111	604	656	29
	11	50	61	615	689	3
	SY	-	-	-	-	-
6. (LC S2/H)	12	107	68	420	351	2
	13	35	39	217	442	0
	14	29	35	466	428	0
	SY	-	-	-	-	-



**Figure F.4: Distribution of Exercises, Problems and Activities throughout the Senior Cycle
Higher Level Mathematics Textbooks**

**Table F.4a: Percentage Breakdown of Exercises and Problems throughout the Senior Cycle
Higher Level Mathematics Textbooks**

Curriculum:	Text - book:	Total Exercises + Problems	% of which are Problems
5. (LC S1&2/H)	10	1260	52.06%
	11	1304	52.84%
	SY	-	-
6. (LC S2/H)	12	771	45.53%
	13	659	67.07%
	14	894	47.87%
	SY	-	-

Appendix F5

Examples

Table F.5: Distribution of Worked Examples throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Total No. of Worked Examples	Real/Realistic	Mathematical
5. (LC S1&2/H)	10	188	59	129
	11	177	68	109
	SY	-	-	-
6. (LC S2/H)	12	117	4	113
	13	122	15	107
	14	96	1	95
	SY	-	-	-

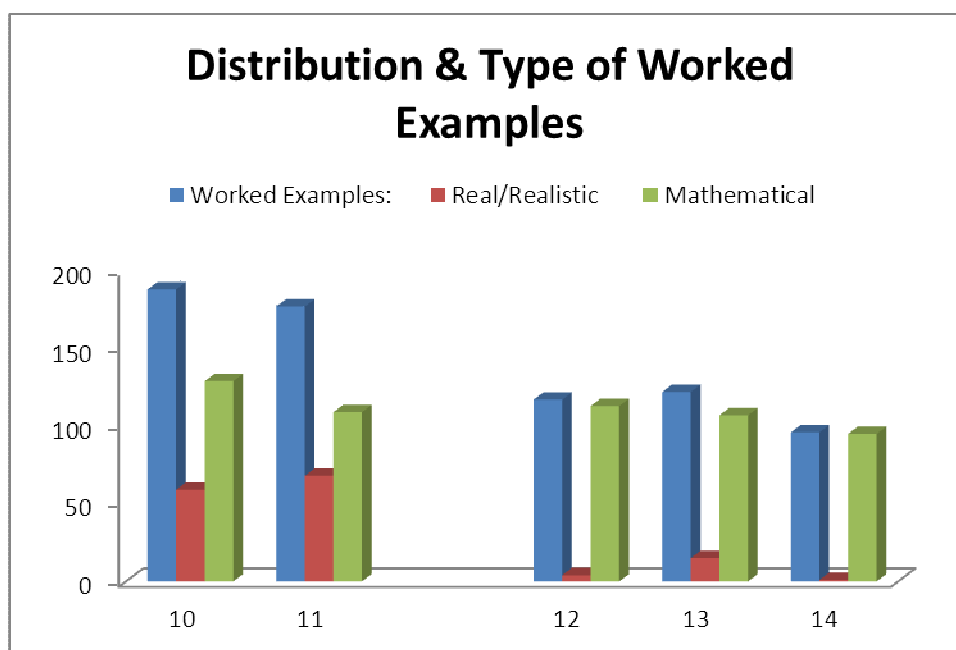


Figure F.5: Distribution of Worked Examples throughout the Senior Cycle Higher Level Mathematics Textbooks

Table F.5a: Ratio of Worked Examples to Exercises, Problems & Activities throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Total Worked Examples	Ratio Examples: Exercises
5. (LC S1&2/H)	10	188	1:06.70
	11	177	1:07.37
	SY	-	-
6. (LC S2/H)	12	117	1:06.59
	13	122	1:05.40
	14	96	1:09.31
	SY	-	-

Appendix F6

Senior Cycle Mathematics Textbook Content Analysis

The following tables (Table F.6a to F.6g) represent the content data from the Senior Cycle Higher Level Mathematics Textbooks. Each column in the following grids represents a strand of content from the Project Maths Curriculum and each row represents a specific content topic as derived from TIMSS. A list of 79 content topics was originally devised, irrelevant content topics were removed after data collection hence the numbering is not continuous.

