Enhancing students’ learning through blended learning for engineering mathematics

Presenters:
Iwona Czapinski i.czaplinski@qut.edu.au and Dann Mallet dg.mallet@qut.edu.au

Project team members:
Pamela Burrage pamela.burrage@qut.edu.au and Steven Psaltis steven.psaltis@qut.edu.au
Overview of the presentation

✓ Research motivation and objectives
✓ MAB125 unit context
✓ Redesign principles
✓ Summer: pilot study
✓ Lessons learnt
✓ Next steps
Objectives of the current project

**Overall goal**

Improve engagement, satisfaction, retention and completion rates of students enrolled in service units through unit re-design.

**Current project**

Investigation of the effectiveness of a re-designed learning and teaching cycle for MAB125.
Need for this type of research

This research will:

1. Help students to acquire specific STEM skills, in response to the current calls for more projects promoting STEM education around the world.

2. Develop innovative, effective teaching methods using Blended Learning approaches as defined by QUT.

3. Address specific educational needs identified through University unit evaluation process.
Nature of this type of research

**Interdisciplinary**

Multiple theoretical backgrounds and approaches used at all stages of the project:

**Conception:** Evidence-based research [2];

**Re-design:** Blended Learning approach [3];

**Research methodology:** Action Research in HE [4];

**Data analysis and interpretation of results:**

The notion of Affordance crucial in Design [5];

Ecological Psychology [6]; Software Design/Human-Computer Interaction [7]; Education [8].
Specific objectives of the project

1. To investigate ways of **effectively** using the online tools *WebWorK* online diagnostics, webinars, *Echo360* lecture recording system and *GoSoapBox*;

2. To improve the delivery of face-to-face (f2f) lectures and tutorials by designing, developing and implementing activities that **explicitly link f2f delivery mode with online tools**, and

3. To improve 1st year **student involvement** by embedding and promoting *QUT Student Support programs* in the unit; developing a model of a close collaboration between academics teaching the unit and QUT Student Success Program and STIMulate.
MAB125 Foundations for Engineering Mathematics – context

Selection principles

(1) Feedback through the University’s learning and teaching evaluation tool (Pulse and InSight):
   - **Dichotomy** between progress rates and teaching satisfaction rates.

(2) Student data generated by the University systems.

(3) Income generated by the unit:
   - Greater than one million $/year.
## MAB125 context – continued

<table>
<thead>
<tr>
<th>MAB125</th>
<th>ENROLMENTS</th>
<th>PROGRESS RATE</th>
<th>PULSE</th>
<th>INSIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM1/2012</td>
<td>499</td>
<td>83.3%</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td>SEM2/2012</td>
<td>126</td>
<td>78.6%</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td>SEM1/2013</td>
<td>496</td>
<td>70.8%</td>
<td>PS1: 4.0</td>
<td>IS1: 4.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PS2: 4.0</td>
<td>IS2: 3.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PS3: 3.8</td>
<td>IS3: 3.9</td>
</tr>
<tr>
<td>SEM2/2013</td>
<td>135</td>
<td>70.9%</td>
<td>PS1: 4.2</td>
<td>IS1: 4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PS2: 4.0</td>
<td>IS2: 4.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PS3: 4.1</td>
<td>IS3: 4.2</td>
</tr>
</tbody>
</table>

