M1 Maths

Program for Years 7-10
Student-Paced

This is a suggestion for a school program in which all students can progress at a pace which suits their background, ability, aspirations and commitment.

Why a student-paced program?

Many educators see value in encouraging a growth mindset in students. A growth mindset is one in which the students see that they have mastered some ideas and not yet mastered others (though they are on their way to mastering them). This contrasts with a static mindset in which the students see that they have mastered some ideas and failed to master others (and so are not capable of mastering them).

A growth mindset fits with the idea that a student is capable of any learning, given the time and effort needed; a static mindset fits with the idea that a student is capable of some learning, but not capable of other learning.

A student with a growth mindset sees value in making the effort needed to progress, whereas a student with a static mindset tends to see no point in struggling with something that they have already seen they can't do.

Although a growth mindset is valued, the Australian maths curriculum for Years 7 to 9 specifies that all students should learn the same things in the same year levels. This means that they have a given time to master an idea, after which, time constraints mean that they have to move on to something else. The result is that many students master some ideas and fail to master others and have little opportunity to work further on the ones they failed. They may come back to them the next year, but the new work will be at a higher level and will assume mastery of the earlier ideas. If a student didn't master these earlier ideas the previous year, they are unlikely to be able to build on them successfully the next year. This regime is almost diametrically opposed to developing a growth mindset.

What is suggested here is that students be given the time they need to master concepts before being required to go on to others. Some students will master the concepts more quickly than others (sometimes very much more quickly). To allow this, students would have to be able to progress through the curriculum at their own pace rather than at the lock-step one-size-fits-all pace suggested in the curriculum documents.

Is doing this going against the intent of the curriculum? If we see the curriculum as a series of ideas that should be presented to the students at specified times, then yes maybe. But if we see it as a series of ideas that should be mastered by the students, then no.

If we represent the progression of ideas in the curriculum as a bar and show the ideas mastered in black and those not mastered in white, then, taking a lock-step approach might lead to a student's knowledge looking something like this by the end of Year 9:

Year 7	Year 8	Year 9
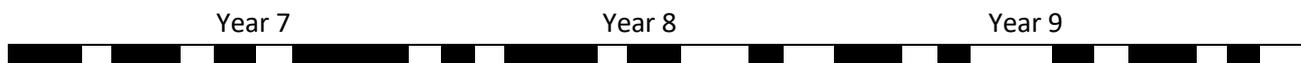
On the other hand, if the same student is allowed to master ideas before being required to go on, then their knowledge might look something like this:

Year 7	Year 8	Year 9
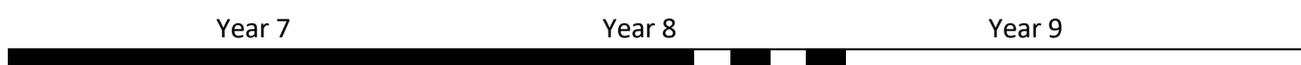
In the second case the student has not been exposed to the 'Year 9' part of the curriculum. But s/he has mastered all of the 'Year 7' part and a solid fraction of the 'Year 8' part.

The amount of learning in both cases might be similar. Though, because, in the second case, less time will have been spent being exposed to material that the student doesn't have the background for, the total amount of learning might well be expected to be greater. What's more, the learning will be more coherent and connected. Also, as the ideas met at an earlier stage are generally more essential for most people than those met later (understanding percentages is important to more people than being able to factorise quadratics), the knowledge in the second case will probably be more helpful in the student's life.

Does the second case satisfy the requirements of the curriculum any less than the first case? It is easy to argue that it satisfies it more, and thus that the curriculum does allow schools to let students progress at the pace for which they are ready. It is certainly true that the school has given the student a more beneficial maths education in the second case.

A Student-Paced Program

The following is a suggestion for implementing a program in which all students can progress through the mathematics curriculum at a pace that suits them.

Students are assessed at the start of Year 7 and are grouped into classes according to the results of that assessment. With the possible exception of minor individual adjustments, they then stay in those classes though Year 7.

All classes then start to work on the Level 1 concepts using a combination of teacher instruction and the M1 Maths modules. All start at the beginning, but the faster

classes will move through the modules relatively quickly (especially where the knowledge has already been met in Years 1 to 6), while the slower classes will take longer on each module and thus progress more slowly.

The students will be assessed through the year as detailed below so that each student's progress is known. By the end of Year 7, some students from slower classes may have progressed further than other students from faster classes, so the student groupings can be adjusted for the beginning of Year 8. The same again for the beginning of Years 9 and 10. This is important as it means that students who bloom late are not limited as to how far they can get.

There will be the issue that, when moving to a faster class, the students will have missed some work. However,

- in schools with reasonably large numbers of students and several classes per cohort, the difference in progress between successive classes will be relatively small;

- also, if the first part of each year is assigned to revision and consolidation, this will give the students who have moved up a chance to catch up any missed concepts;

- also, many of the students should be able to use the modules to catch up missed work independently. This is more likely to be true for students who are moving up.

