

**Gender, Mathematics and
AMSI's ChooseMaths Program:**
Analysis of Students' Attitudes to
Mathematics

in brief

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Executive Summary

The underrepresentation of women in mathematics throughout the educational pipeline and in the mathematics-based workforce motivated the ChooseMaths program, a partnership between the Australian Mathematical Sciences Institute (AMSI) and the BHP Foundation which aimed to build mathematical capacity and increase participation of girls and young women in Science, Technology, Engineering and Mathematics (STEM).

Gender differences in mathematics performance exist from about Year 3 with a widening gap across the school years, and the differences in performance and achievements of girls and boys are easy to measure and are well documented in the literature. In contrast, girls' and boys' attitudes to mathematics are more difficult to quantify and assess objectively. However, the latter are related to or may, in fact, be the main underlying cause of observed difference in performance between the genders.

This report examines whether gender differences exist in students' attitudes to mathematics and how their attitudes change following growth mindset ideas and specially designed mathematical activities. Changes in attitude, and in particular, positive changes in students' self-perceived ability to learn mathematics impact on their engagement and performance.

As part of the ChooseMaths program, data from more than 8000 students in 120 schools around Australia were collected from 2015-2019. This report provides a comprehensive analysis of the student data and focuses on attitudes of students towards mathematics. The attitudes of interest include students' confidence, enthusiasm for mathematics and their mindset towards learning new mathematics.

The analyses include summary statistics stratified by gender and school year and allowing comparisons of attitudes before and after *treatment*. The results show that girls start with lower confidence and enthusiasm but their gains are larger than those seen in boys. Further, the differences in attitude changes between boys and girls and between cohorts of students are much larger than the difference in attitudes between the genders. The summary statistics are enhanced by deeper statistical analyses which lead to a characterisation of distinct student cohorts and highlight the factors that contribute most to the change in attitude following suitable intervention or treatment.

The findings obtained from these analyses are encouraging: they show that attitudes to mathematics improve and confidence in one's mathematical ability increases with appropriate treatment. In addition, more positive attitudes to mathematics, especially of girls and young women, may aid in addressing the underrepresentation of women in mathematics throughout the educational pipeline and in the mathematics-based workforce.

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Recommendations

- Integration of mathematical activities into the mathematics teaching, including new textbooks, and constructive evaluation of the effects on students' attitudes.

Rationale

Students, and especially female students, can be motivated by and are known to respond positively to mathematical activities and growth mindset ideas designed to increase their enthusiasm for and confidence in their mathematical ability. As a consequence of increased enthusiasm and confidence, students attempt more challenging mathematics task and experience success with these. In turn this increases their confidence for the mathematical tasks.

- Investigation of student cohorts that are 'left behind' and development and implementation of strategies, activities and opportunities to re-engage these student cohorts with mathematics.

Rationale

Small proportions of students at all year levels experienced only a very marginal increase in enthusiasm and confidence through growth mindset and other mathematical activities, including a reasonably confident cohort of students. The latter consists of more boys than girls who somehow lost interest.

- Provision of programs or modules for primary and secondary teachers to interact and decrease the differences in teaching modes.

Rationale

Of concern is the decrease in attitudes of students when they enter secondary school and during the first years at secondary school. Different teaching modes in primary and secondary school, and potentially also the teaching by out-of-field teachers in the early years of high school are likely to contribute to this decline in attitude.

A better alignment of teaching styles, vocabulary and delivery of concepts in the mathematics teaching in the last few years of primary and first few years of secondary school will improve the transition for students and is likely to decrease the observed loss of enthusiasm and confidence.

Increasing and improving the supply of appropriately trained mathematics teachers through short courses or upskilling is likely to help with the decline in enthusiasm and confidence, as adequately trained teachers know more about mathematics and mathematics teaching.

Main Findings

Exposure to Growth Mindset ideas and mathematical activities is effective in changing and improving students' attitudes to mathematics

- Confidence and enthusiasm increase.
- There is very strong agreement that students can learn new maths.
- Girls initially have less confidence, enthusiasm and a smaller proportion agree to having a maths brain than boys; but girls have larger gains in confidence, enthusiasm and ability to learn maths than boys.
- Following treatment, the proportions of girls and boys across the different levels of confidence, enthusiasm and ability to learn new maths are more similar than the corresponding pre-treatment proportions, and the correlation between confidence and enthusiasm are stronger post-treatment than pre.

Transition to secondary school

- The levels of confidence, enthusiasm and students' attitude to learning maths are higher in primary school.
- The levels of confidence, enthusiasm and students' attitude to learning maths drop in the year after transition to secondary school.
- Partial improvements across the years are noticeable and by Year 9 mean attitudes have increased again.

Large treatment effects

- Among the different attitudes and their changes following treatment, the increase in the level of enthusiasm is larger for girls and boys than any other change and is present in every cohort in a partition of the student data.
- The increase in the level of confidence and the increase in the ability to learn new maths are large following the intervention.
- Student cohorts starting with low proportions for maths brain show a particularly strong increase in their ability to learn maths following treatment.

Comparison of girls' and boys' attitudes to mathematics

- The distribution of girls' and boys' multivariate scores regarding their attitudes show an almost complete overlap, indicating that there is essentially no difference in attitude between girls and boys.
- There is a small difference of the means of individual attitudes between the genders, but this difference is negligible compared to the difference within the cohorts of students.