The INISSS Project

Improving Numeracy for Indigenous Students in Secondary Schools

Summary Report

1999 - 2001

UNE
THE UNIVERSITY OF
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Assessment
Research
Centre

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NOTE
Page numbers are correct for metric (A4) paper.

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Background and philosophy

In July 1998 a group of teachers met in Launceston, Tasmania to discuss the poor performance of Indigenous students in the previous year's statewide Year 9 Numeracy Assessment and Monitoring Program. By the end of the day there were more questions than answers. Discussion had centred around improving the learning experience for students, through activity based and investigative approaches to teaching in mathematics classrooms, rather than trying to "fix-up" low achieving students, but no one was sure how this could be achieved. From this somewhat inauspicious start arose INISSS (Improving Numeracy for Indigenous Students in Secondary Schools), a project that would eventually last over four years and impact on dozens of teachers and thousands of students.

The INISSS philosophy was deliberately inclusive: all students could learn in mainstream classrooms if they were provided with the right conditions. Rather than taking a deficit view of the initial problem, the approach adopted was underpinned by a belief that providing students with challenging and motivating problems would, ultimately, lead to improved outcomes. The problems were not simply difficult mathematics; instead they used concrete materials and investigations that all had deep mathematical underpinnings that had the potential to extend students well beyond their apparent understanding. They demanded higher order thinking – justification, generalisation and hypothesis building.

Schools and teachers

Schools were chosen for the program on the basis of three criteria: the performance of Indigenous students in the statewide testing program in 1997, the proportion of Indigenous students in the school, and whether there was an Aboriginal Education Worker attached to the school. Schools were invited to participate on the understanding that they would send at least two teachers actually involved in teaching students in the lower ability range, and that they agreed to undertake any evaluation processes established. Eventually 19 schools became involved. These schools were all high schools (grades 7-10) from every part of Tasmania, including rural and urban schools, and schools from a range of socio-economic backgrounds.

The teaching staff involved came from different backgrounds. They included Aboriginal Education Workers and teachers' aides who had few formal qualifications and worked in classrooms under the direction of teachers. Also included were teachers who were primary trained, or who were teaching mathematics "out of area", and a small group of highly qualified and very experienced mathematics teachers. Altogether about 40 teachers and ancillary workers were involved in the professional development process. The common feature among the education staff involved in the program was that they all taught students in lower ability groups. This initial group became known as INISSS A.

A second INISSS group (INISSS B) began in 2000, following the success of the first group. This group comprised 17 schools, mainly district high schools and, although they did cover the state, a majority was from the south. About 30 teachers were involved, and although there were no Aboriginal Education Workers, some parents became involved with this second group. The same approach was taken to the professional development as with INISSS A.

Professional development

Professional development sessions were mainly two-day workshops, with special one-day meetings for particular purposes. Teachers were accommodated overnight, and the

opportunity to work together for long periods of time, and to socialise after an intense day of discussion, set the scene for networking that has continued outside the project.

The professional development sessions had two main themes: development of approaches to teaching that would provide students with interesting and motivating mathematics and improvement of understanding about local Aboriginal issues and culture. The first was achieved through the use of Task Centres that had been used successfully with Aboriginal students elsewhere. Doug Williams, an independent education consultant, led this mathematical theme. The second Indigenous theme was led by the Aboriginal Education Unit and made use of locally produced materials such as *From Gumnuts to Buttons*. Aboriginal Education Workers based in INISSS schools contributed greatly to the project, sharing their extensive knowledge of the community and their perceptions of the attitudes and behaviour of Aboriginal students in their schools.

Evaluation

Evaluation of the project took two forms. The first was videotaped data from professional development sessions and classrooms. This proved to be particularly effective as a tool for sharing what was going on in INISSS school classrooms. Charles Minster, a professional cameraman who became an integral part of the project team, made the videotapes, including initial reports of the project. These tapes were given to project schools, and many teachers showed them not only to staff, but also to their students. The students responded positively to this, enjoying the opportunity to see themselves, and other students, doing mathematics.

