# Evaluating university-to-school peer mentoring in science: the influence of the In2science program in Victorian schools

**August 2009**

**Kerri-Lee Harris and Angelito Calma**

**Centre for the Study of Higher Education**
**The University of Melbourne**

# Contents

## Acknowledgements

This report was prepared by the Centre for the Study of Higher Education at the University of Melbourne, at the invitation of the In2science Board.

We thank the members of the project's Advisory Group for their support, insights and feedback on the design of the study: Professor Rob Norris (Dean of Science, Monash University, and member of the In2science Board); Claire Bolster (Department of Education and Early Childhood Development); Natalie Sum (Department of Education and Early Childhood Development); and John McDonald (In2science program manager).

In addition, we acknowledge the support of the Department of Education and Early Childhood Development in granting permission for the involvement of government schools.

Special thanks to the school principals for permitting access to their schools, and particularly for their considered and valuable insights into their schools' experiences with the In2science program.

Finally, we are especially grateful to the many teachers, students and mentors who made time to speak with us about their individual participation in the program. This study would not have been possible if not for their willingness to describe their experiences and to share their ideas.

Kerri-Lee Harris

Angelito Calma

*August 2009*

# Executive Summary

**Background**

Promoting students' engagement in science learning is a "fundamental goal for science education" (p.4, VCAA, 2008). Students are most likely to achieve in science if they are interested and motivated, and if they have confidence in their abilities to learn science and to tackle new problems. Such assertions have an empirical basis. Recent, large-scale studies of 15 year old school students show correlations between students' attitudes toward science learning and their levels of achievement (Ainley, Kos, & Nicholas, 2008). 'Self-belief' was shown to be an even stronger predictor of success than 'general interest' in the subject.

The In2science peer mentoring program seeks to promote such student engagement with science learning. The program aims to inspire all school students to achieve their potential, and to encourage students to consider science study beyond Year 10.

This report examines the potential for In2science to influence the teaching and learning of science in secondary schools in Victoria. The report explores the 'school perspective', drawing primarily on the insights and experiences of school teachers and principals. The objective is to analyse the influence of In2science in schools which have well-established and continuing involvement in the In2science program. This information will be of value to both the In2science management team, and to schools considering building partnerships with In2science in the future.

The report presents the findings from a case-study analysis of five government secondary schools in Melbourne. The schools were united by the fact that they had each been involved with In2science for several years. All had hosted university students – as peer mentors – in science classes across a range of year levels, involving many of their schools' science and mathematics teachers. The schools were otherwise quite diverse, differing in their structures, histories, student demographics, and specific priorities or 'missions'.

**Findings**

Despite the diversity among the types of schools surveyed, the principals' assessments of the value of the program were consistently positive and remarkably similar. Each of the school principals described the program in terms of promoting the engagement of their students with science learning. Even those schools considered specialist science schools valued the 'passion, knowledge and experience' that the mentors brought to the schools. The mentors were seen as much more than an extra pair of hands in class, and the principals described this university-to-school partnership as one in which the schools 'come out in front'.

In2science promotes students' interest and achievement in science, and changes their perceptions of science and science learning.

The program leads to more interactive and practical-based science classes, drawing on current science knowledge and techniques. Mentors introduce students to science learning 'beyond school', and build connections between science, and students' own interests and experiences.

In2science helps to build students' confidence in science. For many students, the greatest deterrant to continuing in science study is a lack of self-belief. There is evidence that In2science mentors help students overcome this barrier.

Mentors also serve as valuable role models. As young people with their own diverse interests and backgrounds, mentors present a 'face of science' that often surprises school students, and with which students can readily relate.

The results of the study highlight the potential for In2science to significantly enhance the teaching of science in secondary schools. Importantly, the influence of the program extends well beyond the direct assistance provided by the mentors during their time in class.

