Engineering Pathways Preparation through Advanced Maths

CHS School Context

- 8-12 co-ed secondary school in Northern Adelaide
- 986 enrolments
- Category 3 index of disadvantage
- 79 NESB
- 81 Aboriginal
- 140 NEP students

Engagement in Senior Mathematics

- Participating school in The Advanced Technology Project since 2009
- School priority has been increasing engagement of students in science, mathematics and technology (STEM) pathways 8-12
- Prior to 2015, enrolment and achievement data in Mathematics had not improved particularly in SACE Maths subjects.
- Average of 25 enrolments in Stage 1 Maths Studies with 56% achieving ‘C’ grade or higher
- Average of 6 enrolments in Stage 2 Maths Studies with 66% achieving ‘C’ grade or higher. Insufficient enrolments for Specialist Maths class

Engagement in Middle School Mathematics

- Promoting an inquiry approach to develop problem solving / critical thinking skills and development of mathematical understanding
- Developing integrated STEM curriculum to promote transfer and application of skills and knowledge to other contexts
- Developing ‘growth mindsets’ in students by working with students, teachers and parents to believe that all students can improve their numeracy skills and to create a culture that supports students to persist
- Promoting the development of numeracy skills across the curriculum.

Mathematics Curriculum Review

- In 2014, our Curriculum Leaders and Advanced Technology Project teams reviewed structures for delivery of Mathematics
- to meet Australian Curriculum requirements
- to increase engagement and achievement in Mathematics
- to increase enrolments in Mathematics in the Senior School and facilitate greater post school options for students.
- to facilitate an engineering pathway

Previous model

- Students in mixed ability classes in Years 8 and 9
- High achieving students identified by teachers at the end of Year 9 and nominated for preparation for Maths Studies class at Year 10
- Majority of Year 10 Maths classes prepare students for Year 11 Maths Applications, Maths Pathways or Numeracy for Work and Community Life.
- Year 11 Maths Studies cohort was mainly drawn from Year 10 pre- Maths Studies class.
- Maths Studies 1,2 and 3 was offered at Year 11 to prepare students for Yr 12 Maths Studies and Specialist Maths

Disadvantages

- Selection for Maths classes at Year 10 based on achievement at Year 9 not student choice
- Insufficient ‘A’ nominations for the advanced class so supplemented with students with ‘B’ grades
- Students lacking motivation in standard classes
- Stress on class sizes at Year 10 because of student withdrawals and reduced enrolments in Year 10 Pre-Maths Studies class.
- Limited SACE Maths options for the majority of students because have not developed the foundation skills and knowledge at Year 10.
- Low enrolments and achievement in Year 11/12 Maths Studies.
- No Specialist Maths class at Year 12 because insufficient enrolments

New model

- Mixed ability classes Years 8-10
- All Year 10 students engage in Standard Australian Curriculum in core subject classes.
- Advanced Maths offered as a choice subject at Year 10. Students can select one or two semesters. Encouraged to select two semesters.
- Focus of Advanced Maths option is developing algebraic skills to support students on an engineering pathway

Concerns about new model

- Will Year 10 students select Advanced Maths as a choice subject?
- How will students respond to four learning blocks of Maths per week in place of two learning blocks?
- Where will the subject be placed on the choice line structure?
- What happens if insufficient students take up the option of Advanced Maths or drop out during the year?

Response to concerns

- Conducted a survey of all Year 9 Mathematics Classes to gauge how many students would consider choosing Advanced Maths as an option subject in addition to core maths lessons.
- Promoted the subject as an engineering pathway
- Approximately 30% of the Year 9 cohort responded that they would consider selecting Advanced Mathematics as an option subject

Advanced Maths Topics

- Number – Surds
- Trigonometry – Extended problem solving using bearings
- Laws of indices
- Expansions and factorisation – deeper exploration than Standard Maths
- Linear equations
- Simultaneous equations

Introduction to Engineering

- As part of an engineering pathway, a new option subject was also offered at Year 10 in 2015 to introduce students to the engineering design process, increase awareness of engineering pathways and develop skills of teamwork, communication, problem solving and time management.
- The Advanced Mathematics option was promoted to students taking up the Introduction to Engineering choice subject at Year 10

Student feedback

- Advanced Maths option has helped to have a deeper understanding of algebra as learn the basics in standard Maths class and go into more depth in Advanced Maths
- Learning still relevant in Standard Maths class because focusing on topics of measurement, financial maths and geometry.
- Happy to do more Maths but would prefer one learning block (105mins) per day in place of two learning blocks (210 mins) of Maths per day.
- Restricts some subject choices to one semester.

Student Feedback

- Getting into higher maths early gives you the chance to consider Specialist Maths
- Advanced Maths was a decider course – helped you to decide if you want to specialise in maths.
- Wished more advanced maths had been introduced earlier in Year 9. Felt like just going over the same things in Year 8 and 9.
- Did not mind doing the subject as a choice subject. Knew from Year 9 wanted to do advanced maths

Teacher feedback

- Students who enrolled in Advanced Maths choice subject at Year 10 in 2016 are progressing more quickly than other students in Year 11 Maths Methods because they have the background and are able to grasp concepts more quickly.
- Students who did not enrol in Advanced Maths struggle to grasp concepts and lose motivation easily.
- From a teacher's perspective it was a good option to deliver to students as I felt like I had the flexibility to deliver and assess in different ways. I also had to make it more engaging and relevant as they had chosen this as a subject so I focused on task design specifically investigations.

Outcomes

- In 2015 , the first year of the new model, 17 Year 10 students enrolled in Advanced Maths option.
- In 2016, all of the students enrolled in Year 11 Maths Studies in a cohort of 29 students
- In 2017, 5 of the students have enrolled in Year 12 Specialist Maths and 7 of the students in Year 12 Maths Methods
- 7 of the students have also enrolled in Stage 2 Physics.
- 3 students indicated they would be pursuing engineering pathways

Outcomes

- In 2016, 20 students enrolled in Year 10 Advanced Mathematics option
- In 2017 all of these students have enrolled in Year 11 pre- Mathematics Methods in a total cohort of 27 enrolments
- 8 of the 20 students of 2016 Advanced Mathematics cohort have also enrolled in Year 11 pre-Specialist Mathematics class in a cohort of 9 enrolments
- 17 of the 2016 Advanced Mathematics cohort have also enrolled in Stage 1 Physics

Future Planning

- Important to give students the opportunity to go deeper as well as to transfer learning to new contexts
- How do we further develop students' capacity to problem solve and develop mathematical thinking skills?
- How do we increase opportunities for students to specialise in mathematics within the Middle School?

Further information

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