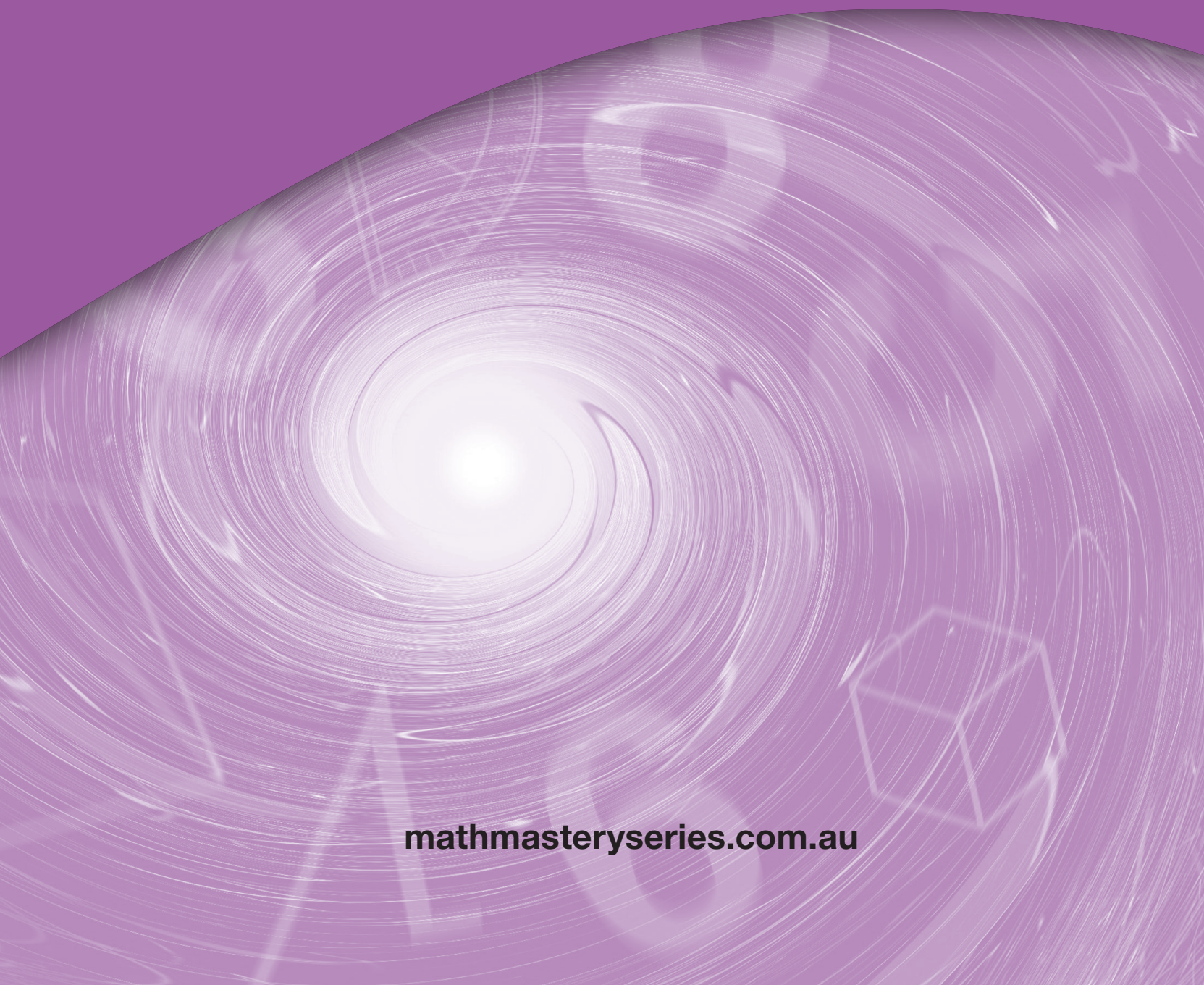
ELEMENTARY MATH MASTERY

NEW EDITION

Dr Rhonda Farkota



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MATH MASTERY SERIES

Direct Instruction

Direct Instruction (DI) is a teaching model created by Professor Siegfried Engelmann and the University of Oregon. Based on the premise that clear, unambiguous teaching, enhances student learning, DI lessons are meticulously scripted, in clear, unambiguous language, with each lesson structured in small incremental portions.

Farkota Direct Instruction

Adapting the scripted lesson concept, the Farkota Direct Instruction (FDI) model modernises the delivery process, and streamlines the script in a manner that strikes a balance between teacher-directed learning and student-directed learning. The role of the teacher in presenting the daily lesson is to deliver, diagnose and debug; the role of the student is to record and represent their data, and report their bugs.

FDI Math Mastery Series

The Math Mastery Series (MMS) programs (JEMM, JEMM+ and EMM) consist of daily scripted lessons composed of strands each starting at base level where foundations are laid. They serve as daily diagnostic tools incorporating assessment as an integral part of the learning process. Student responses, coupled with their own analysis of any incorrect response given during a lesson, provide teachers with reliable diagnostic information better than any acquired in a formal test situation. Being data driven, MMS allows teacher feedback to specifically target individual student misunderstanding.