Teachers' engagement with In2science mentors has a sustained and systemic influence on the practice of science teaching in participating schools: teachers are exposed to current science and knowledge that complements their own knowledge; science classes become more interactive; and teachers are more willing to collaborate and share ideas. The principals at each of the case-study schools emphasised the benefit of In2science in terms of the professional development of their science staff.

A defining characteristic of the In2science program is its collaborative, multi-university approach. Unlike university outreach initiatives which seek to recruit students to particular institutions or particular courses, In2science aims to promote students' engagement with science learning more broadly. In2science mentors are perceived as 'young scientists', not as representatives of their particular universities.

The contribution of In2science to science learning in schools is a distinctive one. Even in schools with an existing focus on science, and with various other initiatives in place to promote science learning, the contribution of the In2science program is highly valued. In2science is seen to complement other science-related initiatives, and schools describe mentors as 'adding value' to other science programs.

The following is a list of the themes and principal findings to emerge from this study.

**Schools' initial motivations for engaging with In2science**

- Improving students' early experiences of science learning, and raising their aspirations for further study, were among the primary motivations for schools joining the program.
    - Principals and teachers expressed an explicit desire to raise students' aspirations for further study, generally, and in science in particular. They stressed the importance of positive, early experiences in school science.
    - Incorporating the passion and enthusiasm of 'young scientists' into the school science environment was considered a central feature of the In2science program, particularly in the middle school years.
- Schools were seeking access to current science knowledge.
    - The mentors were perceived to have sound – even advanced – knowledge in their areas of science, access to the latest information, and familiarity with current scientific techniques.
    - Mentors were considered to be young scientists, not student teachers or classroom assistants.

**The unanticipated benefits to schools**

- Teachers were inspired and encouraged to reflect on their teaching, and to share ideas.
    - Principals and teachers alike described the contribution of the program to the professional development of teachers. This contribution extended beyond access to knowledge.
    - An increase in reflective practice among science teachers was attributed to their involvement with In2science peer mentors.
    - The program was also seen to be encouraging a more open teaching culture, where science teachers were exchanging ideas and working more collaboratively.
- Some mentors, as a result of their experience in schools, were encouraged to consider teaching as a possible career.
    - Schools described this as an additional benefit from the program, citing the need for suitably-qualified science and mathematics teachers in schools.

**The influence of In2science on students' experience of science**

- Students were encouraged and supported to achieve in science.
    - Mentors were able to boost students' confidence in their science abilities. They could also encourage them to ask questions and engage in discussions.
    - The risk of students being left behind was reduced. Students could seek extra assistance, and valued the additional and alternative explanations mentors could provide. The presence of a mentor reduced the 'down time' as students waited for assistance, and helped to ensure students remained on task.

- Mentors also supported the extension of more advanced students. As highly credible sources of scientific knowledge, they were seen to be an ideal source of extra information.

- Students made connections with science beyond school.
  - As role models, mentors 'broke the mould', challenging students' preconceptions of what scientists 'are'.
  - Students were able to identify with mentors, and so were encouraged to see that university and university science might be an option for them as individuals. Such recognition could be based on gender, or on social or cultural background.
  - Mentors also sought to make links from students' own interests, to the associated science. They sought to highlight the relevance of science to 'life', and to a wide range of careers.
  - Students valued opportunities to visit universities, and to see where mentors worked and studied.
  - Mentors also brought 'university to school', introducing examples of their own university work into the class.
  - Through both informal discussion and more formal presentations, mentors described the nature of their university studies, how they came to be doing science at university, and where they thought their studies might take them.

**The influence of In2science on teachers and their teaching**

- Teachers valued the access to assistance and knowledge provided by the mentors, and the contribution of the mentors as role-models.
  - Mentors were valued for the assistance they provided in class, and for the *current* science knowledge that they shared with students and teachers.
  - Teachers also described the benefits they received in terms of access to *complementary* knowledge, and to fresh ideas.
  - Mentors were seen as valuable role models for students, through their combination of knowledge, youth, enthusiasm, and 'beyond-school' experience.
  - Teachers also described the importance of the rapport between mentors and students, as mentors were 'fellow-learners' and not teachers.