The program leaders also decided to take a risk and evaluate the project on the basis of students' learning outcomes, rather than on satisfaction or attitude ratings. However, rather than use a traditional test of mathematics, they wanted an approach to assessment that mirrored the approach being taken to teaching and learning. A system of numeracy performance assessment was devised for this purpose.

The assessment process for each of the INISSS cohorts is summarised below. In each group the initial target group was Year 8 students, and these were tracked into the later years. In addition, a control group of year 10 students who had not been part of the original project also undertook the multiple-choice tests of literacy and numeracy to provide a comparison with those students who had been the target group of the study. Nearly 2000 students were involved in the initial assessment from INISSS A and approximately 1000 students from INISSS B. The control group comprised about 750 students.

INISSS A	INISSS B
Year 7 1998 Statewide testing	
A1 Year 8 March 1999	B1 Year 8 March 2000
Performance tasks	Performance tasks
A2 Year 8 October 1999	B2 Year 8 October 2000
Performance tasks	Performance tasks
A3 Year 9 October 2000	B3 Year 9 October 2001
Performance tasks	Performance tasks
A4 Year 10 October 2001	
Performance tasks	
Multiple choice tests: Maths and Literacy – linked to 1998	

Results

Results show:

- All tests, including the performance assessment tasks were highly reliable.
- No tests, including the performance assessment tasks, showed bias against any sub-groups.
- The performance assessments were measuring the same construct in the same way across all schools and all teachers who marked them.
- On the performance tasks Indigenous students, and girls in particular, made gains that "closed the gap".
- On the conventional multiple-choice tests, comparisons with the control group showed overall statistically significant differences on both numeracy and literacy.
- On conventional multiple-choice tests, Indigenous students made the same gains as the control group in numeracy but much greater gains in literacy.
- Structural equation modelling suggests a "method" effect – how the assessment was carried out makes a difference.

Summary results are presented graphically on the following pages.

INISSS A: Performance assessment

Results from the four performance assessments are shown in Figure 1. They indicate that overall the "gap" in achievement has closed for Indigenous students measured by the performance assessments.

At A1 the difference between mean achievement of non-Indigenous and Indigenous students was statistically significant (p = 0.01). At A4 this difference was not statistically significant (p = 0.19), suggesting that, as measured by the performance assessments, the "gap" in achievement between Indigenous and non-Indigenous students had been reduced to one that was no more likely than by chance alone.