Maximising every benefit an orally delivered math program is capable of yielding MMS programs:

- Map student progress
- Identify precisely where and when students experience difficulty
- Contain inbuilt assessment and correction procedures
- Instil fluency and automaticity in fundamental math skills.

THE MATH MASTERY SERIES PROGRAMS

EMM — Elementary Math Mastery

Ideally suited to upper primary and first year secondary students, and secondary school remedial classes.

Requires daily 20–25 minutes to implement, plus 5–10 minutes for corrections and feedback.

EMM features 160 lessons, each composed of 20 strands. Students answer one question per strand daily:

- Addition
- Subtraction
- Multiplication
- Division
- Number patterns
- Equations and inverse operations
- Whole number properties
- Fractions
- Decimals
- Measurement
- Space
- Geometry
- Average, percentage, ratio, chance
- Math language
- Money
- Time
- Algebra
- Visual perception
- Data analysis
- Problem solving

JEMM+ — Junior Elementary Math Mastery+

Ideally suited to middle primary and upper primary students, and first year secondary school remedial classes.

Requires daily 20–25 minutes to implement, plus 5–10 minutes for corrections and feedback.

JEMM+ features 120 lessons, each composed of 15 strands. Students answer one question per strand daily:

- Counting
- Addition
- Subtraction
- Multiplication
- Division
- Number patterns
- Fractions
- Decimals
- Measurement
- Space
- Data and Chance
- Money
- Time
- Visual perception
- Problem solving

JEMM — Junior Elementary Math Mastery

Ideally suited to middle primary students, and primary school remedial classes.

Requires daily 20–25 minutes to implement, plus 5–10 minutes for corrections and feedback.

JEMM features 80 lessons. Students answer one question per strand daily with Lesson 1 introducing:

- Whole number addition
- Whole number subtraction
- Number facts
- Place value
- Number patterns

Building on these base strands the following lessons introduce:

- Lesson 21 Money
- Lesson 31 Measurement
- Lesson 41 Fractions
- Lesson 51 Time
- Lesson 61 Data and Chance

Each JEMM lesson concludes with Strategic Thinking, a hands -on approach to problem solving.

These programs help all students, but particularly those who:

- Have not reached required numeracy level for their age
- Have low motivation to learn, or low self-efficacy
- Are classified as at-risk learners
- Have difficulty concentrating, and would benefit from repeated structured teaching and practice.

MMSanimation

MMSanimation is a voice-over with animation of each lesson, for each program. These **animations reflect** that critical part of the Lesson **script** (shown in coloured **CAPS**) **that requires the teacher to point at the electronic display**. **MMS**animation was created primarily for three reasons: firstly, absent students need to catch up; secondly, support for students with special needs; and thirdly, general teacher support. **EMM**animation: **mathmasteryseries.com.au/mmsanimation/**

Contents

EMM INTRODUCTORY NOTES

Generally speaking, mental math programs are warm-up exercises consisting of a 'grab-bag' of questions taken from various math strands with little constructive thought behind the design. Of limited value as learning programs, they do however perform one important function: the oral presentation and constraint on time pressures students to concentrate. Unfortunately, teachers are encouraged to, and often *do*, use them as work-sheets, thus failing to capitalise on the important contribution aural perception and pressure of time can play in the learning process. Although there has been a general failure to exploit the enormous developmental potential an orally presented math program is capable of yielding, the MMS is purpose-built to maximise this potential. Specifically designed around the document: Mathematics – a curriculum profile for Australian schools, EMM is a daily program for the entire class that can be easily integrated into any school's math curriculum for upper primary, first year secondary and remedial classes.

EMM comprises **20 different strands** (one question from each strand per lesson). It requires **20–25 minutes to implement, plus 5–10 minutes for instant feedback, diagnosis and correction procedures**. Diligent implementation over the course of the school year will see students answering a total of 3600 questions (presented orally) at the end of which time they will have achieved mastery (equated here with an average daily score of at least 80%) of fundamental math skills in all core areas.

Each of the EMM 20 strands **starts at base level** and moves through its particular field, merging and interrelating with the 19 other strands being run concurrently. Since the **daily incremental portions learned by the students in each strand are small**, and because they are **reinforced and built upon** in subsequent lessons, **they are mastered**.

EMM comes in a **teacher-friendly format** with **all lesson scripts provided; those with little math expertise will find it easy to implement**. Each lesson is complete within itself, and each strand has been choreographed with the focus on overall mastery of basic math skills. The teacher simply presents the program in the scripted format. The EMM electronic reference stimuli (ERS) includes all diagrams, formulas and display material, maximising time efficiency and allowing for effortless implementation.

A perennial problem for teachers at the start of each school year is the diverse, and all too often, inadequate, academic standard of their new class. In an ideal world, teachers could safely assume that students entering their classroom on the first day of a school year would be capable of performing at a level appropriate to their particular grade, and that the foundations necessary for them to progress satisfactorily on their academic paths would be firmly in place. Unfortunately, this is seldom the case. A primary objective of EMM is to address this problem.