- In2science had an influence on teachers' practice, leading to more interactive classes and promoting innovation.
  - Mentors *enabled* teachers to include more activity-based learning through the knowledgeable assistance they provided.
  - The program was also a *driver* behind the increased interactivity. Teachers felt an obligation to utilise the mentor in class, avoiding 'chalk and talk' lessons wherever possible.
  - Teachers also described situations where having a mentor had encouraged them to experiment with novel activities.

**Building sustainable partnerships between schools and In2science**

- On the part of the schools, successful introduction of In2science was attributed to:
  - Having an enthusiastic teacher in the role of In2science link teacher.
  - Voluntary participation by teachers, with the program expanding gradually as the 'word spreads'.
  - The support from the leadership of the school, and alignment with the school's mission.
- The relationship was considered sustainable.
  - Involvement requires only the continuing commitment of a coordinating teacher, and the support of the school leadership. No other school resources are required.
  - Over time In2science becomes an integral part of the science teaching in the school. However, even in the early years of participation there are benefits to the students and teachers involved.

**The role of the partner universities, from the perspective of schools**

- The current level of support from In2science management was highly valued, and seen to be critical to the success of the program.
- Schools stressed the importance of the careful recruitment and selection of mentors, and the value in 'briefing' mentors on their roles and responsibilities, to the continued success of the partnerships.
- Schools were also interested in building on their relationship with the mentors, and with In2science generally, to create further links with science in universities.

From the perspectives of participating schools, In2science is a highly valuable program supporting them in their efforts to engage school students in the study of science. The mentors play an important role in directly supporting students' learning, and in presenting an image of science and science learning that helpfully challenges students' preconceptions. Schools' participation in the program also has a broader effect on science teaching and learning. Teachers provide more opportunities for student interactions and investigations, and there is a 'ripple effect' that extends beyond the teachers directly involved in the program.

In2science mentors are regarded as 'young scientists', not trainee teachers. Their specific contributions are diverse, influenced by their individual disciplinary backgrounds and dispositions, and by the needs and objectives of their host teachers. Both of these features – recognised as strengths of the program – also have implications for the recruitment of mentors, and for the guidance provided to mentors and schools. The university-based In2science coordinators play a critical role in ensuring that mentors are well suited, well prepared, and well supported.

The schools surveyed in this study were unanimous in their support of the program to date, committed to continuing their relationship into the future, and keen to endorse the program as a valuable strategy for enhancing science learning in schools.

> *I wanted the students to connect with science beyond the classroom. I was the head of science at that stage, I got us involved in the program, and I've not regretted it.*
> (#8; teacher & link teacher: S5)

> *And even if you just recruit one science teacher … they start doing really interesting work in class … and 3 kids get excited about science. You've got to talk about what a measurable outcome that is straight away – 3 kids who know science isn't boring. And 3 can become 6, and 6 can become 12.*
> (#20; Principal; S1)

# Chapter 1:
# Background information

*To be human is to be curious about the world we live in, to wonder why it is that way, and to ask about our place in it. A fundamental goal for science education is to stimulate, respond to and nourish such curiosity, wonder and questioning. Science provides us with one view of the world – a view that changes as our knowledge and understanding of science evolves.*
*(extract from Victorian Essential Learning Standards (Science) page 4; VCAA, 2008)*

## 1.1 Introduction

Science education is an identified priority in Australia. Science is recognised as a core component of general education, developing "citizens who are capable of engaging in informed debate about science and its applications" (p.5, VCAA, 2008). In addition, concerns have been raised about Australia's ability to meet the future skills needs of a knowledge-based economy, with data indicating declining interest in science study.