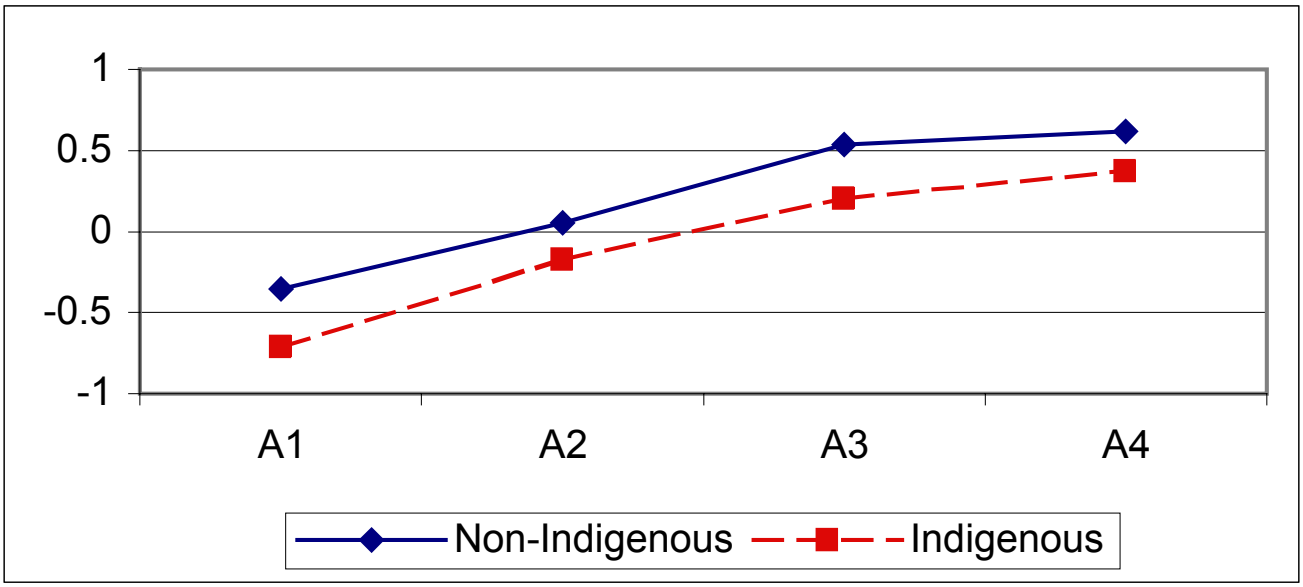


Figure 1: INISSS A performance assessment results by Indigenous status

When this is broken down by gender and Indigenous status, the stand-out feature is the performance of Indigenous girls. By the final Year 10 assessment these girls were achieving as well as non-Indigenous girls (Figure 2).

The performance task however, was not associated with literacy ability, as might have been expected, especially in light of these results. The correlation between literacy and the Year 10 performance assessment task was the same as for the test of mathematics ability. The table below shows correlations among the three key variables corrected for measurement error.

	Task	Maths	English
Task	1.00		
Maths	0.46	1.00	
English	0.12	0.12	1.00

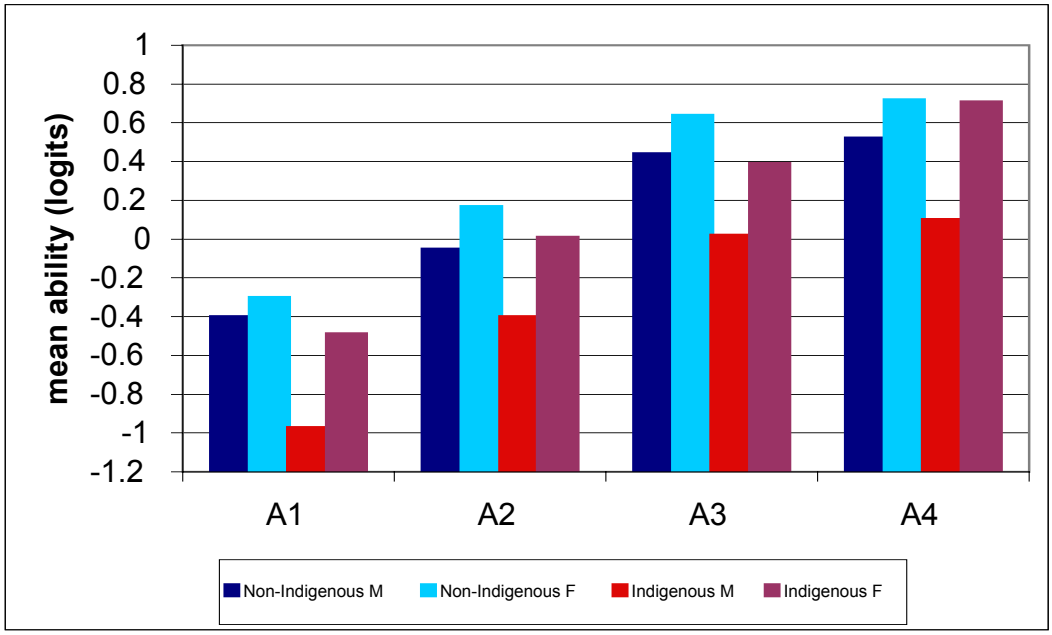


Figure 2: INISSS A performance assessment results by gender and Indigenous status

INISSS A: Numeracy and Literacy multiple-choice tests

Conventional tests of numeracy and literacy were given to Year 10 students in INISSS A schools and to a control group.

The overall test results are shown for numeracy and literacy. In both instances there was no statistically significant difference between INISSS A students and students in control schools in 1998. In 2001, however, the differences were statistically significant for both areas, numeracy and literacy, with INISSS A schools showing higher performance. The approach to teaching in INISSS A schools seemed to lead to improved student outcomes in both the target area of numeracy and the incidental area of literacy.