At the outset, EMM assumes nothing in terms of student academic level. The program has been **designed to accommodate every student, and elevate every student's academic level no matter where they start from**, provided, of course, the students do not have significant learning disabilities. In the early stages of EMM the questions are basic. Students with developed skills may wonder what the program has to offer. This will not last long. These basic questions quickly build to questions that will challenge every student. Of course, the challenge to some will be greater than others, but every student will have been taught the skills necessary to answer every question—there are no tricks.

The design of EMM is such that **students discover for themselves the formulas necessary to solve relatively complex problems automatically and speedily**. Students soon see they are up to the task, and because they know they have acquired the necessary skills, actually look forward to the challenge.

Once foundations to the core areas have been laid and tested, they are built on with small precise portions. None of this incremental information is left on the shelf. Students move on to questions that gradually increase in complexity, all the while relying on the skills they have acquired along the way. These **questions shift from abstract numbers to real-life situations** so students see the relative worth of mathematics in situations that arise in the everyday world. Students quickly learn that everything they are taught is important; everything they learn is revisited, developed further, and gradually integrated into the broad mathematical landscape. This **gradual and consistent development of skills** is one of the key elements in the success of the Math Mastery Series.

The traditional practice of teaching mathematics in single topics creates many problems for students. Presenting them with a heap of new information in one hit, expecting them to master it; then move onto another, often unrelated topic, master that too, and so on, is a big ask. The problem is compounded when students are not re-familiarised with the topics throughout the year. EMM circumvents this problem by running 20 concurrent strands. Because the strands are run concurrently, **students are soon familiar with the many connections existing between the various math disciplines, and become fluent and automatic in applying them**.

An essential feature of EMM is its **ability to focus student attention** on the learning process. This is achieved by the teacher orally introducing the concepts and questions at a pace easily enough accommodated by students who are concentrating, but which gives them no time to tune-out. Students stay alert because they know a question immediately follows the introduction of a concept. The **electronic reference stimuli (ERS)** further **enhances student engagement** and, in particular, **helps students with special needs** stay on track.

It is important there be no interruption to the lesson once in progress. The stream of student focus and concentration must be on what the teacher is saying. This is best achieved by conducting the lesson at a relatively brisk pace, and not stopping for queries or distracted students who want the question repeated more than once (all questions are put to the students twice). Queries should be attended to after correction time in *What bugs you?* Students who are used to working at a slower pace quickly learn what's required of them.

In maximising the benefits of EMM the importance of the teacher's role cannot be over-emphasised. Because the program's lessons are interdependent, and because the interrelating strands build entirely upon themselves, diligent teacher implementation is essential. The MMS Professional Learning Reading Plan could assist in this regard.
mathmasteryseries.com.au/professional-learning-reading-plan/

THE EMM STRANDS

1 Addition	11 Space
2 Subtraction	12 Geometry
3 Multiplication	13 Average, percentage, ratio, chance
4 Division	14 Math language
5 Number patterns	15 Money
6 Equations and inverse operations	16 Time
7 Whole number properties	17 Algebra
8 Fractions	18 Visual perception
9 Decimals	19 Data analysis
10 Measurement	20 Problem solving

USING THE SCRIPT

EMM provides teacher alternate modes of delivery.

Electronic Reference Stimuli (ERS) includes all visual diagrams, formulas and display material and is incorporated into the script. Note: ERS download information is provided by email at time of purchase. For queries contact **hello@mathmasteryseries.com.au**.

AND

EMManimation a teacher-directed animation approach .

What you stress is in **bold** text.

What you say appears in this type.

What you say and simultaneously point at on the electronic display or whiteboard appears in **CAPITAL LETTERS**.

13 *Refer to ERS Question 13.*

SNAPSHOT

part A 1 square
part B 3 squares

The **average** tells how many there would be in each part if the total sum were evenly shared.

PART A is one part and **PART B** is the other part.

QUESTION 13 How many parts altogether?
(Repeat question)

What you do appears in *italics*.

PROGRAM STRUCTURE

EMM consists of 160 scripted lessons structured in rounds of five. Whenever a new concept is introduced it will always be in the first lesson of a round. It is in the last lessons of the rounds where these concepts will be put to the test.

	Number of sessions to complete MMS			
	EMM	JEMM+	JEMM	TOTAL
Teacher delivered scripted lessons	160	120	80	360
Student Self-evaluations	8	6	4	18
Marathons	40	30	20	90
EMM/JEMM+/JEMMathon tasks	8	6	4	18
Round tasks	24	18	12	54
Challenges	4	4	4	12
TOTAL number of sessions required	**244**	**184**	**124**	**552**

EMM SESSION SCHEDULE

	SESSION	NUMBER
ROUNDS 1–4	Daily Data Round 01 L01–05	01, 02, 03, 04, 05
	Round 01 Task	**06**
	Daily Data Round 02 L06–10	07, 08, 09, 10, 11
	Round 02 Task	**12**
	Daily Data Round 03 L11–15	13, 14, 15, 16, 17
	Round 03 Task	**18**
	Daily Data Round 04 L16–20	19, 20, 21, 22, 23
	Self-evaluation L01–20	**24**
	EMMathon 1	**25, 26, 27, 28, 29**
	EMMathon 1 TASK	**30**

