Mastery Learning to address the assumed knowledge gap, encourage learning and reflection, and future-proof academic performance

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What are some of the challenges?

- Issues at high school
  - Around 33% of years 7 to 10 mathematics classes are taught without a qualified mathematics teacher
  - Declining enrolments in Mathematics/increasing enrolments in General (Elementary) Maths/increasing enrolments with no senior mathematics
What are some of the challenges?

- Issues in first year university
  - “Recommendations”, “Assumed knowledge” versus “Prerequisites” -> under-preparedness
  - Higher than acceptable failure rates and higher than acceptable attrition
  - Students can pass without exhibiting all subject intended learning outcomes
  - Poor retention of knowledge and skills
  - Students complain of a lack of feedback
The response to date ...

Some success with -

- Diagnostic testing and pre-teaching (Foundation Mathematics)
- Top-down and bottom-up perspectives – graduate attributes (inc. threshold learning outcomes) and threshold concepts
- Content in context
- Active learning
- Peer-learning
- Other learning support - Mathematics Study Centre
What is Mastery Learning?

• A philosophy of instruction:
  • Endorses the belief that all students can learn and achieve the same level of content mastery when provided with appropriate learning conditions (especially time)
• a set of methods for teaching and assessing
  • Objectives organised into units
  • ‘Mastery’ is usually defined at 75 or 80% in tests (and/or exams)
  • Students failing to achieve mastery are given further attempts until mastery is achieved. Feedback and remediation are provided prior to further testing
• Research to suggest that mastery learning improves achievement, retention of content and attitudes to learning
How have we implemented Mastery Learning?
Implementation

- Criterion referenced tests – one hour, online
- Formative assessment precedes summative assessment
- Mastery tests assess fundamental knowledge and skills
- “mastery” defined by 80% or higher
- Immediate feedback to feed-forward
- Remediation
- Three attempts available to demonstrate mastery
- Optional final exam
Implementation
Outcomes
## Foundation Mathematics – Autumn 2014

<table>
<thead>
<tr>
<th>Background</th>
<th>Autumn 2012</th>
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<th>Autumn 2013</th>
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Mathematical Modelling 1 – Spring 2014

Comparing results for 33130

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<td>Z</td>
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Percentage

Grade
Comparing results for 33230
What did you particularly like about this subject? ... ‘the second chance tests’ ... fundamentally the point of the subject (any subject, really) is to help people understand the material and help them study it, and I think these second chances do both of these things. Showing exactly where people aren’t doing so well and (importantly) letting them see the results of their study soon after. I think is not only a really good way to help people target their study most effectively and understand their own learning process, but also just a great way to reinforce the value of study in people’s minds – you can see your marks improving almost immediately. (SFS Mathematical Modelling for Science Autumn 2013)
What did you particularly like about this subject?
Having the mastery tests on topics. It helped retain the concepts longer.
(SFS Foundation Mathematics Autumn 2014)

Mastery tests throughout the semester made me keep up to date with my work and has taken off stress for my final exam.
(SFS Foundation Mathematics Autumn 2014)

The mastery tests made you learn continuously instead of cramming at the end of the semester.
(SFS Foundation Mathematics Autumn 2014)
What did you particularly like about this subject? The assessment task layout and how they allowed you to have a second chance and fix mistakes, this has been very successful method of learning and understanding and I would recommend it in more subjects. 
(SFS Foundation Mathematics Autumn 2014)
What did you like particularly in this subject?
The ‘2nd chance’ class test. If a student has not done too well in the class test, a second seating of a test is available. It is not the same test but similar and this does wonders to a student’s confidence in a subject that leaves very few standing tall.

(SFS Mathematical Modelling for Science Autumn 2013)
The option of a second chance for the class tests allowed us to gain an understanding of our areas for improvement and demonstrate our ability to correct our errors.  
(SFS Mathematical Modelling for Science Autumn 2013) 

I found the testing methods a bit different and that they took a lot of the pressure out of the tests.  
(SFS Foundation Mathematics Autumn 2014).
... but ...
Although the questions were basic, the pressure behind each of these Mastery Tests was huge! It was as if I was doing a final exam every single week and because of that and I was studying part-time, and so my other subject was hampered.

(Focus group – Mathematical Modelling 2 Autumn 2014)

For the purposes of passing it was sufficient. But I don’t feel confident moving forward.

(Focus group – Mathematical Modelling 2 Autumn 2014)
(Facilitator) Mastery of the test or the course?

(Student) Mastery only of the test and not the subject of course.

(Focus group – Mathematical Modelling 2 Autumn 2014)
Why the difference?
Implementation

- The mastery tests were too similar to the sample tests. There was not enough variability in the questions in the publishers’ websites.
Questions