	Mean Difference	t	df	p
MAT01	0.20	3.61	1315	0.00**
MAT98	0.09	1.83	1862	0.07
ENG01	0.36	3.96	1321	0.00**
ENG98	-0.01	-0.13	2002	0.89

** significant at 0.01 level

Overall Numeracy

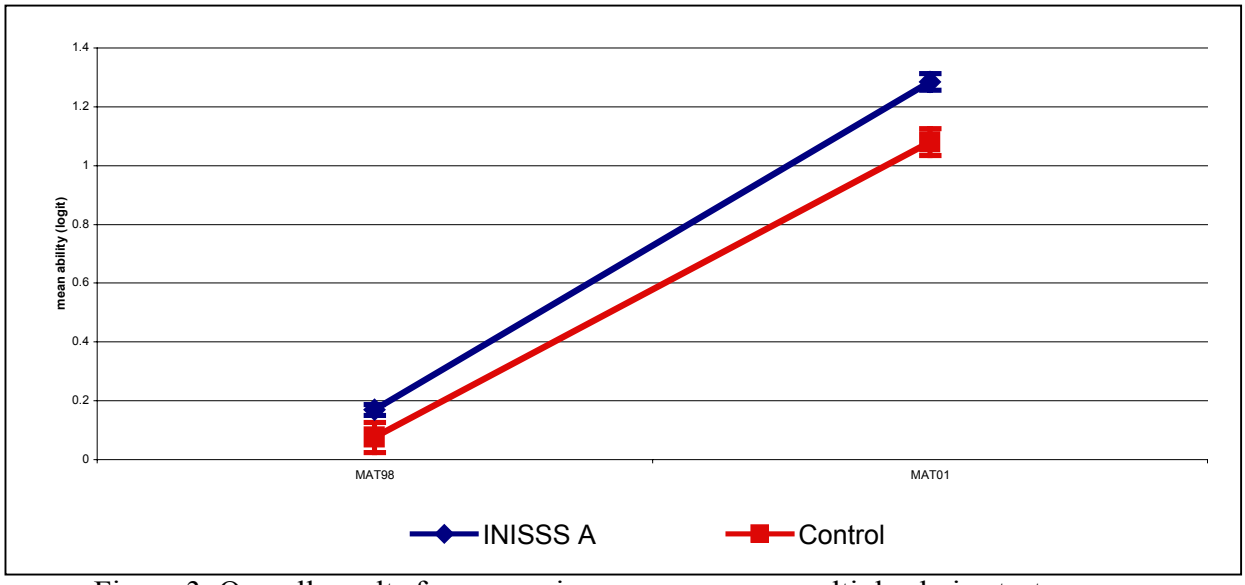


Figure 3: Overall results for comparison on numeracy multiple choice tests

Overall Literacy

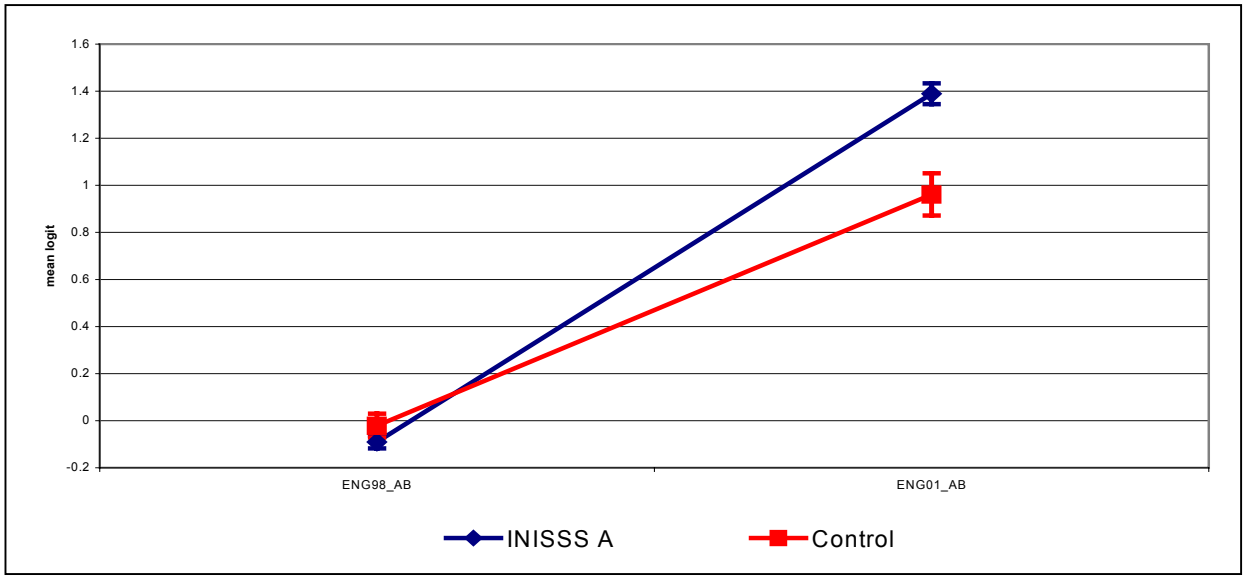


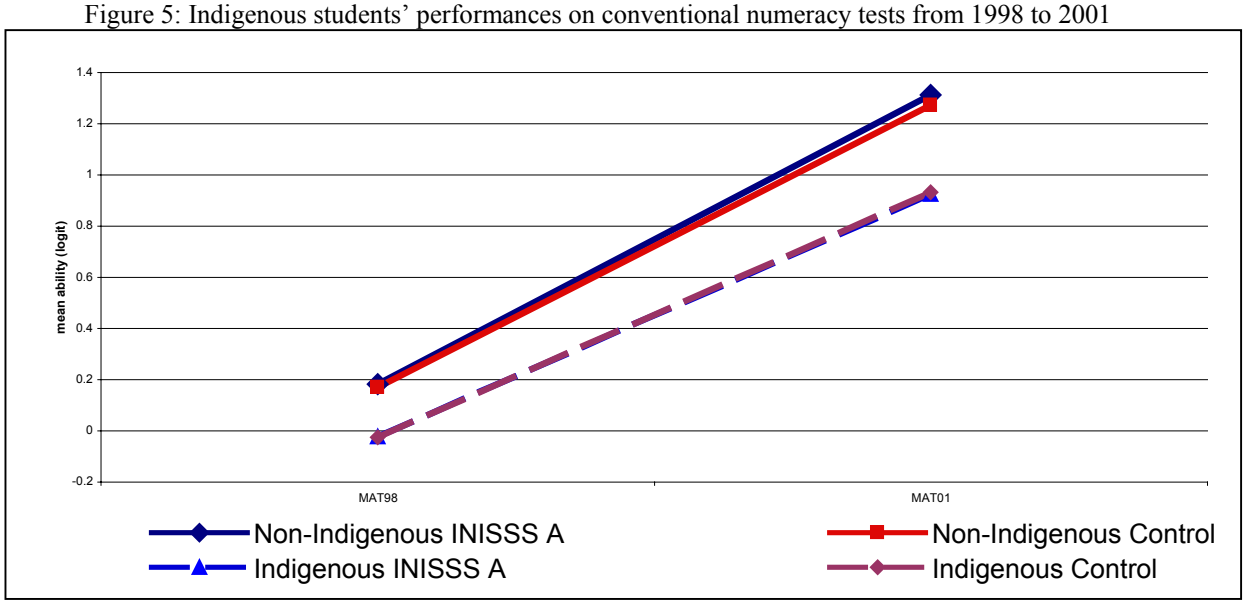
Figure 4: Overall results for comparison on literacy multiple choice tests

Indigenous students' performance on multiple choice tests

The figures suggest that on conventional tests of numeracy, Indigenous students in INISSS A schools made almost identical gains to those in control schools. In literacy, however, the changes were very marked. Given that Indigenous students showed increased improvement on the unbiased performance tasks, the method of assessment may make a difference. This is consistent with results from structural equation modelling.