	SESSION	NUMBER
ROUNDS 5–8	Daily Data Round 05 L21–25	31, 32, 33, 34, 35
	Round 05 Task	**36**
	Daily Data Round 06 L26–30	37, 38, 39, 40, 41
	Round 06 Task	**42**
	Daily Data Round 07 L31–35	43, 44, 45, 46, 47
	Round 07 Task	**48**
	Daily Data Round 08 L36–40	49, 50, 51, 52, 53
	Self-evaluation L21–40	**54**
	EMMathon 2	**55, 56, 57, 58, 59**
	EMMathon 2 TASK	**60**

	SESSION	NUMBER
ROUNDS 9–12	Daily Data Round 09 L41–45	61, 62, 63, 64, 65
	Round 09 Task	**66**
	Daily Data Round 10 L46–50	67, 68, 69, 70, 71
	Round 10 Task	**72**
	Daily Data Round 11 L51–55	73, 74, 75, 76, 77
	Round 11 Task	**78**
	Daily Data Round 12 L56–60	79, 80, 81, 82, 83
	Self-evaluation L41–60	**84**
	EMMathon 3	**85, 86, 87, 88, 89**
	EMMathon 3 TASK	**90**

	SESSION	NUMBER
ROUNDS 13–16	Daily Data Round 13 L61–65	91, 92, 93, 94, 95
	Round 13 Task	**96**
	Daily Data Round 14 L66–70	97, 98, 99, 100, 101
	Round 14 Task	**102**
	Daily Data Round 15 L71–75	103, 104, 105, 106, 107
	Round 15 Task	**108**
	Daily Data Round 16 L76–80	109, 110, 111, 112, 113
	Self-evaluation L61–80	**114**
	EMMathon 4	**115, 116, 117, 118, 119**
	EMMathon 4 TASK	**120**

	SESSION	NUMBER
ROUNDS 17–20	Daily Data Round 17 L81–85	121, 122, 123, 124, 125
	Round 17 Task	**126**
	Daily Data Round 18 L86–90	127, 128, 129, 130, 131
	Round 18 Task	**132**
	Daily Data Round 19 L91–95	133, 134, 135, 136, 137
	Round 19 Task	**138**
	Daily Data Round 20 L96–100	139, 140, 141, 142, 143
	Self-evaluation L81–100	**144**
	EMMathon 5	**145, 146, 147, 148, 149**
	EMMathon 5 TASK	**150**

	SESSION	NUMBER
ROUNDS 21–24	Daily Data Round 21 L101–105	151, 152, 153, 154, 155
	Round 21 Task	**156**
	Daily Data Round 22 L106–110	157, 158, 159, 160, 161
	Round 22 Task	**162**
	Daily Data Round 23 L111–115	163, 164, 165, 166, 167
	Round 23 Task	**168**
	Daily Data Round 24 L116–120	169, 170, 171, 172, 173
	Self-evaluation L101–120	**174**
	EMMathon 6	**175, 176, 177, 178, 179**
	EMMathon 6 TASK	**180**

	SESSION	NUMBER
ROUNDS 25–28	Daily Data Round 25 L121–125	181, 182, 183, 184, 185
	Round 25 Task	**186**
	Daily Data Round 26 L126–130	187, 188, 189, 190, 191
	Round 26 Task	**192**
	Daily Data Round 27 L131–135	193, 194, 195, 196, 197
	Round 27 Task	**198**
	Daily Data Round 28 L136–140	199, 200, 201, 202, 203
	Self-evaluation L121–140	**204**
	EMMathon 7	**205, 206, 207, 208, 209**
	EMMathon 7 TASK	**210**

	SESSION	NUMBER
ROUNDS 29–32	Daily Data Round 29 L141–145	211, 212, 213, 214, 215
	Round 29 Task	**216**
	Daily Data Round 30 L146–150	217, 218, 219, 220, 221
	Round 30 Task	**222**
	Daily Data Round 31 L151–155	223, 224, 225, 226, 227
	Round 31 Task	**228**
	Daily Data Round 32 L156–160	229, 230, 231, 232, 233
	Self-evaluation L141–160	**234**
	EMMathon 8	**235, 236, 237, 238, 239**
	EMMathon 8 TASK	**240**

	SESSION	NUMBER
	CHALLENGE 1	**241**
	CHALLENGE 2	**242**
	CHALLENGE 3	**243**
	CHALLENGE 4	**244**

Scheduled time

Lessons should be scheduled daily. Generally speaking by Round 6 (Lessons 26–30) an EMM lesson should take no more than 30 minutes.

myEMMdata Student Workbook

The role of the teacher in presenting the daily lesson is to deliver, diagnose and debug; the role of the student is to record and represent their data, and report their bugs.

MMS, being data driven, means capturing that data is critical to teacher diagnosis and the students' consequent path to mastery.

