Developing mathematical understanding through spoken and written language

Western Spring College (TLIF 1-090)

For the Ministry of Education

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Summary

This small scale project was specifically targeted at Year 9 and 10 mathematics students in Western Springs College. The aim was to benefit these students by enhancing their mathematical understanding as reflected in their ability to talk and write about mathematical concepts and processes. The purpose of the innovation was to use carefully designed activities that require students to engage in productive talk and writing to help develop their mathematical understanding and increase their sense of self-efficacy. The inquiry is innovative because it aimed to develop new classroom practices that improve learning outcomes for mainstream and rumaki students, by adopting a collaborative planning and researching model.

Inquiry Team

Project Leader: Sam Tailby, Year 9 and 10 teacher

The other members of the project team were: Jared Hockley, HOD mathematics and Year 10 teacher. Bella Pomare, Year and 10 teacher in the Rumaki, Nga Puna O Waiorea.

Christine Allen, Year 10 Mathematics and Science teacher in the Rumaki, Nga Puna O Waiorea.

External advisors: Professor Terry Locke, and Professor Bronwen Cowie, University of Waikato, provided support in mathematics pedagogy. Dr Sashi Shama contributed professional learning for teachers on the place of writing in enhancing mathematics. Dr Michael Johnston from Victoria University of Wellington provided support in relation to the development of a maths self-efficacy scale (MSES) and data analysis. Professor Terry Locke and Dr Michael Johnston assisted with the writing of the final report.

Background

The rationale for the inquiry was the observation that teachers of mathematics are generally unlikely to view themselves as teachers of writing or as writers despite the central role that language plays in learning, understanding, and the performing mathematics. The team’s hypothesis was that learning would be enhanced by encouraging students to explain their thinking in mathematics, answer problems in writing, and translate algebra into words and words into algebra.
The inquiry

The team had very explicit linkages between their research questions, the activities they introduced and how they measured the differences that they were seeking. Teachers used a range of pedagogical approaches aimed at building mathematical vocabulary, getting students to talk together and solve mathematical problems, and reflect on their learning. These included concept circles, snowball and learning logs.

Joint planning occurred approximately every two to three weeks. Less formal collaboration occurred through departmental meetings, discussions and email. The joint planning time was used to share ideas, discuss how new strategies were working, plan and implement data collection, and find ways of integrating new strategies that were found to be effective in the Mathematics Scheme of Work.

Data instrumentation and collection

Data collected included parallel forms of a mathematics test, student surveys, classroom observations, student focus groups and close analysis of the data from 40 students.

Key findings

- The strategies used by these junior secondary mathematics teachers had a major impact on student performance and a significant impact on their mathematics self-efficacy.
- In general, the strategies planned by the team were well received by the students as helpful, and at times motivating and enjoyable.
- The use of Concept Circles in particular had additional benefits as the teachers used them more regularly.
  - they were extremely useful for differentiation for mixed ability classes and for
  - formative assessment of students’ learning found misconceptions often showed up when students were sharing their work with each other or when the teacher was circulating throughout the lesson discussing with students what they had written.
• Writing facilitates conceptual understanding and is a tool for metacognition.
• Not all writing is productive, it needs to be focused on the intended learning outcomes of the learning experiences.
• The value of activities to students is influenced by how they are set up and monitored by teachers.
• Students have learning preferences which influence their response to particular activities, so providing opportunity for student choice was important.

Key implications

• It is noteworthy that the interventions trialled in this project were equally effective for Māori and non-Māori students. There were also no differences in results in terms of gender. Boys and girls responded in similar ways to this intervention.
• There are implications for self-efficacy theory and research. The team commented that their analysis of pre-test and post-test performance and self-efficacy data showed that improvement in achievement led to improvement in self-efficacy, and that there was no evidence that having high self-efficacy at either time point was associated with improvement of achievement. The findings confirm the old adage that “success builds success”. In self-efficacy terms, it was the experience of mastery for these students which enhanced their self-efficacy as maths learners.
• There are clear implications arising from this project for mathematics teaching in junior secondary schools both in New Zealand/Aotearoa and elsewhere. The writing strategies trialled are clearly described in the full report (available from the project leader) and can be used by other teachers with appropriate professional development.
Plans for sharing the findings

The team has plans to share findings with teachers in other curriculum areas in the school and with teachers beyond the school via conference presentations, report writing, academic publications and professional networking.

The testing procedures which were developed in this project (for both performance and maths self-efficacy) can be made available to other researchers and teachers on request.

Reference List


**For further information**

If you would like to learn more about this project please contact Samuel Tailby at: tailbys@wsc.school.nz
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