IMPROVING STUDENT LEARNING: MATHEMATICS SELF-EFFICACY AND DEEP APPROACHES TO LEARNING

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Underprepared maths students

New Zealand pupils below average in maths results - TIMSS

New Zealand ranks below England, Ireland, the USA, and Australia across maths at both Year 5 and Year 9 and science at Year 5 in the 2015 Trends in Mathematics and Science Study (TIMSS).

Under-prepared maths students

A national New Zealand study funded by TLRI and led by Prof. Mike Thomas and a group of researchers found that *fifty-six* Years 12-13 (17-18 years old) secondary students, *seventy-three* first-year tertiary students and 174 teachers and tertiary educators perceived that **lack of self-confidence**, **lack of study skills** and **gaps in mathematical knowledge** contributed to the issue of under-preparedness.

41% of first-year tertiary students perceived the **secondary-tertiary transition to be very difficult** due to heavy workload, differences in assessment format, teaching pace and expectation of independent learning. This view matched with 60% (N=20) of tertiary educators but contradicted 25.3% (N=154) of the teachers.

As the students moved from school to university, high-achieving tertiary students (50%, N=35) felt that their **level of confidence in mathematics were lower at tertiary level than in their secondary education.**

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The fundamental principle of higher education is that the student

has TO BE RIGHT within herself,
has TO BELIEVE in herself,
has FAITH in herself and
has a MEASURE OF CONFIDENCE

before anything of worth can happen in her learning."

(Barnett, 2007, p.58)

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Mathematics self-efficacy

Refers to beliefs that one is able to learn or perform specific mathematical tasks.

“A strong sense of efficacy to regulate one’s motivation and instructional activities undergirds belief in one’s academic efficacy and aspirations” (p.231).

Self-regulation entails “skills and strategies for planning and organizing instructional activities, utilising resources, adjust one’s own motivation and using metacognitive skills to evaluate the adequacy of one’s strategies and knowledge” (Bandura, 1997, p. 77).

Research has informed us that

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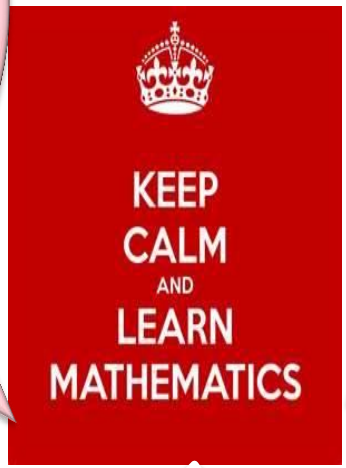
Lower levels of confidence: Females and those with a lower prior knowledge of mathematics. (Carmichael & Taylor, 2005)



Self-confidence is associated with enjoyment and liking mathematics and negative emotions (fear of mathematics and test anxiety), persistence and preference for challenge (or risk-taking) and math test scores. (Malmivuori, 2006)

Student belief about mathematics result from direct learning experiences. (Hutchison et al., 2006)

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As self-efficacy increases, achievement increases. (Bandura, 1993)

Students with high self-efficacy believe that they can solve the problem, which indicates that they will persist in the face of difficulty and seek more difficult challenges in comparison to peers who do not possess such beliefs. (Stevens et al., 2004)

There is a direct relationship between high self-efficacy, low level of surface approaches and high level of deep approaches. (Phan 2011)

Modification of teachers' instructional strategies subsequent to minimal training was linked to increases in their students' self-efficacy. (Stevens et al., 2007)

My research overview

- Context-Under-prepared mathematics students
- Purpose-Examine the nature of self-efficacy of maths students
- Sample-Mathematics engineering and business
- Method-Questionnaires and maths results
- Findings-Predictor of maths performance

Research design

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Sample

Business (Degree), Engineering (Diploma) and Foundation (Certificate) programs in 2013.

The majority of the participants were young (17-25 years old) and male (55.3%).