Internationally there are calls to encourage more young people into science study at school and university, and ultimately into science-related careers. Various studies and reviews have examined particular aspects of the situation in Australia in order to better understand the nature of the challenge facing this country. For example, recent studies have reported the precise patterns of enrolments in school science and mathematics subjects (Ainley et al., 2008; Barrington, 2006), the qualifications and supply of science and mathematics teachers in secondary schools (Harris, Jensz, & Baldwin, 2005; Harris & Jensz, 2006), and the teaching of mathematics and chemistry in universities (Hughes & Rubenstein, 2006; Jensz, Carroll, & Gibson, 2005). Correspondingly, various initiatives have sought to address the issue, including a range of programs to support the effective teaching of science in secondary schools (DEST, 2003; ETC, 2006). Included among such initiatives are university-to-school peer mentoring programs. The In2science peer mentoring program in Victoria is an example of such a program.

In the In2science program, secondary school teachers host university students who are currently studying tertiary-level science, and these 'peer mentors' support the in-class teaching and learning: working directly with students as they learn, and working with the teachers to develop and implement science-related projects and activities. The In2science peer mentoring program was modelled on the Perth-based STAR Peer Tutoring Programme and commenced in 2004.

The primary aims of In2science are:

- "To generate enthusiasm for Science (especially the enabling subjects of Chemistry, Physics and Mathematics) in students in the middle years of their secondary education (Yr 7-10).
- To place university students in schools to act as positive role models to secondary school science students, inspiring them to achieve their potential.
- Through the role models, promote the value and rewards of Science as a positive career choice
- To foster links between schools and universities."

  *(excerpt from In2science website: www.latrobe.edu.au/scitecheng/mentoring/what_is_it.htm)*

In essence, In2science seeks to promote students' engagement with science learning. While some students may be encouraged to further study in science, the aim is to inspire all students to achieve their potential.

From modest beginnnings, In2science has grown to involve 44 schools, three universities (including five campuses), and around 490 mentor placements. In the past year, In2science estimates that 5700 secondary school students in Victoria had an In2science peer mentor working alongside them in their science or mathematics class.

A two-year longitudinal study of the STAR program previously demonstrated the potential for such programs to support students and teachers in the classroom (Harris & Shaw, 2006). The STAR study also identified factors associated with successful peer mentoring programs, information relevant to program coordinators and to the peer mentors involved. It did not, however, focus on the detail of successful classroom activities, nor the strategies for sustainably embedding the program within the teaching culture of the schools involved.

Teachers are routinely surveyed as part of the internal evaluations undertaken by the management of In2science. In addition, the In2science manager and university contact officers liaise with contact teachers in participating schools, and thereby receive regular feedback on teachers' expectations and experiences. School students and mentors are also surveyed regularly as part of the program's internal evaluation cycles.

There are benefits, however, to review of the program by an independent agency. Any constraints that respondents might feel in feeding back directly to the program management are removed, as the researchers are not known to the participants, whose responses remain anonymous in all reporting back to In2science. In addition, the independence of the researchers promotes an objective approach to the analysis and reporting.

This is the third independent evaluation of the In2science program undertaken by the Centre for the Study of Higher Education (CSHE). The 2009 study departed from the focus of the previous studies. The 2006 study, for example, was characterised by a focus on the experiences and motivations of peer mentors (Farrell & Harris, 2006). In contrast, the 2009 study concentrated on the experience of schools and school teachers, and featured an investigation of the influence of the program on the teaching of science in schools.

To this end, the study adopted a case based approach involving five schools with a total of 23 years involvement with In2science between them. Interviews with teachers and principals were the defining feature of the study, complemented by interviews with student groups and recent 'mentors' from the case-study schools.

The aim of this study was to provide information and resources that would be of direct benefit to participating schools. The project reporting was in two stages, and of two types. This first report documents the findings of the study for the information of the In2science Board. The second document will take the form of a guide to schools and teachers, presenting strategies for the successful introduction of the program, including examples of sustainable partnership development between schools and the In2science program.

