INSIGHTS FOR TEACHERS
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New Zealand student self-belief and confidence, and implications for achievement

Findings and implications from PISA for teaching and learning mathematics

Student achievement in mathematics is related to many factors. This Insight for Teachers looks at a range of student attributes, measured in PISA 2012, that focus on students’ confidence (self-efficacy), self-beliefs (self-concept), learning approaches and motivation as well as examining how these factors relate to mathematics achievement among 15-year-olds.

PISA is an international study that assesses and compares how well countries are preparing their 15-year-old students to meet real-life opportunities and challenges. PISA provides information on student achievement and how this relates to student and family, teaching and learning, and school-related factors.

Between 2003 and 2012 New Zealand experienced a decline in the average maths score achieved in PISA. This change in achievement parallels changes in learning beliefs, learning approaches and motivation among New Zealand students.

Research Design

PISA 2012 was administered in 177 schools in New Zealand to over 5,000 15-year-old students. Both schools and students were randomly selected to represent all schools and students. The majority of 15 year-olds in this study started school in 2001.

Students were assessed in reading, mathematical and scientific literacy and were also asked to respond to a background questionnaire. Questions about their learning beliefs, learning approaches and motivations were related to maths, which was the major domain assessed in 2012. The last time maths was a major domain in PISA was in 2003. Questionnaires were also completed by the principal of each participating school.

Key Findings

Figure 1 shows the trends in average maths scores between 2003 and 2012 for both New Zealand and the OECD. Whilst the maths performance of New Zealand remains above the OECD average, it was one of several countries that had a decline (23 points). Other such

Key Implications

• The performance and progress in mathematics of 15-year-olds is associated with their own beliefs about their maths ability, their confidence to tackle maths problems and the extent to which they are anxious about maths activities. Differences among students in these respects can mean a student is up to 1.5 - 2 school years ahead or behind in mathematics.

• Other attributes such as openess to problem solving and perseverance are also associated with performance in maths at age 15 years.

• Girls, Māori and Pasifika students and students from low socio-economic backgrounds have lower belief and confidence in their maths abilities and higher maths anxiety.
countries include Australia (20 points), Finland (26 points) and Sweden (31 points).

In PISA 2003 and 2012, students were asked a series of questions about their abilities in maths. They were asked to agree or disagree with statements such as *I learn maths quickly* and *I have always believed that maths is one of my best subjects*. Students who agreed with these questions were defined as having higher self-concepts, and students who disagreed had lower self-concepts.

**Students with higher self-concepts tend to have higher PISA maths scores and students with lower self-concepts tend to have lower PISA maths scores.**

Students were also asked questions about how confident they felt about completing a range of maths problems. For example, they were asked how confident they felt about *calculating the petrol-consumption rate of a car* or *solving an equation like 3x + 5 = 17*. This showed us the extent to which students had relatively high or low maths self-efficacy.

Students were also asked questions related to maths anxiety. They were asked to agree or disagree with questions such as *I feel helpless when doing a maths problem* or *I often worry that it will be difficult for me in maths classes*. This showed us the extent to which students tended to report themselves as more or less anxious.

**Students with relatively low anxiety towards doing maths problems or activities were more likely to achieve a higher PISA maths score. These students also tended to have higher self-efficacy.**

**Students with relatively high anxiety were more likely to achieve a lower maths score. These students also tended to have lower self-efficacy.**

Figure 2 shows changes in maths self-efficacy, self-concept and anxiety between 2003 and 2012. In 2012, students were reporting themselves overall to be less confident about completing maths problems (self-efficacy), to have less belief in their maths abilities (self-concept) and to be more anxious in relation to maths activities.

The relationship between maths achievement and learning beliefs and behaviours between boys and girls are consistent with the overall findings for New Zealand students. Boys scored on average higher in maths and reported themselves as more confident (self-efficacy), having a stronger belief in their ability in maths (self-concept) and less anxious than girls. **New Zealand had one of the highest increases in anxiety in girls between 2003 and 2012.**

Similar patterns can be observed among students from different ethnic backgrounds and different socio-economic backgrounds. Māori and Pasifika students achieved lower scores on average than Pākehā and Asian students, and students from low socio-economic backgrounds achieved lower scores on average than students from high socio-economic backgrounds.

**Figure 1.** Trends in New Zealand average maths scores

**Figure 2.** Changes in reported maths beliefs and behaviours between 2003 and 2012 in New Zealand
Māori, Pasifika students and students from low socio-economic backgrounds report themselves as less confident (self-efficacy), having less belief in their abilities (self-concept) and more anxious in relation to maths.

PISA has also identified other student attributes associated with higher maths performance. These are openness to problem solving, perseverance, instrumental motivation (relevance of maths to life, including future study and career options) and attitudes to school. Of all these factors, maths self-efficacy (confidence), maths self-concept (beliefs about maths abilities) and maths anxiety have the strongest association with maths performance (see Figure 3).

A difference of 35 points in maths is equivalent to one school year in New Zealand

Implications for the Classroom

Students who hold more positive beliefs about their ability to learn maths and to solve maths problems can be ahead in maths by about one-and-a-half to two school years by the age of 15. Students who worry more and feel more nervous about maths activities can fall behind by as much as one-and-a-half to two school years by the age of 15. According to the OECD, classroom practice that scaffolds student learning, provides feedback on how students can improve, and reinforces the link between effort and outcomes can support maths learning and progress. Students who are anxious benefit additionally from becoming familiar with the wider maths curriculum and having the chance to practise maths problems.

The more students report they have the opportunity to learn (exposure to) formal maths in the classroom and are exposed to maths problems, the higher their maths achievement is likely to be. This link is particularly strong in New Zealand, where students who report more exposure to the breadth of the maths curriculum and to maths problems are sometimes two years further ahead in maths than students with less exposure.

Being curious and open to new challenges in maths and persevering when working through tough problems are positively related to maths achievement. Classroom practice that engages students’ curiosity and reinforces perseverance can support maths learning and performance.

It’s important to note that all these factors are inter-related and difficult to disentangle from each other. Change in one area will most likely have an effect on other areas.

In all cases the evidence from PISA shows that particular focus needs to be given to enhancing (or reducing, in the case of anxiety) these maths learning beliefs and behaviours among girls, Māori and Pasifika students and students from socio-economically disadvantaged backgrounds.

References


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Lynne Whitney, Michelle Lamy, Saila Cowles, Steve May

Evidence, Data and Knowledge Ministry of Education

Further reports and information can be found at www.educationcounts.govt.nz

For more information on this report, please contact research.info@minedu.govt.nz