Content Data List:

4. Common Fractions	39. Proportionality Problems
7. Percentages	76. Trig
9. Negative Numbers & their properties	41. Area
13. Exponents, roots and radicals	42. Trig ratios
19. Rounding & significant figures	43. Patterns, Relations & Analysis
20. Estimating computations	44. Equations & formulae
22. Set Properties	47. Linear Functions
23. Set Operations	53. Inequalities
24. Venn Diagrams	54. Approximating Values
25. Units	56. Data Representation & Analysis
26. Perimeter, Area & Volume	57. Classification of Data
74. Measure	58. Classification of Studies (including limitations, ethical concerns & aspects of error)
28. 2D Geometry: Coordinate Geometry – Line	59. Summary Statistics
29. 2D Geometry: Coordinate Geometry – Circle	60. Randomisation (including Bias)
30. 2D Geometry: Basics – angles	61. inferential Statistics
31. 2D Geometry: Basics – shapes	62. Counting principles
32. 2D Geometry: Polygons & Circles	63. Permutations & Combinations
33. 3D Geometry problems	64. Defining Probability
34. Transformations	65. Measuring Probability
35. Congruence & Similarity	66. Laws of Probability
36. Constructions using straightedge & Compass	67. Probability Experiments
37. Proof & Theorems	73. Software
38. Proportionality Concepts	79. Internet

Table F.6a:
TB 10

S.1	S. 2	Cont.
		4
		7
		9
		13
		19
		20
		22
		23
		24
		25
		26
		74
		28
		29
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Table F.6b:
TB 11

S.1	S. 2	Cont.
		4
		7
		9
		13
		19
		20
		22
		23
		24
		25
		26
		74
		28
		29
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		62
		63
		64
		65
		66
		67
		73

Table F.6c:
LC SY S1&2/H

S.1	S. 2	Cont.
		4
		7
		9
		13
		19
		20
		22
		23
		24
		25
		26
		74
		28
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		62
		63
		64
		65
		66
		67
		73

Table F.6d:
TB 12

S. 2	Cont.
	4
	7
	9
	13
	19
	20
	22
	23
	24
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	74
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	67
	73

Table F.6e:
TB 13

S. 2	Cont.
	4
	7
	9
	13
	19
	20
	22
	23
	24
	25
	26
	74
	28
	29
	30
	31
	32
	33
	34
	35
	36
	37
	38
	39
	76
	41
	42
	44
	47
	53
	54
	56
	57
	58
	59
	60
	61
	62
	63
	64
	65
	66
	67
	73

Table F.6f:
TB 14

S. 2	Cont.
	4
	7
	9
	13
	19
	20
	22
	23
	24
	25
	26
	74
	28
	29
	30
	31
	32
	33
	34
	35
	36
	37
	38
	39
	76
	41
	42
	44
	47
	53
	54
	56
	57
	58
	59
	60
	61
	62
	63
	64
	65
	66
	67
	73

Table F.6g:
LC SY S2/H

S. 2	Cont.
	4
	7
	9
	13
	19
	20
	22
	23
	24
	25
	26
	74
	28
	29
	30
	31
	32
	33
	34
	35
	36
	37
	38
	39
	76
	41
	42
	44
	47
	53
	54
	56
	57
	58
	59
	60
	61
	62
	63
	64
	65
	66
	67
	73

Appendix F7

Motivational factors (Rivers Matrix)

Table F.7: Distribution of Motivational Factors throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Historical Notes	Bio-graphies	Career Information	Problem Solving	Photos	Humour/ Quotes
5. (LC S1&2/H)	10	9	0	23	656	58	0
	11	2	0	5	689	0	0
	SY	-	-	-	-	-	-
6. (LC S2/H)	12	6	2	16	351	25	0
	13	1	1	2	442	0	0
	14	1	0	3	428	0	0
	SY	-	-	-	-	-	-