Numeracy

Figure 5: Indigenous students' performances on conventional numeracy tests from 1998 to 2001



Literacy

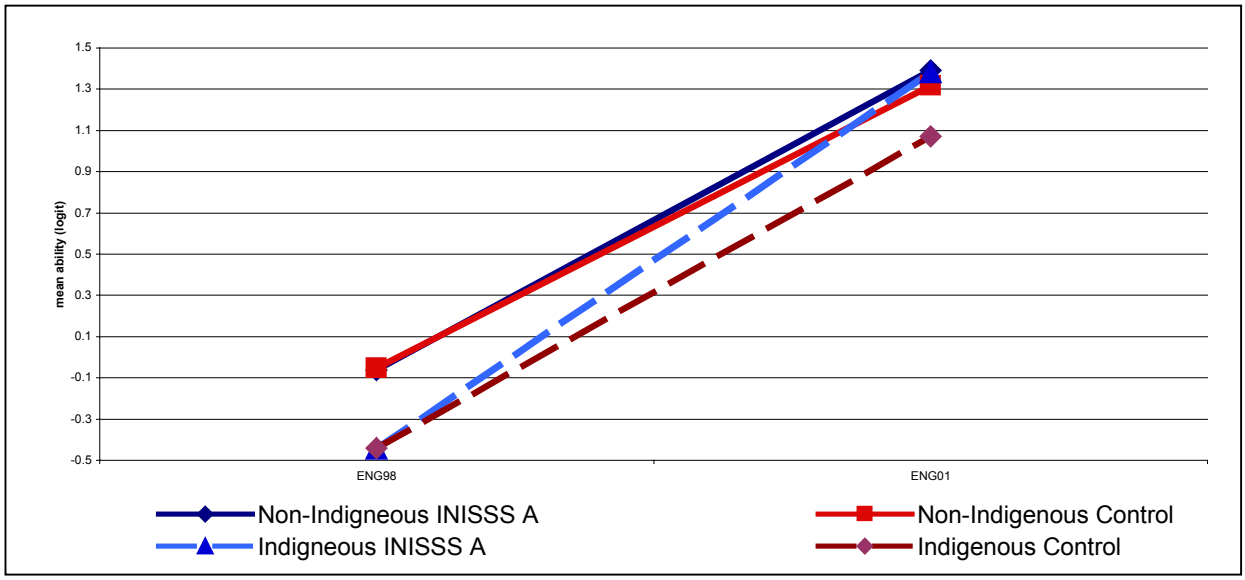


Figure 6: Indigenous students' performances on conventional literacy tests from 1998 to 2001

INISSS B: Performance assessment

Students in the second cohort, INISSS B, followed the same assessment schedule as INISSS A. Performance tasks were used on three occasions: in March and October 2000 with Year 8 students, and in 2001 with the same group of students, now in Year 9.

The results are similar to those of INISSS A. Indigenous students showed gains, and in fact, achieved slightly better than non-Indigenous students after six months of the project. The same pattern of continuing improvement of Indigenous students in Year 9 was seen in INISSS B. There were less Indigenous students in INISSS B schools, so the results have not been broken down by sex.

