Challenges
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Curriculum Design
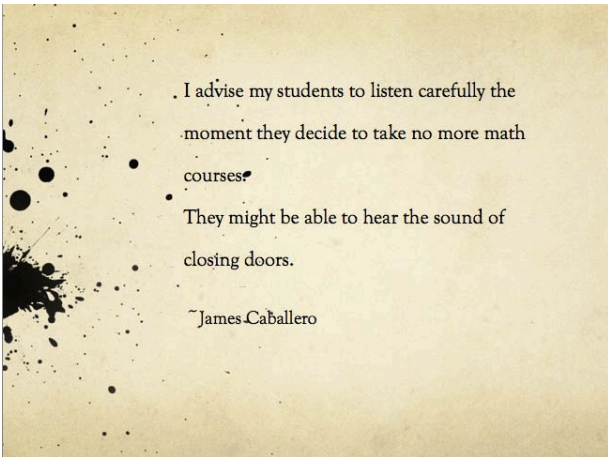○○○○○

Opportunities
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Curriculum re-design to provide opportunities for a diversity of students.

Katherine A Seaton

Department of Mathematics and Statistics
La Trobe University

Assumed Knowledge in Maths Forum (2014)

Challenges
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Curriculum Design
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Opportunities
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> I advise my students to listen carefully the moment they decide to take no more math courses.
> They might be able to hear the sound of closing doors.
>
> ~James Caballero

http://www.mathsinsider.com/wp-content/uploads/2012/06/No-more-math-courses.png

Everybody a mathematician?, CAIP Quarterly 2 (Fall, 1989).

Challenges
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Curriculum Design
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Opportunities
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The external environment

Pre-requisites for Bachelor of Science:

All Victorian institutions require English plus:
(ignoring the "middle band")

- University D: nothing else

- Universities S and V: any maths

- University M: any one of Biology, Chemistry, Geography, Mathematical Methods, Specialist Mathematics, Physics or Psychology.

- **La Trobe University** from 2013
  - B Sc (Applications in Society): nothing else
  - B Sc: maths methods <u>or further maths</u>; plus one of Biology, Chemistry, Environmental Science,Specialist Mathematics, Physics or Psychology

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Challenges
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Challenges
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Curriculum Design
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Opportunities
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The internal environment

Further considerations:

- ☐ All students in both LTU degrees required to take some **quantitative literacy** subject in first year.

- ☐ The physics and mathematics majors are delivered through the B Sc (and need methods).

- ☐ Common first year in Engineering being introduced.

- ☐ Mid-year entry to engineering was desirable.

- ☐ Students without maths methods wanted to enter engineering and [maths] teaching.

- ☐ No net increase in subjects or duplication of teaching (i.e. not the University M solution).

- ☐ Teaching model working well.

Challenges
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Curriculum Design
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Challenges
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Curriculum Design
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Opportunities
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The internal environment

Bridging Program:

The La Trobe Bridging Maths Program (1996-2012):

- Considered equivalent to Maths Methods.

- Cost recovery and up-front payment.

- Hidden costs non-trivial.

- Ran two evenings per week from October to February.

- Worked well for older students - maturity required.

- Not designed for school leavers - timing.

- Delivered face-to-face at Bundoora.

- Not for credit, not formally enrolled with LTU.

- Did not deliver us many students - small class size
  (but did deliver some to University R).

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Challenges
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Challenges
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Curriculum Design
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Opportunities
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Existing [Stable] Curriculum

Semester One:

Pre-requisite: VCE Methods or Specialist Maths [or Bridging]
Two parallel streams within one subject:

Number Systems
Sets
Functions (composition, invertibility)
Sequences and Series
Complex Numbers
Proofs

Calculus
Limits and continuity
Differentiation
Chain and product rules
Graph sketching
Fundamental Theorem of Calculus
Integration, incl. by parts

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Challenges
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Curriculum Design
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Opportunities
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Existing [Stable] Curriculum

Semester Two:

Pre-requisite: First semester subject (previous slide)
Two parallel streams within one subject:

Linear Algebra

Vectors
Matrices & Determinants
Lines and Planes
Linear Systems of Equations
Gaussian Algorithm
Matrix Inversion

Calculus

First order differential equations
Separable, and integrating factor
Second order DEs
Taylor's Theorem and Taylor's
polynomials
Approximation methods for DEs

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Challenges
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Curriculum Design
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Opportunities
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Re-designed Curriculum

You can't teach problem solving unless you are a problem solver.

Jim Wilson (the mathematician, not the TV sports journalist)

Photo by Katherine Seaton, La Trobe campus bridge and moat.