The workbook is the equivalent of a GPS, monitoring the quality of implementation, and tracking both teacher performance and student achievement. It is an academic journal, where students employ daily various forms of data representation to record, summarise and represent their own all-important data, thereby enabling both teacher and student to specifically target misunderstanding and monitor progress.

Delivering a particularly strong educational component, the workbook slots in perfectly with the Australian Curriculum Sub-strand, Data Representation and Interpretation.

To assist the teacher in explaining visual aspects of the workbook, Electronic Reference Stimuli is available at the below link. Also available are Descriptors structured into five major elements describing the skills and knowledge students typically acquire as they become more adept.

mathmasteryseries.com.au/student-workbook/

Workbook components:

Daily Data: Each day, students record and summarise their own data. For incorrect responses, classified as Bugs, students shade the BugKey in the corresponding row on the BugBoard. This allows teachers to continually monitor progress and determine whether remediation is needed. For example, see myEMMdata pages 2–9.

Visual representation: This provides foundational knowledge and daily practice in reading and interpreting data to prepare students for the *Round task*. For example, see myEMMdata pages 2–9.

Round task: EMM is structured into 32 rounds each consisting of 5 lessons. At the end of each round students read, interpret and complete tables and graphs building on the *Visual representation* foundational knowledge. For example, see myEMMdata pages 10–11.

Self-evaluation: After every 4 rounds (20 lessons) students self-evaluate and reflect on their growth in knowledge, understanding and achievement. They record their feelings, providing teachers with an insight into their thoughts, and the opportunity to comment. For example, see myEMMdata pages 12–13. Thanks to Kevin Duffy, Principal WA, for his valuable input here.

EMMathon: These restructured lessons enable students to demonstrate their BugFree status. EMMathons affirm fluency, further enhance self-efficacy, and assess how well students have consolidated their knowledge and understanding. For example, see myEMMdata pages 14–15.

EMMathon to BugFree: Students convert their scores to percentages to determine their BugFree status. This encourages students to concentrate on personal growth rather than comparison with other students. Conversions should be performed either after each EMMathon, or after each Marathon. See myEMMdata pages 58–61; 118–121.

Challenge: These are designed to stimulate the thinking process, requiring students to reflect on what they have learned. Ideally, they are implemented at the end of the EMM program. See myEMMdata pages 122–125.

Awards: These motivate and reward students by emphasising growth, effort and completion of tasks. Club BugFree Award: For students who score all correct responses over a number of consecutive lessons. The recommended benchmark for this award is 20 consecutive lessons. Sixteen awards are provided allowing teachers to lower the benchmark at their discretion. See myEMMdata pages 127–133. Optional awards (Accurate Marking Award, Neat Workbook Award) could also be assessed in 20 lesson blocks. See myEMMdata pages 135–141.

INTRODUCTORY SCRIPT FOR IMPLEMENTING MMS WITH myEMMdata Student Workbook

1. *Write on board: Lesson 1 and today's date.*
2. *SAY*: Open your Workbook to page 3 and find Lesson 1. You are going to write your answers to Lesson 1 in this column. Write the **DATE** above Lesson 1.
3. *SAY*: Now look at page 2 and find the Lesson 1 Workspace. Use this space for working out what you cannot do in your head.
4. *Follow the Elementary Math Mastery Lesson 1 script pages 2–5 up to the corrections*.
5. *SAY*: Over the coming lessons I may decide to make an award for accurate marking.
6. *Correct all questions, see EMM page xi.*
7. After corrections and before debugging *SAY*: Look at page 3 and find the word BugBoard. A Bug is an incorrect response where you are unable to understand why you are wrong. Look at the BugBoard. For those incorrect responses classified as Bugs shade the BugKey on the corresponding row under the column headed one.
8. *DEBUG see EMM page xi.*
9. After debugging *SAY*: Look at page 2 and find the arrow at the bottom of the page. The arrow is pointing to the Visual representation images. I'll read what it says. You follow: **For each Lesson the whole of my data is represented in a bar made of 20 rectangles. From the baseline, I summarise my data by shading the number of rectangles equal to my score.** You can see the bar under Lesson 1. From the baseline, shade the number of rectangles equal to your score.
10. *Observe and check students have followed correctly.*

Note: At the end of Lesson 5, introduce the first Round Task. Ideally, a Round Task requires an entire session and should be completed before commencing the next lesson.

SAY: Look at page 3 and find the arrow at the bottom of the page. The arrow is pointing forward. I'll read what it says. You follow: **After recording and summarising my data for these 5 lessons, I go to page 10 and complete my Task for this Round.** Everyone turn to page 10 and complete the Round 1 Task.

myEMMdata Student Workbook Electronic Reference Stimuli (WERS)

To support your introduction go to the Math Mastery Series website under FREE Resources: **mathmasteryseries.com.au/student-workbook**.