In Years 8 to 10, the teacher may not stick to a rigid sequence of modules. Rather, there should be time for a bit of revisiting according to student needs and requests. This too will make the transition easier if students move up to a faster class.

Under traditional systems, classes belong to a particular year level and use a textbook for that year level. Under the proposed student-paced system, classes will not generally be working on just the content for one particular year level, so there will not always be an appropriate textbook for the class for that year. However, the M1 Maths modules are not assigned to year levels and students would have access to all the modules at all levels at any time, so this would not be an issue.

The above applies to the Knowledge part of the curriculum. In parallel with developing Knowledge, it is suggested that about a quarter of learning time is spent developing Skills at about the same level as the knowledge being learnt. The skills include mental arithmetic, problem solving, investigating and communication. The M1Maths Skills modules can be used for this.

Students who decide part way through a year that they would like to go faster than the class they are in have a couple of options. Firstly, they could study knowledge modules independently ahead of the class; secondly, they could do more on the skills part of the program. Developing problem solving and investigating skills will improve their thinking and assist them to progress more rapidly through the knowledge part of the program in future years. They may then be ready to move to a faster class at the end of that year. In extreme cases, they could move during the year.

Knowledge Assessment

Knowledge assessment might consist of short Module tests and longer Level tests.

There could be a Module test for each module. These could be similar to the revision sets in the modules, consisting of just a small number of questions and they can be produced by taking a revision set and tweaking the questions. They should take students about 5-10 minutes, though it isn't necessary to restrict the time available. To pass the module tests, students should get every question correct. Emphasis should be mostly not on showing working, but on getting the right answer.

There will also be a Level test for each level. These will be longer (say a lesson) and should cover all the Knowledge modules at that level plus a scattering from earlier levels. Sample Level tests are available at the *Tests* link on the main menu. Actual tests can be produced by tweaking these. Students can then use the tests on the site for practice and test preparation.

Every student has a Knowledge points tally which builds up over the four years from Year 7 to Year 10. They score 2 points for each Level 1, 2 or 3 module test they pass, 4 points for each Level 4 module test and 3 points for each Level 5 module test. The level test is then out of a number that brings the total points for that level to 100. So, for example, Level 1 had 26 modules worth 2 points each, so there are 52 points available from module tests and the level test will be out of 48, making a maximum possible score of 100; Level 4 has just 12 modules, but they are worth 4 points each, so there are 48 points available from module tests and the level test will be out of 52, again making a maximum possible score of 100.

When a student accrues 85 points at Level 1, they are credited with 100 and can then start to do assessment and collect points at Level 2. When they accrue 85 points at Level 2, they are credited with another 100 and can then start to do assessment and collect points at Level 3. And so on. A student who completes Level 5 will have 500 knowledge points.

Module tests might be scheduled each week, say in the second half of Friday's lesson, and also outside of lesson times, e.g. at after-school or lunch-time tutorials. Students can sit any module tests of their choosing at their current level. They can repeat a module test as many times as they need. Students who don't want to sit a module test in a given session can continue with other work.

Level tests could be sat at the end of each term during a lesson or during an exam block. Most students will only really need to sit one knowledge level test each year or so, so, like the module tests, sitting them should be optional. However, some students might like the opportunity to improve their score each term. Students who don't want to sit a test can continue with other work.

Monitoring Student Progress

The *Progress Tracker* spreadsheet can be used to track student progress. It is available by clicking the *Progress Tracker* link under the *Programs* link on the Main Menu. The file will need to be downloaded and opened in Excel to display properly.

Each time a student passes a module test, they get a mark in the appropriate cell. Each time they improve their score on a Level test, their new score is entered in place of the earlier one. (If they score worse than previously, nothing is changed.)

The spreadsheet will keep track of the students' knowledge tallies and will un-grey the next level when the student is credited with 100 points at the current level. Once the next level is un-greyed, the student will do assessment at that level and continue to add to his or her tally, building it possibly to 500 points or maybe even further if they decide to do some Level 6 modules in Year 10.

Skills Assessment

At the end of each term, the students also have the opportunity to sit a skills test at the same level as their knowledge test. This will be out of 100 points, 25% on mental arithmetic, 25% on problem solving, 25% on investigating and 25% on communication. The arithmetic and problem components are done in class; the investigating component is done over a period of a week as an assignment; the communication mark is based on the work they do on the problem solving and investigating components.

Students' skills scores are entered into the same *Progress Tracker* spreadsheet at the appropriate level and, again, they keep their best score.