Appendix F8

Comprehension Cues (Rivers Matrix)

Table F.8: Summary of the use of colour throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Page Background Colour	Font Colour	Graph-line Colour
5. (LC S1&2/H)	10	Hints: Purple Formula: Blue Exercises: blue Examples: green Definitions: Green Keywords: green Theorems/Axioms: Orange Reminders: Change per chapter (Blue, Pink, Green, Orange)	White, Black, Blue, Green, Pink	Red, Blue, Black, Green, Purple, Brown,
	11	Hints/Definitions/Formulae: Blue Examples & exercises: Yellow	Red, Black, Blue, White	Blue, Red, Black
	SY	-	-	-
6. (LC S2/H)	12	Hints: Purple Formula: Blue Exercises: blue Examples: green Definitions: Green Keywords: green Theorems/Axioms: Orange Reminders: Change per chapter (Blue, Pink, Green, Orange)	White, Black, Blue, Green, Pink	Red, Blue, Black, Green, Purple, Brown,
	13	Hints/Def/Formulae: Yellow Keywords, Examples & Definitions: Interchange dependant on chapter colour (Purple (pink), Blue, Green, Red (orange))	Black & dependant on chapter colour. For example chapter 1 is Purple and writing is black & purple	Blue, Black, Red, Green, Purple
	14	Hints/Def/Formulae: Blue Examples & exercises: Yellow	Red, Black, Blue, White	Blue, Red, Black
	SY	-	-	-

Appendix F9

Technical Aids (Rivers Matrix)

Table F.9: Distribution of Technical Aids throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Computer Software	Calculator	Internet
5. (LC S1&2/H)	10	14	59(12)*	12
	11	17	17	2
	SY	-	-	-
6. (LC S2/H)	12	1	25(12)*	0
	13	0	19(11)*	0
	14	0	4	0
	SY	-	-	-

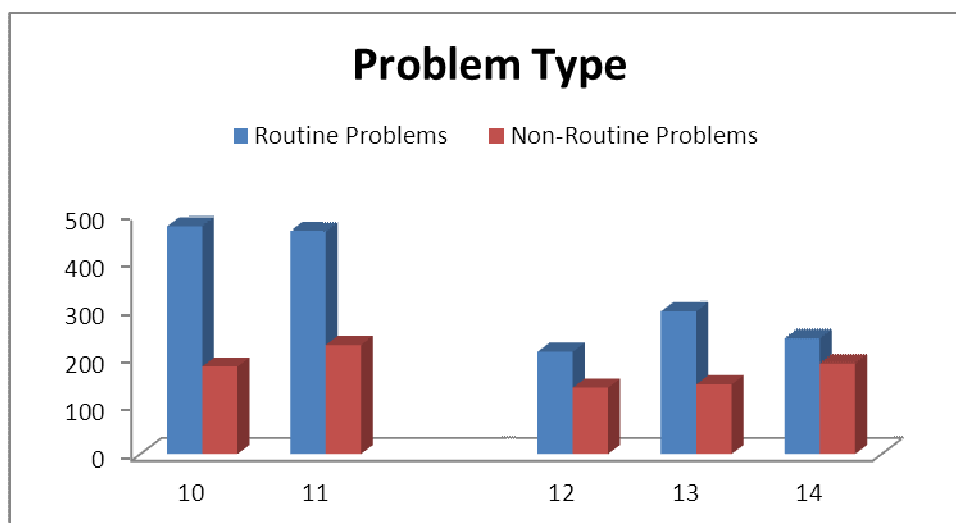
*The figure in brackets represents instances where the calculator is referred to in the context of 'Do not use your calculator'

Appendix F10

Problem Solving

**Table F.10: Distribution of Routine & Non- Routine Problems throughout the Senior Cycle
Higher Level Mathematics Textbooks**