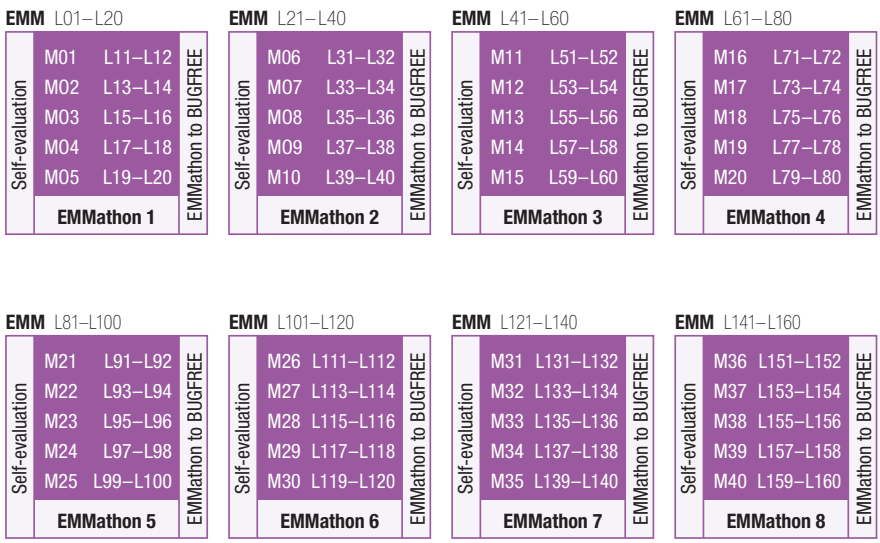
EMMATHON

After students have self-evaluated their first group of 20 lessons (myEMMdata page 12), teachers are advised to run an EMMathon.

An EMMathon is made up of 5 Marathons. A Marathon consists of 2 lessons from the previous 10, where the teacher presents the entire 40 questions without any teacher modeling (i.e. teacher presents the question only).

The first Marathon (myEMMdata page 14, coded M01 in the plan below) revisits Lessons 11 and 12 (coded L11–L12) where only the question is presented. The second Marathon (M02) revisits Lessons 13 and 14 (L13–L14) etc. After the first EMMathon is completed, teachers return to the program presenting Lessons 21–40 as per the EMM script.

After students have self-evaluated their second group of 20 lessons (myEMMdata page 26), teachers run a second EMMathon (myEMMdata page 28), then return to the program, and so on. Each of the darker shaded sections below denote an EMMathon round. An EMMathon round consists of 10 lessons restructured into 5, effectively adding 40 sessions to the EMM program.



Teachers may consider commencing EMMathons later in the program or adapting them in some other way that better befits the ability of their students. For example, a Marathon could consist of a set of 4 lessons from the previous 20. See pages 146–149 myEMMdata Student Workbook for optional template.

Electronic Reference Stimuli: EMMathon – see ERS provided by email at time of purchase.
For queries contact **hello@mathmasteryseries.com.au**.

EMMathon to BUGFREE

EMMathons provide students with the opportunity to demonstrate they are BugFree; they affirm fluency and further enhance self-efficacy. Following the first EMMathon students should complete EMMathon 1 Task, myEMMdata page 58, and then, go to page 60 and convert their own EMMathon 1 scores to BugFree levels. Conversions should be performed after each EMMathon.

PRETEST

Before beginning the program, Lesson 160 or any lesson divisble by 20, may be used as a pretest. Once the lesson is reached and completed the results can be compared to the pretest. Thanks to Far North Queensland Region, Education Queensland, for this suggestion.

CORRECTIONS

It is important to be consistent with corrections.

The following is a suggested plan:

- Students exchange books for corrections
- Teacher selects students to answer from the work they are correcting
- Teacher announces the question number and the selected student calls the answer
- Teacher repeats the given answer indicating correct – if incorrect teacher selects another student to respond, and so on
- Students circle any incorrect response – if correct no mark recorded.

To gauge instant feedback on the overall class performance, have students raise a hand each time they mark an incorrect response.

After marking:

- Books are returned and students record their total number of correct responses at the bottom of the column for that lesson
- Students shade incorrect responses classified as Bugs (see below) in the corresponding row on the BugBoard (see page xiv).

At a glance the teacher can now gauge the overall performance of each student, for each strand, for each round. Students who score all correct responses over 20 consecutive lessons receive a Club Bugfree Award. The teacher may lower the benchmark at their discretion.

WHAT BUGS YOU?

A BUG is an incorrect response where the student is unable to understand why they are wrong. **It is cruical to DEBUG directly after corrections**. Select students to identify questions that are causing them concern (What bugs you?). Revisiting the script with class discussion may be required here. See mathmasteryseries.com.au/wp-content/uploads/2024/08/debuggingtranscript_emmq7.pdf. **This debugging process is the most critical step on the path to mastery**. NOTE: Question 20 is designed to challenge students luring them into the process of constructive thinking. It is therefore recommended that this question not be debugged.

LOW-PERFORMING STUDENT SUPPORT: CHIN-IT APPROACH

The MMS was designed for single class grade groups, however, low-performing students may benefit from working in a group following the MMS CHIN-IT approach. In a nutshell, the CHIN-IT approach involves the teacher presenting each round twice (5 lessons make up a round). In the first presentation of the round, sections are presented lock-step with students writing each response on their individual whiteboards, and then they CHIN-IT (display whiteboard under chin); the teacher scans the responses and if no errors are evident, moves on to the next section etc,

otherwise the teacher debugs errors. If after three attempts the question is not debugged the teacher moves to the next section, noting students who need individual attention. After the round has been completed, or after each lesson, the teacher repeats the round (or lesson), ***as per normal*** (i.e. presents entire lesson, corrects, and debugs the student-identified bugs recorded in their Student Workbook).

