Effective Practice in Education
Professional development case studies in Auckland and Northland schools

Enhancing achievement and student engagement in statistics
Quick smart

A short sharp professional development intervention at an Auckland secondary school has helped focus teacher practice on raising student achievement in statistics

“It sometimes seems that change has to involve a long process but it’s amazing how quickly targeted, effective teaching can progress students’ thinking,” says Team Solutions secondary mathematics facilitator Louise Addison. In this case study, we look at a quick intervention which has led to change in teacher practice that has resulted in increased student achievement and engagement in statistics.

Secondary Numeracy Project

The Secondary Numeracy Project (SNP) was introduced in 2005 with the aim of helping students develop a deeper understanding of mathematics. Team Solutions facilitators have worked with over seventy-five secondary schools in Auckland and Northland as part of the Project.

An evaluative report published by the Ministry of Education, Findings from the Secondary Numeracy Project 2008, indicates that teaching strategies adopted and used by successful numeracy schools include:

• greater emphasis on students’ understanding of key ideas
• an increased focus on student thinking and students explaining their thinking
• an increased awareness of the progression of students’ mathematical thinking
• an increased use of real-world contexts.

De La Salle College in Mangere East is a state integrated, decile 1, Catholic secondary school for boys from years 7-13, with a high percentage of Pasifika students. There are ten mathematics teachers in the school, about half of whom teach at years 7-8. The school is in its second year of the Secondary Numeracy Project, facilitated by Linda Cheeseman and Louise Addison from Team Solutions at The University of Auckland’s Faculty of Education.

The role of the In-School Facilitator (ISF)

At De La Salle College, Amanda Felise is the In-School Facilitator (ISF) for numeracy. Amanda is primary trained, having taught for a number of years at Roscommon Primary School where she first encountered the Numeracy Project.

“I had some really good role models in my primary teaching career,” she says. “In primary I think you have more time to practise your craft. In secondary you have this curriculum to get through. I understand this pressure, having taught my year 9 class this year - but I’m really happy I have been able to try and balance these competing pressures to get some positive results with both my year 8 and year 9 classes.”
In-class support

As the ISF, Amanda has funded release time to enable her to visit every year 7-9 classroom to complete in-class observations. “The in-class support is key to making shifts for teachers and students,” maintains Amanda. “At the start of the programme, one of our year 9 teachers was initially reluctant to have me observing in his classroom. Now, he says he wishes it could happen every week! He sees the value of it in order to reflect on his own teaching practice.”

Having another pair of eyes and ears in the classroom means that teachers engage in more conversations around students’ mathematical understanding. “Observations can help teachers with those ‘I didn’t know he could do that’ or ‘I thought he knew that’ moments. These are important in developing our awareness of what’s happening in classes.”

School-wide professional development

Every two weeks Amanda facilitates an hour-long professional development session with mathematics teachers during a school-wide staff development time. Because De La Salle College covers years 7-13, there is a mix of primary and secondary trained teachers in the mathematics department. A focus of these sessions is sharing aspects of pedagogy and the development of content knowledge. Facilitator Louise Addison notes that, “It is the combination of strong content knowledge and effective pedagogy that is important for effective teaching and learning.”

Recent activities discussed have been ‘warm ups’, how to differentiate tasks and developing more group work. “It might be a simple thing like choosing three ‘warm up’ algebra questions at the start of a lesson to give the teacher a good idea of where the students are at,” says Amanda.

Differentiation

“There is no perfect model for successful teaching,” says Amanda. “However, it is vital to have differentiated learning in your classes so students can experience success. Teachers are moving away from saying ‘this is my lesson and I have to get through it’ to planning different activities, taking more account of what students know and focusing more on where to go next with students.”

At the start of the lesson Amanda tries to begin with some maintenance questions and some formative questions. For students who get these all correct there will be set work to do; for the others, perhaps a focused workshop. “I will run a workshop on expanding expressions and say, ‘who wants to come’ – this will be a group session in one part of the classroom. I run groups at all my levels, not just for the students who need help,” says Amanda. “I’ll say, if you got all these questions right, come up here and we’ll do some extension work. Everyone has to shift, including our bright students. We have some super bright boys here.”