## 1.2 Methodology

This study was not designed to take a representative sample across all In2science participating schools. Only schools with established and continuing relationships were selected. The study purposively targetted such 'success stories' in order to examine the nature of these successful partnerships. Therefore, the questions asked in this study are not so much about *is the program working?* – this can be assumed as the schools are active participants in a voluntary program – rather, the focus is more upon *how does it work*? and *what does it take to keep it working?*

The ultimate objective of the study was to identify the characteristics of successful partnerships. This information can assist In2science management in determining future directions for the program, and can also assist other schools seeking to build effective and sustainable relationships with In2science.

The study was designed to address the following four questions:

1. What contributions do peer mentors make to students' engagement with science learning at school?
2. What evidence is there that the program encourages school students to continue science study beyond Year 10?
3. How does the program influence science teacher practice?
4. Under what conditions do schools develop substantive and sustainable engagement with the program?

The following criteria were used in the selection of a sample of schools for the case studies:

- A substantial history with In2science, in terms of number of years, and number of mentors and teachers involved;
- Current involvement in the program;
- Diversity in student demographic, based on the 'SFO' ratings provided by DEECD; and
- Diversity in the geographic location, and therefore the demographics of the school catchment.

The experiences and insights of teachers and principals were central to the method employed in this study. Teachers were considered best placed to describe the influence of In2science on their own teaching practice. Principals provided the perspective of school leadership, while coordinating ('link') teachers – teachers at the nexus between the school and the In2science management – were also deemed likely to have particular insights into Questions 3 and 4.

In addition, teachers were considered well placed to comment on questions concerning students' engagement and student learning (Q1 & Q2). It was known from previous studies that the data which could be obtained directly from surveying students – particularly junior school students – was likely to be limited in character. Few students are able to fully articulate the nature of their experiences. Through their teaching, however, teachers are continually considering student engagement and monitoring student learning, informally and formally.

Data from in-depth interviews with teachers and principals was complemented with group interviews with students from some participating teachers' classes, and with a questionnaire-based survey of mentors from the case-study schools.

Recruitment

With ethics approval from the University of Melbourne and permission from the Victorian Government's Department of Education and Early Childhood Development (DEECD), letters of invitation were sent to nine government schools. The relevant regional directors of education were informed of the study, as per advice from DEECD.

With the permission of each school's Principal, the following five schools subsequently contributed to the study:

Coburg Senior High School; Eltham High School; Gleneagles Secondary College; Footscray City College; Northcote High School.

Permission was also received from a sixth school. However, it was not possible to arrange interviews with teachers or students within the timeframe of the study.

Summary details of each school are provided in Appendix 1.

The principals each nominated a 'contact teacher'. Via the contact teacher, invitations were extended to all science and mathematics teachers with experience of hosting peer mentors in their classes, currently or previously. The contact teacher for each school was typically also the 'In2science link teacher' – the person charged with liaising with the university-based In2science management. The letters of invitation particularly identified teachers of science in Years 7 to 10, but did not preclude mathematics teachers, or VCE science and mathematics teachers.

In addition, participating teachers were encouraged to invite participation by students in one or more of their classes. Students were invited to participate in small-group interviews.

A total of 15 teachers, 6 school principals, 28 schools students and 6 mentors participated in the study.

Most interviews were conducted on site in the schools, and were audio-recorded and transcribed for analysis. A semi-structured interview approach was employed. Mentors and one former principal responded to the survey questions by email.

Data analysis

A thematic analysis of the transcripts was undertaken. In particular, the data was examined in the following areas:

- What the interviewee sought from the program, and their motivation for being involved;
- The influence on student learning and students' experience of science;
- Descriptions of the types of activities mentors engaged in; and
- The influence of the program upon teaching practice.

In addition, the data was examined for insights from 'the school perspective'. This primarily drew upon the interviews with principals and coordinating science teachers, although not exclusively. The data was examined in the following areas:

- Why the school chose to be involved;
- What benefits there were to the school;
- Suggestions regarding the sustainability of the program in schools;
- Advice to other schools considering involvement; and
- Suggestions regarding the management of the program.