PLACEMENT INTO PROGRAM

Because EMM assumes nothing in terms of student academic level, it is important that all students enter the program at Lesson 1. If students achieve an overall success rate of 100% in the first two Rounds (Lessons 1–10), continue the program presenting the questions only. Once student overall success rate in a Round drops below 95%, return to the beginning of the previous Round and repeat those lessons using the entire script.

PREPARING TO TEACH EMM

Read pages i – xv, and then familiarise yourself with the script by reading the first Round (Lessons 1–5). Set up and check electronic equipment for ERS. If you are not using the myEMMdata Student Workbook, have students prepare workbooks for Round 1 (see page xiv) prior to commencing the program.

When introducing students to EMM explain that in the beginning lessons they will be working with basic skills they probably already have, however, in order to meet the challenges ahead they will need to become fluent (able to respond accurately and without hesitation) and automatic (able to respond without conscious attention) with these skills. Go to Lesson 146 and present Question 20 by way of example. Go next to Lesson 21 and present Section 5 to demonstrate the manner in which you will be delivering the lessons. Explain the lesson structure.

LESSON STRUCTURE

- 20–25 min: Intensive teacher-directed instruction

  Using script, teacher models at a brisk pace, but not too fast. Each sentence should be delivered in small chunks. For example: “The difference between two numbers” *pause* “tells how much more or less” *pause* “one number is than the other.” Length of pause is equivalent to students silently and quickly repeating what was said.

  No interruptions—student focus must be on the teacher.

  Teacher poses a question for each strand. Length of time for student response depends on degree of difficulty – could be as little as 5 seconds. Students respond by writing answer in the column assigned to that lesson. Students may do calculations on the facing page.
- 1–2 min: Corrections
- 4–8 min: DEBUG (see page xi)

PROBLEM SOLVING (Question 20)

These higher-order questions demand deeper thinking. Rather than debugging the question, to build understanding, encourage students to explore and share problem-solving strategies. For example: classify; draw a diagram; generalise; guess and check; identify attributes; look for a pattern; make a list; make predictions; re-arrange; simplify the problem and solve part of it; verify; visualise; work backwards.

IMPLEMENTATION CHECKLIST

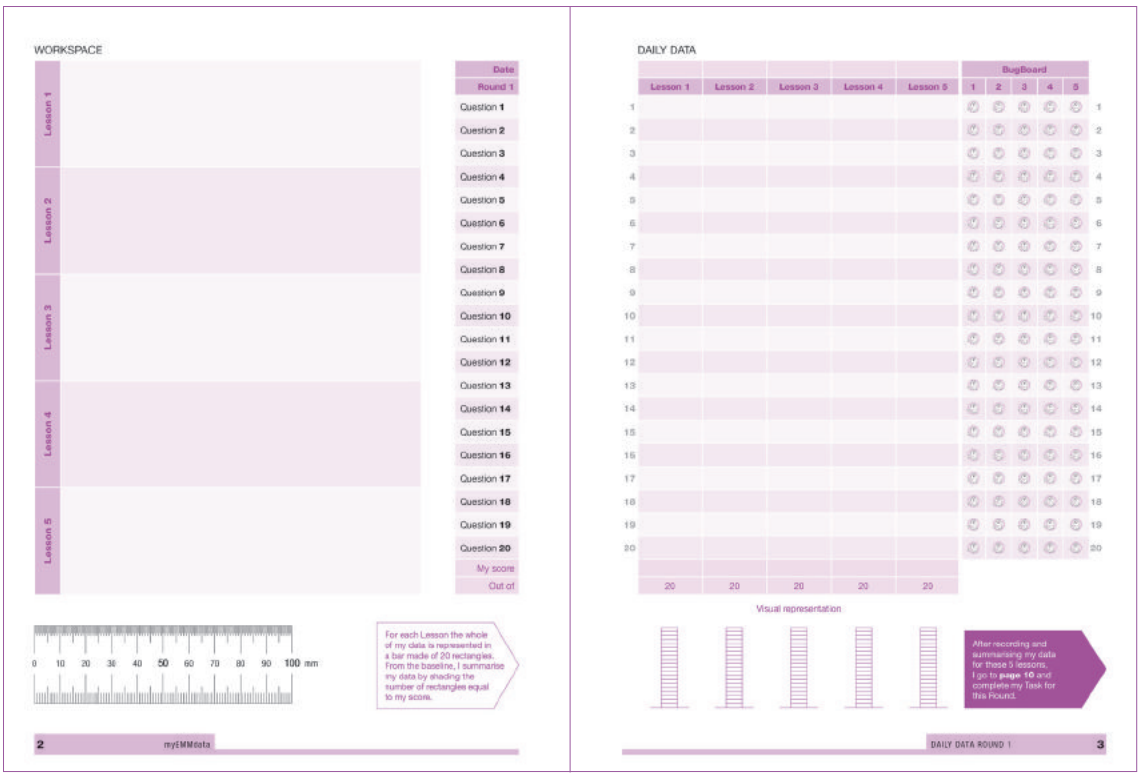
A regular school review of the quality of implementation, and the school's systematic action to improve it, will strengthen teacher performance and enhance student achievement. To this end, the checklist could be used; it aims to encourage teachers to work together, sharing what teaching behaviours work well, and identifying what behaviours might need refining.