Students progress to the next Skills level when they proceed to the next Knowledge level. However, if working at Level 3, a student can have another go at the Level 2 Skills test rather than attempting the Level 3 test in order to improve their mark. The student's skills tally is the sum of their best scores on the Skills level tests attempted so far.

The spreadsheet also adds the knowledge and skills tallies to get an overall tally and this could be used to rank students.

The assessment at the start of Year 7 to assign students to classes might consist of the Level 1 Knowledge test and the Level 1 skills test. This would initiate the students' tallies.

A-E Grades

If A-E grades are required for reporting, they could be generated using a chart like the one to the right. The student's tally is plotted at the end of each term and the grade band the point falls in determines the grade given. Such a chart could also be used to track progress visually and to see how well the student is on track for where they want to be at the end of Year 10.
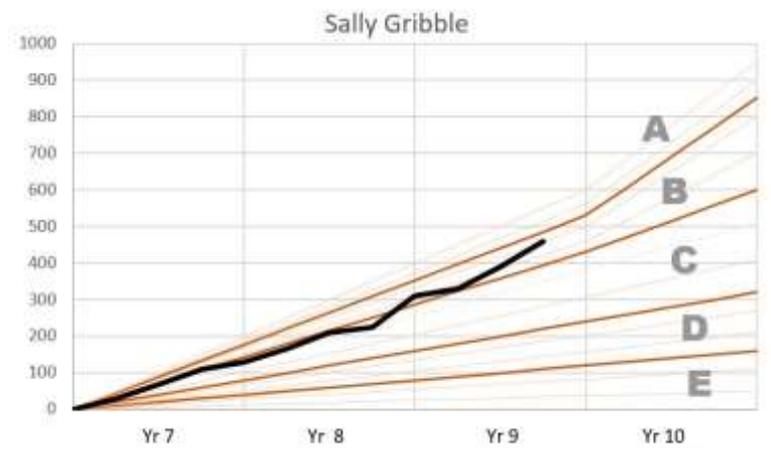
Teaching Sequence

A student-paced program will not allocate topics to year levels, terms and week as tends to be done in traditional approaches. Instead, it will just be a sequence of modules beginning with Level 1 and working up. Classes and students will progress through the sequence at their own pace.

One possible sequence for the knowledge modules is:

M1-1→4   A1-1→3   N1-1→5   G1-1→3   S1-1→2   N1-6→10 A1-4→6   P1-1

M2-1→3   N2-1→4   G2-1→6   A2-1→3   P2-1→3   S2-1→2

N3-1→3   A3-1→5   G3-1   P3-1   S3-1→3   M3-1→4   A3-6→10

N4-1   A4-1→3   M4-1   P4-1   S4-1→2   A4-3→6   G4-1

A5-1→8   N5-1   M5-1→2   A5-9→13

Using such a sequence, teachers can focus their teaching on the modules most appropriate to where the students in their class are up to, e.g. late Level 2 to early Level 3, while revising earlier modules.

The teacher should spend about half their teaching time teaching the Knowledge concepts needed for where the students are up to. About a quarter of the time should be for students to work independently on their areas of need (e.g. to master modules already taught or to go ahead). And about a quarter should be for the Skills part of the program.

Other Advantages of this Type of Program

- The program and the assessment are very transparent to the students and completely under their control. They will know exactly what they need to do to make progress and this will motivate many to work hard to do so.

- The program and assessment are very transparent to parents and this makes it easier for parents to encourage and reward effort on the part of their children. It also allows students and their parents to see whether the child is on track to reach the level they aspire to by the end of Year 10.

- Through the M1 Maths website, parents have access to the same learning materials as the students. All the concepts are explained in a way that should be accessible to students and parents. So, even parents who are not confident with the maths can learn together with their children and thus do more to help them.

- No student ever fails; any increase in their tally is progress and tallies never go down. Reporting should compare students only with their own past achievement and their aspirations, not with other students or year level expectations.

- Module tests break the achievement into bite-sized chunks which students tend to be more confident with. With the learning in manageable chunks, students tend to be more willing and able to learn independently. The prospect of passing module tests and building one's tally is motivating and many students take charge of their own progress. At one school using a similar system, up to half the students in a cohort would attend voluntary after-school tutorials to prepare for and sit module tests. If nothing else, the extra time spent doing maths is of benefit to those students.

- The fact that knowledge and skills contribute equally to the students' combined tallies means that students will value the skills part of the program and make effort with it. It also means that teachers will devote significant time to the development of students' skills. In many traditional programs, mental arithmetic, problem solving, investigating and communicating tend to get crowded out by the pressure of the knowledge content. Where progress through the knowledge is flexible and where students and teachers value the skills part of the course, this shouldn't happen.

- It's very easy to tell who the top student is at any stage and so students can compete for this position, knowing where they stand at all times. There could be honour boards for the top students in a cohort and possibly standing school records for various stages, e.g. end of Year 7, and recognition for students who break these records.