SELPE Case Study Summary: Using Co-Design to Advance Learning in Senior School Mathematics

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Purpose:
To advance the learning of high-achieving Year 11 mathematics students beyond the Year 11 curriculum in a way highly relevant to them using a co-design model, and to explore the suitability of the model for this purpose.

Introduction and Context:
Five high-achieving mathematics students undertook an accelerated program throughout Years 10 and 11 that saw them complete ACARA Year 10 Mathematics and SACE Stage 1 Mathematics in 18 months. This offered a perfect opportunity for the students to advance their learning beyond the traditional curriculum for the final 6 months of Year 11.

I worked with the students to co-design mathematics-based courses designed to integrate with their interests and future pathways.

Method:
Initial data collection of semi-structured interviews progressed to collaboratively designing a personalised course for each student, including curriculum, outcomes, assessment tasks, assessment criteria, and learning programs. This included:

- Students using a scaffold, discussions with parents and myself, and personal research to choose their accreditation type and topics to study.
- Students developing their own curriculum using MOOCs, mathematical Internet resources, SACE Subject Outlines and current curricula.
- The students and I negotiating their assessment tasks through discussion. Options were restricted to SACE-approved outcomes and tasks for the student who chose to be accredited but open for the others.
- The students tapping into self-directed learning skills, developed and encouraged as part of their last 18 months of study at the ASMS, to remain in their original mathematics classes but use the time to do their own study.
- Agreeing on appropriate resources, which included teachers for discussion and workshops, textbooks, internet resources and teaching videos and MOOCs.

Outcomes and Discussion:

<table>
<thead>
<tr>
<th>Student</th>
<th>1 (M)</th>
<th>2 (F)</th>
<th>3 (M)</th>
<th>4 (M)</th>
<th>5 (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future Pathway</td>
<td>Engineering</td>
<td>Undecided</td>
<td>Science &amp; Maths</td>
<td>Undecided – definitely uni</td>
<td>Medicine</td>
</tr>
<tr>
<td>Use of program</td>
<td>Broaden knowledge, acceleration, accreditation</td>
<td>Broaden knowledge, fun</td>
<td>Broaden knowledge, deepen knowledge</td>
<td>Broaden knowledge, accreditation</td>
<td>Acceleration, fun</td>
</tr>
<tr>
<td>Goal of program</td>
<td>Learn beyond curriculum, head start for Year 12</td>
<td>Prepare for Year 12</td>
<td>Learn beyond curriculum, make Year 12 easier</td>
<td>Make Year 12 easier</td>
<td>Expand maths knowledge</td>
</tr>
<tr>
<td>Topics Chosen</td>
<td>Differential Calculus, Trigonometric Calculus</td>
<td>Business Maths, Economic Maths</td>
<td>Logic, Polynomials, Matrices</td>
<td>Matrices, Trigonometric Functions, Polynomials</td>
<td>Interdisciplinary mathematics in Chemistry, Biology and Physics</td>
</tr>
</tbody>
</table>

The diversity of students’ responses to initial data collection and choices in topics and assessment confirmed the need for using a program with a high level of personalisation, differentiation, and student influence, such as co-design. It also showed the need for a high level of teacher influence as all students chose courses that
would require them to structure the curriculum and learning differently from pre-existing courses. The process had to be carefully scaffolded to ensure students understood the choices they could make: any co-design model that is left too open will not be successful as students are operating at a high level of challenge in developing a course with unfamiliar content and ‘rules’ and need strong support to do this.

Co-design was successful in allowing students to link topics to their needs and future pathways. The initial model of scaffold, discussion and providing curriculum resources as a starter was also highly successful in helping students make challenging and relevant decisions about their curriculum and accreditation. Developing assessment proved to be more challenging as students selected more ‘traditional’ mathematical assessments and only after considerable discussion really started engaging with the possibilities of what assessment could look like. This needed stronger scaffolding.

As the students are currently working through the program, post-course interview data will be available at the end of the year, focussing on student perception of the program meeting the goals, uses and needs identified in the pre-course interview. Student achievement and reflections will also indicate the success in advancing learning, although the choices students have made already show evidence for this, as shown in Table 1.

The ASMS has had a heavy focus on co-design as a strategic direction for the school as of 2014. This program is notable for two reasons: it is the only significant co-design occurring in the Year 10 and 11 mathematics program introduced as part of the school’s strategic direction (some other programs that could be considered as partially co-design were already in place), and it is one of very few first degree co-design programs in the school. This program will continue, with refinements, for next year, and the success will help shape the implementation of first-degree co-design in other areas.