Teacher _____ Peer _____ Date ___ / ___ / ___

Category	Key indicators (use check marks)	Comment
Organisation and management of classroom (Initiating)	○ Workbook distribution routine ○ Lesson procedure evident ○ Student awareness of procedure	
Teacher delivery	○ Voice clear and firm	
Follow lesson script	○ Delivery without digression ○ Points at ERS as required ○ Corrections completed ○ DeBugs directly after corrections	
Lesson pace	○ Delivery brisk but not too fast ○ Sentences delivered in chunks ○ Student response time adequate	
Corrections	○ Directly after final question ○ Performed quickly ○ Procedure consistent	
Teacher attention	○ Delivery of script: watches faces ○ Student writing: watches workbooks ○ Corrections: watches students	
DeBug	○ Procedure evident	
Student Workbook	○ Lesson dated ○ Incorrect responses circled ○ Bugs identified on BugBoard ○ Tasks completed (e.g. Visual representation; Round tasks; Self-evaluation; Marathons) ○ Student pride and care evident	
Organisation and management of classroom (Closing)	○ Routine for completed lesson ○ Routine to monitor Workbook data ○ Positive approach	

FOR THOSE NOT USING PRESCRIBED WORKBOOK

Ideally, use a 96-page spiral-bound exercise book for the student to record, analyse, extract, and report from. There are 160 lessons or 32 rounds. For diagnostic purposes (see Corrections page xi) each round of 5 lessons should be contained within a double-page spread.



Each right-hand page should be ruled as shown in the myEMMdata Student Workbook (see snapshot above). The right-hand page is for recording answers, one column per lesson. If students miss a lesson the column should be left blank until they catch up. The left-hand page is for rough working out.

Other components of the myEMMdata Student Workbook are too complex to replicate. These include: Round Task; Self-evaluation; EMMathon to BugFree; Challenge. However, Student Awards are available for download in PDF format.

mathmasteryseries.com.au/student-workbook/

AUTHOR'S NOTE

The student-directed versus teacher-directed learning debate is an ancient one; indeed, the polemic goes back to Plato. In my doctoral research: **https://www.acer.org/files/FarkotaThesis.pdf** I carried out a comprehensive review of the relevant research and literature, and reached the inescapable conclusion that some skills were better acquired through one approach, and some through the other. When it came to the employment and cultivation of higher order skills, where reasoning and reflection were required, it was clear that a student-directed approach to learning was better suited. But when it came to the acquisition of basic skills, the empirical evidence unequivocally showed that a teacher-directed approach won out.

It is well accepted that problem solving skills operate from a knowledge base that has been acquired through practice; in fact, genuine competence in both problem solving and basic skills *only* comes with practice. Significantly though, it is actually when the base knowledge in a discipline is being acquired that the foundations for effective problem solving are being laid. Because the essential knowledge required for automaticity is stored in long term memory, it is best retained when explicitly taught and practised repeatedly. This automaticity, originating from practice, empowers students to maximise their mental capacity by concentrating exclusively on the more complex task of problem solving.

It is also well accepted that to perform a task competently one requires not only the requisite skills, but also the self-belief in one's ability to implement performance. In the learning process this is termed *self-efficacy*, and when laying the foundational skills in mathematics, or for that matter any academic discipline, it is important that student self-efficacy be accommodated. Students with low self-efficacy in a particular skill area are reluctant to engage in tasks where those skills are required, and if they do, they are more likely to quit when encountering difficulty.

Students engaged in the learning process automatically monitor their progress. For this reason the capacity to self-evaluate progress is an integral and ongoing component of the EMM program. Because EMM tasks gradually increase in difficulty, students have clear criteria by which they can independently assess their performance and gauge their progress. As they progress they acquire more skills and become more proficient at the self-evaluation process.

EMM lessons were deliberately designed not to be seen as tests, but testing is precisely what is happening on a daily basis. Without being conscious of it, students are willingly engaging in ongoing assessment. As such the lessons serve as a powerful diagnostic tool clearly mapping student progress, identifying precisely where and when they are experiencing difficulty. Their responses, coupled with their own analysis of any incorrect response they have given during a lesson, provide teachers with reliable diagnostic information better than any that can be acquired from a formal test situation. This is crucial to EMM's success as it allows for teacher feedback to specifically target individual student misunderstanding. Because students receive this daily feedback on their performance, they are acutely and immediately aware of their progress, which strengthens their self-efficacy, sustains their motivation, and enhances their academic achievement.

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