Statistics in the curriculum

Effective Pedagogy in Panagrau/Mathematics Best Evidence Synthesis Iteration (p3) states, “Effective teaching for diverse students demands teacher knowledge.” This can be a challenge as the statistics component of The New Zealand Curriculum contains significant changes from the 1992 curriculum.

Amanda, like many mathematics teachers, was not initially confident about her content knowledge of the new statistics objectives. Louise worked with Amanda to build her knowledge in this area, especially around exploring patterns and relationships in data.

Maxine Pfannkuch, senior lecturer at The University of Auckland, writes: “Currently, many students are taught mean, median, mode and graphs with an emphasis on how to construct them rather than how to use them to think with data. Learning to be a data detective by wondering whether some factors might explain differences between two groups or whether there is a relationship between two variables is part of learning the game of statistics.”

A short, focused intervention

As a Team Solutions mathematics facilitator, one of Louise’s roles is to develop the skills of the numeracy ISF. “The ISF model is effective because it allows me to work as a facilitator with a teacher who can influence others,” says Louise.

The intervention planned by Louise for Amanda’s year 8 class was short and sharp – a two week block during the last week of term 3 and the first week of term 4 in 2009. A key aspect of this intervention is that mathematics and statistics are related but different ways of thinking and solving problems, as stated in The New Zealand Curriculum (p26)).

Together, they planned an eight-lesson statistics unit where students would take raw data and use technology, in this case TinkerPlots®, to create dot plots. Students were then engaged in describing the data’s shape, middle and spread so they would be able to make generalisations about the data using appropriate vocabulary.

Louise worked with Amanda to explore how using TinkerPlots® could open up ‘new and different ways of learning’ as required by the e-learning section of The New Zealand Curriculum (p36). This work brought instant results.

In-class modeling

During modeled sessions, Amanda was able to observe how the students interacted with Louise and noted how they discussed statistical problems. After each observation, Louise and Amanda would reflect on key aspects of the session.

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Lorenzo Ainuu, Year 8 student, De La Salle College
“When Louise was teaching the students in my classroom and I was observing, I was also one of the learners,” says Amanda. Louise adds that, “I always explained what I noticed and why I chose to do what I did in the classroom. The great thing is that now Amanda can model for other teachers in their classrooms.”

Engaging students

Louise and Amanda were keen to make statistics more engaging for the students. They decided to use actual student data and compare it with data from the Census at School database. “We could use the students’ own data – for example their height, foot length, armspan and which super power they would most like to have. We included this raw data in our statistical analysis so the students felt more connected to it,” says Louise. Using multivariate data was important as it is a requirement for the relevant statistics achievement objectives in The New Zealand Curriculum.

“The penny dropped for me,” says Amanda, “as I could see how Louise encouraged the students to discuss what was happening with the data – the shape and patterns. Within eight lessons the boys could start to see the shape of the dot plot data and begin to generalise.”

All students were more engaged. Amanda reports that one boy who had found maths particularly challenging was not only engaged but able to use the correct vocabulary terms in context. “I didn’t know he could do that and it was wonderful to see. Because students kept experiencing success, they stayed engaged.”

Student achievement gains

For the statistics intervention, students in the class were pre-tested and post-tested. After the pre-test, Louise and Amanda analysed the results and constructed a series of lessons for teaching statistics based on students’ prior knowledge and the desired outcomes from the curriculum.

From the data it was decided to focus on 5 key learning outcomes, which were:
1. Describe shape of data
2. Describe middle of data
3. Describe spread of data
4. State conclusion
5. Justify conclusion

A student workbook was developed with a series of tasks which focused on developing students’ skills. The workbook was written after the pre-test to focus on developing skills where students were weakest.

This process provided Amanda and the other maths teachers at De La Salle with examples of effective statistics pedagogy. It was also used to get students thinking with data and becoming ‘data detectives’ rather than just calculating statistics and drawing graphs. “The BES highlights that selection of tasks which take into account students’ current competencies and long term learning goals is critical,” notes Louise.