Of the 85 students, 67 students completed the Refined Self-efficacy Scale (Marat, 2005).

Final assessment results for the survey group were collected and linked to the students' survey responses.

The Refined Self-Efficacy Survey (Marat, 2005)

Consists of six sections and 85 items.

They included self-efficacy in solving numerical and measurement problems (I), geometry (II), algebra (III), statistics (VI) and using mathematical processes (V) and self-belief in motivation, cognitive, resource management strategies, self-belief for self-regulated learning, and self-assertiveness (VI).

RSE Survey

Examples of items

Motivation strategies

How well do you believe that you understand the most complex concepts in mathematics?

Cognitive strategies

When you study mathematics how well do you believe you can outline the material to help organize your thoughts?

Selection strategies

How well do you believe you can persist on a topic in mathematics when you find the material difficult?

Self-regulated learning

How well do you believe you can remember information presented in class and textbooks in mathematics?

Results

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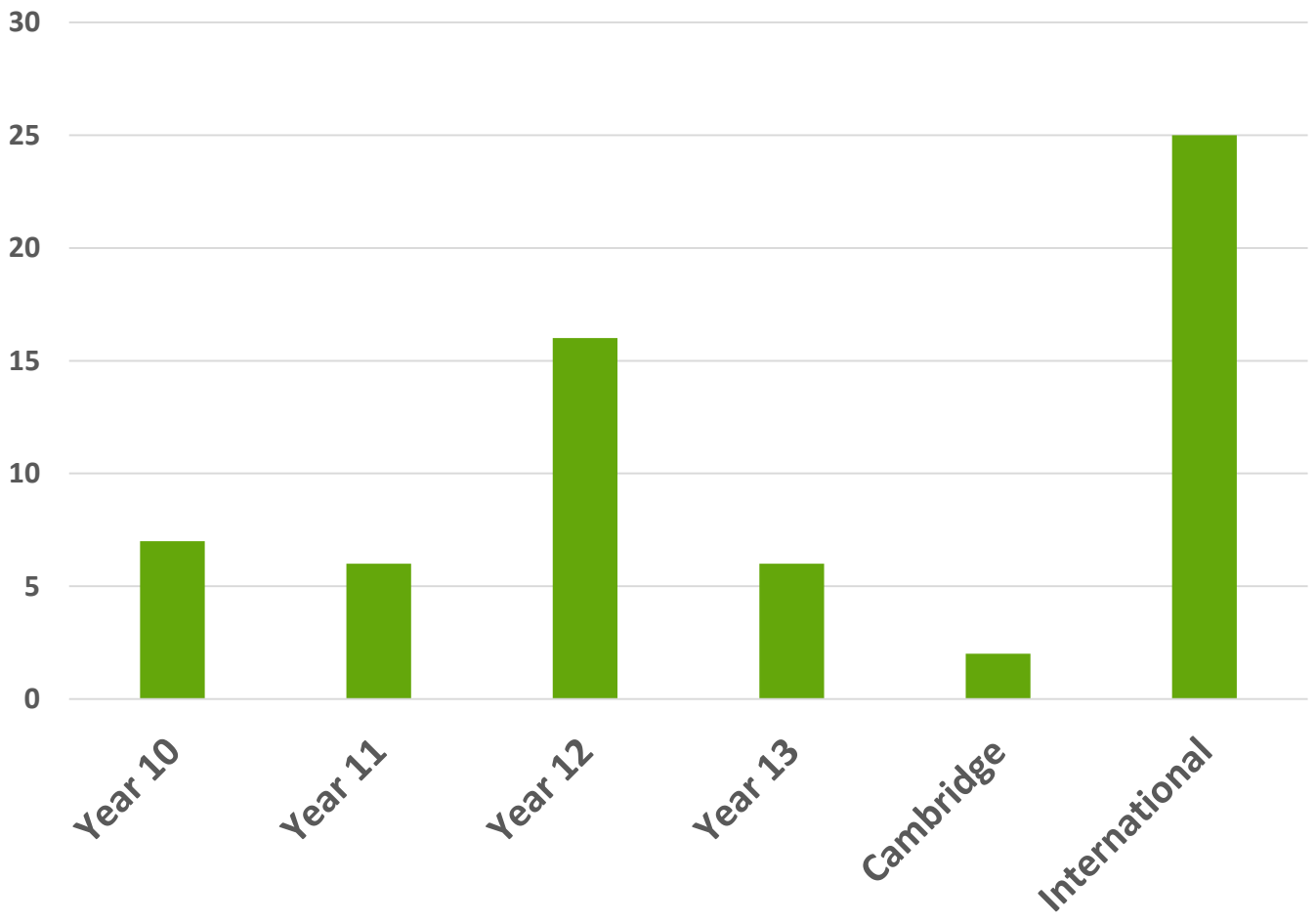
Highest level of Sec Maths background