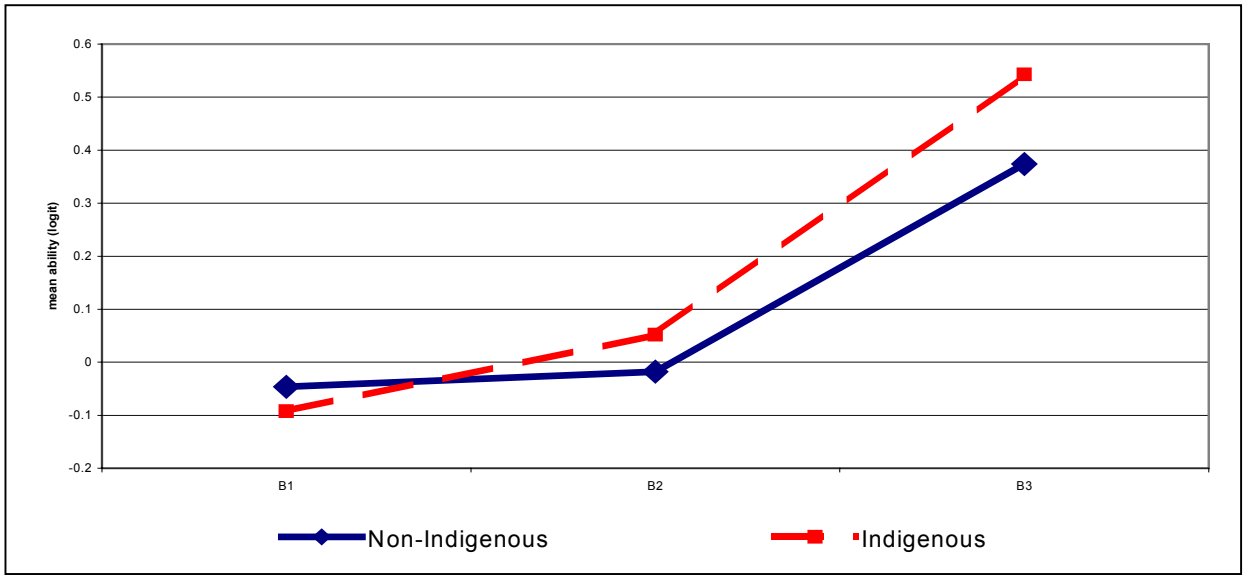


Figure 7: INISSS B performance assessment results by Indigenous status

Conclusion

Taken together the results indicate that INISSS has met its goal of improving numeracy outcomes for Indigenous students.

Other conclusions

- Numeracy can be measured reliably by performance tasks using teacher judgment.

- The method of assessment makes a difference.

- Different ways of assessing influence outcomes for some groups.

What has INISSS achieved?

- Improved outcomes for Indigenous students.

Both groups of schools showed improved outcomes for Indigenous student measured by the performance assessment tasks. On conventional assessments, numeracy results for Indigenous students in INISSS A schools were the same as a control group, but literacy gains were much greater for INISSS A Indigenous students.

- A new model for professional development.

Professional development continued for eighteen months intensively, with two-day residential meetings. Occasional meetings for special purposes followed this, and small amounts of seed funding for specific projects in INISSS schools.

- A new model of assessment.

Teacher marked performance assessment tasks in a numeracy context were reliable and consistent across all schools and teachers. The tasks provided interpretable information about students' numeracy achievement across a range of contexts.

Why has this been achieved?

- Investment in teachers and classrooms

The project supported teachers and classrooms directly involved with low-achieving students. The approach was inclusive – it was not based on a deficit model.

- Focus on Indigenous issues

Every professional development session contained some focus on Tasmanian Aboriginal issues and culture. The participation of Aboriginal Education Workers, Indigenous parents and community members was crucial.

- Focus on non-trivial mathematics

The Task Centre and Multi-media units provided all students, including low-ability students, opportunities to engage in worthwhile, meaningful mathematics. They supported "working mathematically" approaches. The focus on students' discussing and writing about mathematics, and working collegially in groups may have helped to improve literacy outcomes. Research from elsewhere has shown that these approaches promote deep learning.

- Appropriately resourced and over a reasonable time frame

The project ran for sufficient length of time for new teaching approaches to become embedded in classroom practice. Teachers developed strong, continuing networks because of the opportunities provided by residential workshops.

- Commitment by teachers and schools

Teachers were very committed to the project, even when systemic support by schools was limited. The strong leadership from outside schools that has led to lasting change is in contrast with current change literature that has focussed on school change led from within. This needs further research.

- Rigorous evaluation

The strong evaluation demonstrated that the project was serious about making change. It helped to validate the work that teachers were doing. Regular feedback, both qualitative and quantitative, endorsed the changes. The performance tasks matched the teaching approaches and provided reliable information about students' improvements. This was backed up by conventional measures.

- Videotaping classrooms and sharing practice

This provided strong support for teachers that they were all working together. It also showed students that other schools were doing the same kinds of mathematics. This has led to some schools using video in classrooms, integrating technology with mathematics teaching.

- Teacher input into the professional development

Teachers contributed in a variety of ways. They led sessions, allowed their classrooms to be videotaped, commented on and improved the performance assessment and, most of all, took huge risks in their classrooms. The pay-off was improved behaviour and learning outcomes in their students. The professional development was centrally coordinated, so that teachers did not have the administrative burden, but was teacher focussed to meet their expressed needs.