Challenges
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Curriculum Design
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Opportunities
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Re-designed Curriculum

Semester One:

Pre-requisite: VCE Methods or Specialist
Two parallel streams within one subject:

Number Systems

Sets
Functions
Sequences and Series
Complex Numbers
Proofs or Probability

Linear Algebra

Vectors
Matrices & Determinants
Lines and Planes
Gaussian Algorithm
Matrix Inversion

OR

⩽ Further Maths: Introductory Calculus

Based on Bridging Program, using FOLD

Challenges
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Curriculum Design
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Opportunities
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Re-designed Curriculum

Semester Two:

Pre-requisite: Maths Methods or Specialist Maths or
Introductory Calculus
Two sequential blocks within one subject

Calculus

Limits and continuity
Differentiation: Chain and product rules
Taylor's Theorem and Taylor's polynomials
Fundamental Theorem of Calculus
Integration, incl. by parts

Differential Equations

First order differential equations: Separable, and linear
Second order DEs
Approximation methods for DEs

Challenges
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Curriculum Design
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Opportunities
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Pathways

Pathways to STEM:

Why is this more than just re-arranging topics?

Background	Sem. 1	Sem. 2	Sem. 1	Beyond
$\geqslant$ Methods	NS & LA	Calc & DEs	Year 2	
$\leqslant$ Further	Intro. Calc.	Calc & DEs	NS & LA	Year 2
Mid-year entry		Calc & DEs	NS & LA	Year 2

Challenges
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Curriculum Design
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Opportunities
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Mid-year entry		Calc & DEs	NS & LA	Year 2

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Challenges
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Curriculum Design
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Opportunities
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$\leqslant$ Further	Intro. Calc.	Calc & DEs	NS & LA	Year 2
Mid-year entry		Calc & DEs	NS & LA	Year 2

Students without Maths Methods can begin in the B Sc or B Sc (App. Soc) and transfer to Engineering or Computer Science or Nanotechnology degrees.

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Challenges
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Curriculum Design
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Opportunities
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Why is this more than just re-arranging topics?

Background	Sem. 1	Sem. 2	Sem. 1	Beyond
$\geqslant$ Methods	NS & LA	Calc & DEs	Year 2	
$\leqslant$ Further	Intro. Calc.	Calc & DEs	NS & LA	Year 2
Mid-year entry		Calc & DEs	NS & LA	Year 2

Pathway fits into Bachelor of Teaching (Secondary).

Challenges
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Curriculum Design
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Opportunities
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Pathways

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$\geqslant$ Methods	NS & LA	Calc & DEs	Year 2	
$\leqslant$ Further	Intro. Calc.	Calc & DEs	NS & LA	Year 2
Mid-year entry		Calc & DEs	NS & LA	Year 2

Students who do not pass first semester can continue without delay, because the semesters are de-coupled.

Challenges
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Opportunities
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Pathways

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Background	Sem. 1	Sem. 2	Sem. 1	Beyond
$\geqslant$ Methods	NS & LA	Calc & DEs	Year 2	
$\leqslant$ Further	Intro. Calc.	Calc & DEs	NS & LA	Year 2
Mid-year entry		Calc & DEs	NS & LA	Year 2

Students can change their minds and pick up maths or physics majors mid-year, because the semesters are de-coupled.

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Challenges
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Opportunities
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Pathways

Quantitative Literacy:

Not everyone needs calculus as their "quantitative literacy" (numeracy) subject.

We also offer:

- Mathematical Applications for Biology;
- Statistics for Life Sciences or Psychology;
- Discrete Mathematics (IT).

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Opportunities
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Revisit the constraints

Re-design has ticked the boxes:

✓ Introductory Calculus is one possible quantitative literacy subject in first year.

✓ The physics and mathematics majors are open to more students.

✓ Mid-year entry to engineering or science.

✓ Students without maths methods can enter engineering and [maths] teaching.

✓ Net decrease in subjects and no duplication of teaching.

✓ Addresses many of the issues with the Bridging Program.

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Opportunities
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Doors open

http://homefixtures.blogspot.com.au/2012/02/open-door.html.

Challenges
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Curriculum Design
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Opportunities
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Doors open

Doors Open by Vilhelm Hammershoi (1905).

http://benroseart.com/what-does-light-look-like-vilhelm-hammershoi/

Challenges
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Curriculum Design
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Opportunities
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Doors open

http://www.wbrz.com/news/uss-last-sardine-plant-closing-its-doors/

http://homefixtures.blogspot.com.au/2012/02/open-door.html.