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Correlations

- Moderate positive correlation (Pearson's R=0.55; p=0.000) between the expected results and actual results.

- Positive correlations

  Self-efficacy in using cognitive, motivation strategies, self-regulated learning and assertiveness correlated more strongly with the expected grades (R=0.64, p=0.000) than the actual grades (R=0.30, p=0.018).

- Moderate correlations between self-efficacy in solving numerical and measurement (R=0.44, p=0.001) and geometry problems (R=0.35, p=0.035) with the expected grades

- Weaker correlations between self-efficacy in solving mathematical problems in algebra (R=0.28, p=0.028) and statistics (R=0.29, p=0.018) with the actual performances.

Multiple regression

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5069.098	5	1013.820	2.715	.040[b]
	Residual	10454.816	28	373.386		
	Total	15523.914	33			

a. Dependent Variable: Examination marks

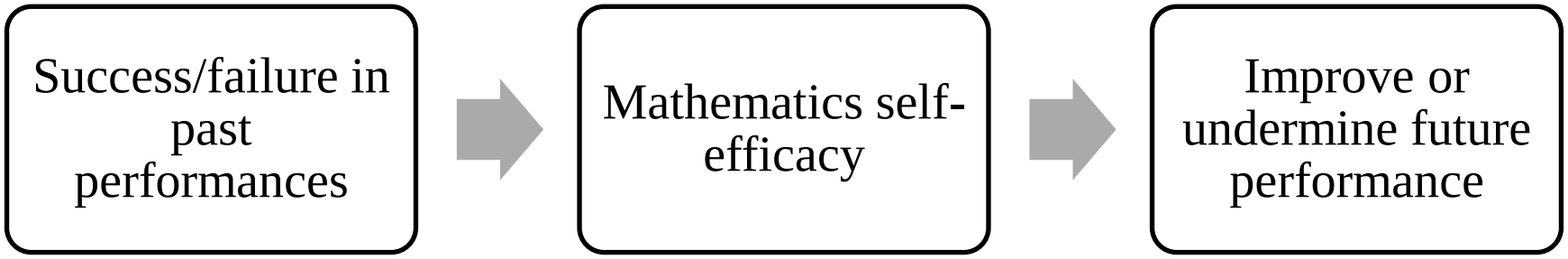
b. Predictors: (Constant), Self-efficacy is solving statistics problems, Self-efficacy is solving numerical and measurement problems, Self-belief in using cognitive, motivation and resource management strategies, self-regulated learning and assertiveness, Self-efficacy is solving geometry problems, Self-efficacy is solving algebra problems

A self-enhancement model of self-efficacy

Self-efficacy in using cognitive, motivation, selection processes and belief for self-regulated learning

Success in learning mathematics

A skill development model of self-efficacy



More effort

More incentives

More resilience

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Activity

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Discuss some strategies which develop/retard the development of self-efficacy

Case studies.

A reflection

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