Results showed that every student made progress in at least 3 of the 5 learning outcomes and 93% made progress in at least 4 or 5 of them (see table 1). “In eight sessions the students have made major shifts. They are excited by their success,” says Amanda.

This intervention also shows that a focus on the ‘big ideas’ in statistics can lead to skill development as the students also improved in these areas with no explicit teaching of these skills (see table 2).

Skill development was previously the focus of most statistics teaching at De La Salle College. Amanda now has the knowledge and understanding to work with the department to make changes in this area.

How professional development helped to raise student achievement

Table 1: Percentage of students demonstrating understanding across the 5 learning outcomes

<table>
<thead>
<tr>
<th>Learning outcome</th>
<th>Pre</th>
<th>Mid</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe shape of data</td>
<td>0</td>
<td>50</td>
<td>82</td>
</tr>
<tr>
<td>Describe middle of data</td>
<td>0</td>
<td>39</td>
<td>68</td>
</tr>
<tr>
<td>Describe spread of data</td>
<td>4</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>State conclusion</td>
<td>4</td>
<td>29</td>
<td>71</td>
</tr>
<tr>
<td>Justify conclusion</td>
<td>4</td>
<td>21</td>
<td>46</td>
</tr>
</tbody>
</table>

Table 2: Percentage of students demonstrating statistical skills

<table>
<thead>
<tr>
<th>Skill</th>
<th>Pre</th>
<th>Mid</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draw dot plot</td>
<td>68</td>
<td>89</td>
<td>93</td>
</tr>
<tr>
<td>Interpret graph</td>
<td>54</td>
<td>89</td>
<td>96</td>
</tr>
<tr>
<td>Identify middle of data</td>
<td>4</td>
<td>50</td>
<td>71</td>
</tr>
</tbody>
</table>

Table 1: shows student progress in the 5 learning outcomes during the series of targeted statistics lessons with a year 8 class at De La Salle College. Results show that every student made progress in at least 3 of the learning outcomes and 93% made progress in at least 4 or 5 of the learning outcomes.

Table 2: shows the same students’ progress in 3 statistical skills. The results reveal that taking a ‘data detective’ approach where students explore patterns and relationships in data can also develop students’ skills in drawing dot plots, interpreting graphs and identifying the middle of data.
Moving forward

From 2010 De La Salle College will no longer receive Ministry-funded release time for the Secondary Numeracy Project but the school will continue to commit time to develop mathematics learning. “Our principal Brother Steve is very supportive of anything focused on student achievement,” says Amanda. “I have been given an extra two hours per week for 2010 and this will allow me to continue to do in-class observations and modeling with maths teachers.”

Amanda and her head of department Viliami Latu have plenty of ideas for how the mathematics department can continue to develop. “Viliami is very supportive and the data from the Numeracy Project plus the intervention from Louise have enabled us to see where we can go. It’s numeracy professional development but it’s also just good teaching practice.”

Louise sums it up: “Effective teachers assess students’ current thinking, understand the reasons for this thinking and know how to progress this thinking. The intervention has shown the success of this approach to teaching statistics.”

References


Acknowledgements

Effective Practice in Education: Professional development case studies in Auckland and Northland schools is a series of case studies that has been developed to demonstrate effective ways that schools work in partnership with Team Solutions. Each case study looks at innovative professional learning partnerships that bring about sustainable change in teaching practice to improve student achievement and engagement.

This profile is significant because it shows how a short, focused professional development intervention can change teacher practice and have a significant impact on student achievement.

Team Solutions would like to thank Brother Steve Hogan, principal at De La Salle College for his cooperation. Thanks also to Amanda Felise, her head of department Viliami Latu, and Amanda’s year 8 students for sharing their learning journey when we visited to prepare material for this case study.

Te kāhui akoranga ngaio

Camilla Highfield, Director

Team Solutions mathematics contacts for Auckland and Northland schools

Team Solutions provides quality professional development to support teachers and leaders in Auckland and Northland schools. It is an integral part of the Faculty of Education at The University of Auckland. In most instances the service provided by Team Solutions is funded through the Ministry of Education.

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