Curriculum:	Text - book:	Routine Problems	Non-Routine Problems
5. (LC S1&2/H)	10	473	183
	11	463	226
	SY	-	-
6. (LC S2/H)	12	213	138
	13	295	147
	14	240	188
	SY	-	-



**Figure F.6: Distribution of Routine & Non- Routine Problems throughout the Senior Cycle
Higher Level Mathematics Textbooks**

Table F.10a: Breakdown of Routine Problem Type throughout the Senior Cycle Higher Level Mathematics Textbooks

Curriculum:	Text - book:	Real	Realistic	Fantasy	Purely Mathematical
5. (LC S1&2/H)	10	41	212	1	223
	11	6	215	1	240
		-	-	-	-
6. (LC S2/H)	12	2	26	0	185
	13	1	24	1	214
	14	1	19	0	277
	SY	-	-	-	-

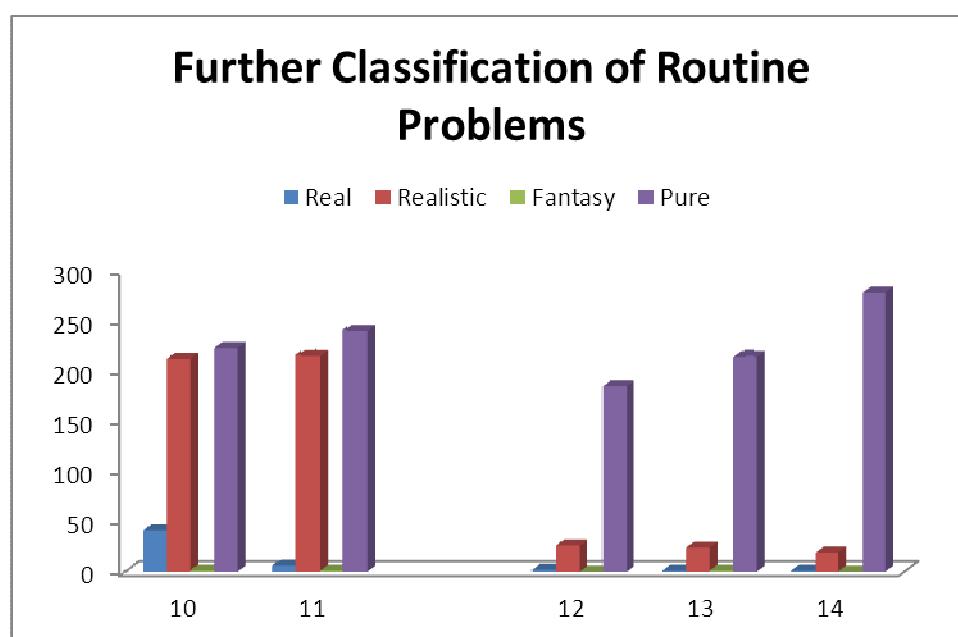
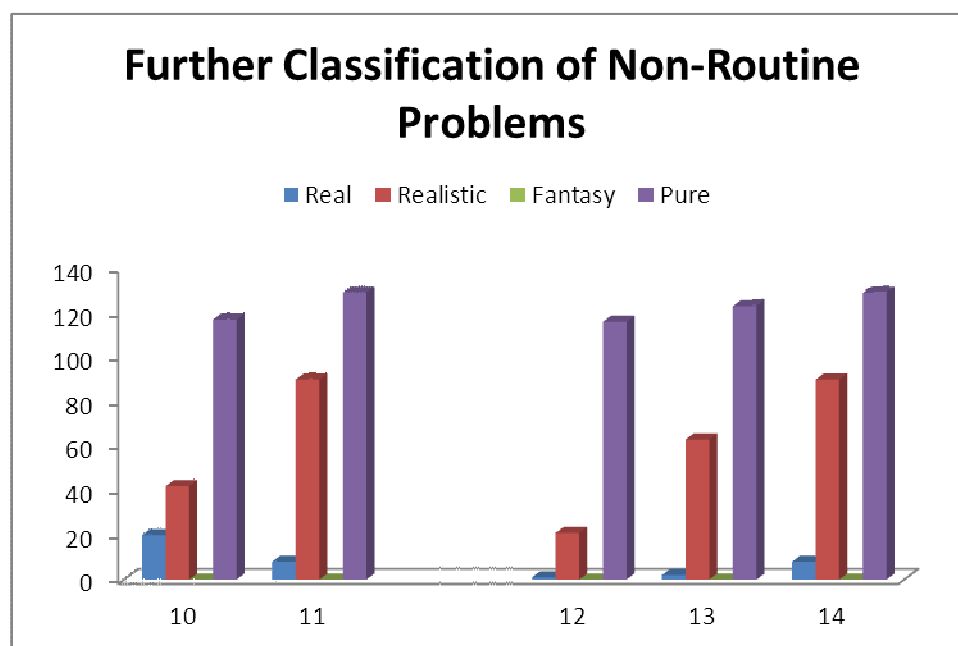