**PS1**: This unit is providing me with good learning opportunities.

**PS2**: I am taking advantage of opportunities to learn in this unit.

**PS3**: I am satisfied with this unit so far.

**IS1**: This unit provided me with good learning opportunities.

**IS2**: I took advantage of the opportunities to learn in this unit.

**IS3**: Overall, I am satisfied with this unit.
## MAB125 context – continued

### System data – number of attempts

<table>
<thead>
<tr>
<th>Total enrolments in MAB125 between 2010-2013 – 2101 students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attempts and course enrolments</td>
</tr>
<tr>
<td>2 attempts (the same course) – 140 students</td>
</tr>
<tr>
<td>2 attempts (course changed) – 3 students</td>
</tr>
<tr>
<td>3 attempts (the same course) – 27 students</td>
</tr>
<tr>
<td>4 attempts (the same course) – 2 students</td>
</tr>
<tr>
<td>6 attempts (the same course) – 1 student</td>
</tr>
<tr>
<td>Total of multiple attempts – 173 students</td>
</tr>
<tr>
<td>Tuition fees</td>
</tr>
<tr>
<td>Domestic – 19 students</td>
</tr>
<tr>
<td>International – 11 students</td>
</tr>
<tr>
<td>Commonwealth supported – 143 students</td>
</tr>
<tr>
<td>All full-time enrolments</td>
</tr>
<tr>
<td>Fees remitted</td>
</tr>
<tr>
<td>10 students over the years</td>
</tr>
</tbody>
</table>
MAB125 context – past practice

Challenge areas

(1) Large cohorts, diverse abilities/preparation

(2) Teaching staff turnover (lack of ‘ownership’)

(3) Teaching methods quite traditional:
   - Lectures and tutorials;
   - Limited use of collaborative learning, promotion of student engagement;
   - Basic use of online resources and teaching materials.
Blended Learning approach

Re-design principles

QUT MOPP and other resources (LATICE Blackboard site).


Pilot project - Summer semester 2013

Re-designed elements

(1) Blackboard site.

(2) New technologies:
   a) Online diagnostic (special attention);
   b) GoSoapBox;
   c) Webinars;
   d) Recorded lectures.

(3) Improved learning cycle between various delivery modules (i.e. lectures, tutorials, workshops, online resources).

(4) Improved communication and collaboration with STIMulate and Student Success Program.
Pilot project - Summer semester 2013 - data collection

Data collection techniques

(1) Questionnaire distributed to students (theoretical background for formulating the questions: the notion of affordance).

(2) Data retrieved from QUT system (Blackboard usage, online diagnostic data).

(3) Data provided by STIMulate and Student Success Program.
Pilot project - Summer semester 2013 - the notion of affordance

**Affordance** is a potential for an action created within a particular environment.

Good (2007): a unit of analysis that should be seen as being “nested” within the broader concept of functional context. The functional context is also included in a broader concept – the frame of reference.

![Diagram showing the relationship between frame of reference, functional context, and affordance. The affordance is constructed on intrinsic characteristics of the tool.]
Pilot project - Summer semester 2013 – data analysis

**Online diagnostic:** its potential as identified by academics

(1) Practising the content of the unit prior to the lecture.

(2) Practising the content of the unit after the lecture.

(3) Practising for the quiz.

(4) Revising material covered in unit prior to final exam.
Pilot project - Summer semester 2013 – preliminary conclusions

Preliminary conclusion: students did not perceive the full potential offered by the tool, therefore the possibility to enhance their engagement has not been entirely exploited. Why?

Hypotheses:
(1) Differences in frames of reference of students and academics:
   a) prevented students from perceiving the potential of using the online diagnostic prior to the lecture (as a tool enhancing their knowledge, assuring flow between online component and f2f delivery - lecture);
      b) encouraged students to associate the online diagnostic with an assessment tool only;
(2) An appropriate functional context making the full potential of the tool salient to students has not been created.
Changes implemented in 2014

(1) Improved design of the BB site:
   - Interactive tables.

(2) Improved blended learning approach:
   - Added flipped classroom component.

(3) Improved pedagogical design:
   - Challenge questions.

(4) Improved collaboration with QUT Student Support divisions:
   - Online diagnostic providing usage data to STIMulate and Student Success Program.

End of semester: Questionnaire distributed to students
Lessons learnt

Key messages

(1) Innovation is beneficial to and appreciated by everyone:
   - Overall satisfaction with challenge questions;
   - Overall student satisfaction with flipped classroom and BB design;
   - Help from STIMulate fully embedded (made almost ‘invisible’) in the unit.

(2) Communication constitutes a crucial component of success:
   - Better coordination of and collaboration with teaching team;
   - Better communication to students about the importance and value of the new design of the unit.
Next steps

(1) Analysing 2014 implementations (in both semesters).

(2) Sharing experience through promotion of findings and recommendations across other units and programs.

(3) Disseminating broadly the results.
Selected bibliography - continued