Figure F.7: Breakdown of Problem Type throughout the Senior Cycle Higher Level Mathematics Textbooks

**Table F.10b: Breakdown of Non- Routine Problem Type throughout the Junior Cycle
Mathematics Textbooks**

Curriculum:	Text - book:	Real	Realistic	Fantasy	Purely Mathematical
5. (LC S1&2/H)	10	20	42	0	117
	11	8	90	0	129
		-	-	-	-
6. (LC S2/H)	12	1	21	0	116
	13	2	63	0	123
	14	8	90	0	129
	SY	-	-	-	-



**Figure F.8: Breakdown of Non- Routine Problem Type throughout the Junior Cycle
Mathematics Textbooks**

Appendix F11

Senior Cycle Mathematics Textbook Expectation Analysis

The following tables (Table F.11a to F.11g) represent the expectation data from the Senior Cycle Higher Level Mathematics Textbooks. Each column in the following grids represents a strand of content from the Project Maths Curriculum and each row represents a specific expectation as derived from TIMSS. A list of 24 expectations was originally devised, an additional 6 Project Maths specific expectations are noted in the syllabi analysis.

Expectation Data List:

Knowing

1. Representing
2. Recognising Equivalents
3. Recalling Mathematical Objects & Properties

Using Routine Procedures

4. Using Equipment
5. Performing Routine Procedures
6. Using More Complex Procedures

Investigating & Problem Solving

7. Formulating & Clarifying Problems &
8. Developing strategies (Designing)
9. Solving
10. Predicting
11. Verifying

Mathematical Reasoning

12. Developing Notation & Vocabulary
13. Developing algorithms
14. Generalising
15. Conjecturing
16. Justifying & proving
17. Axiomatising

Communicating

18. Using Vocabulary & Notation
19. Relating Representations
20. Describing/Discussing
21. Critiquing

Making Communications

22. Inter Subject Connections
23. Across Subject Connections
24. Give Real Life Examples
25. Instrumental Learning
26. Relational Learning
27. Fostering Positive Attitudes
28. Inquiry Based Learning
29. Applications
30. Connecting Solutions & Questions

Table F.11a:
TB 10

S. 1	S.2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

Table F.11b:
TB 11

S. 1	S.2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

Table F.11c:
LC SY S1&2/H

S. 1	S.2	Exp.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

		25
		26
		27
		28
		29
		30

Table F.11d:
TB 12

S. 2	Exp.
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12
	13
	14
	15
	16
	17
	18
	19
	20
	21
	22
	23
	24

Table F.11e:
TB 13

S. 2	Exp.
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12
	13
	14
	15
	16
	17
	18
	19
	20
	21
	22
	23
	24

Table F.11f:
TB 14

S. 2	Exp.
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12
	13
	14
	15
	16
	17
	18
	19
	20
	21
	22
	23
	24

Table F.11g:
LC SY S2/H

S. 2	Exp.
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12
	13
	14
	15
	16
	17
	18
	19
	20
	21
	22
	23
	24

	25
	26
	27
	28
	29
	30