The emergent themes constitute the study's findings, and these themes were used to define the structure of the report.

The report

The findings of the study form the basis of the report's structure. In particular, Chapters 2 to 4 categorise the findings in terms of three broad areas: the motivation for schools' involvement (Chapter 2); the influence on students' experience of science (Chapter 3); and the influence on science teaching (Chapter 4).

Quotes are used extensively throughout these chapters. These provide the evidence in support of the findings, and are also the most authentic representation of the views of study participants. In some places, lengthy quotes are included as they provide contextual information of relevance to interpretation of the comment. To assist the reader, however, bolding is used to highlight the key comments.

The final chapter (Chapter 5: Key features of successful In2science partnerships) is, in essence, an *application* of the findings. It is more normative in character, listing the characteristics which underpin sustained and successful school involvement in the program, from the perspective of schools.

While not primarily comparative, the overall experience of each school was considered in the context of its history with the program and its 'mission', as described by the school principals. This is in part reflected in the thematic findings chapters (Chapters 2-4), and informed the development of the final chapter.

Attribution and identification

In accordance with the conditions of approval for the study, comments included in the report are not attributed to individuals, nor to identified schools. However, in keeping with the case-study approach, comments are coded to enable grouping by school.

All quotes are identified using the following coding:

Interview number; respondent 'type'; class details; school code (*e.g. #3; teacher; general science, Yr 8; S1)*

- Each interview was assigned a unique identification number. Students were interviewed in groups, and quotes from student groups do not distinguish individual students.
- Respondents were classified into non-overlapping groups: teacher; teacher & link teacher; Principal; students; mentors. 'Link teachers' were teachers with responsibility for liaising with In2science management and for coordinating the In2science program within their schools.
- Class details were included for all students and most teachers. This indicates the classes in which the interviewees worked with In2science peer mentors.
- Each school was assigned a code, from S1 to S6.

# Chapter 2:
# Why schools choose to be involved

*This year there are four teachers that nominated to be involved in the program, but that doesn't mean that it's just those four teachers that actually benefit from it.* (#22; Principal; S2)

In2science is a voluntary program. Participating schools elect to be involved, and within these schools, individual teachers are able to nominate to host an In2science peer mentor. It is informative, therefore, to examine the motivations behind the decisions of schools to participate.

The schools participating in this study had been involved in In2science for at least three years. Two of the schools were among the first cohort, hosting mentors since the inception of the program in 2004. This study was therefore able to explore schools' *original motivations* for participating, and the reasons behind their *continued* involvement.

This chapter describes the influence of the program on schools rather than on individuals. The data is not confined, however, to the comments of principals. Teachers, and particularly the link teachers, offered considerable insight into the motivation behind each school's participation. In addition, the perceptions, experiences and views of teachers are highly relevant with regard to the culture of teaching in the school, and particularly the ways in which they interact with their school colleagues.

**Overview**

Despite the diversity among the schools surveyed, the principals' assessments of the value of the program were consistently positive and remarkably similar. Each of the school principals described the program in terms of promoting the engagement of their students with science learning. Even those schools considered specialist science schools valued the 'passion, knowledge and experience' that the mentors brought to the school. The mentors were seen as much more than 'an extra pair of hands' in class, and the principals described this university-to-school partnership as one in which the schools 'come out in front'.

Notably, the principals all reported that the program was making an important contribution to the professional development of their science teachers. They described how their original perceptions of the program were that student engagement would be promoted through the direct interactions in class between school students and the 'enthusiastic, young scientists' as mentors. And all agreed that this was making a very important contribution. In addition, however, several principals also emphasised the value of the program in terms of its broader influence on the teaching of science in their schools. Teachers were encouraged to employ more interactive methods in class, had access to new knowledge, and were developing more collaborative and reflective practice.

Schools were originally motivated to be involved in the program for two broad reasons – to enthuse their students in science classes, and to access current knowledge and practice in science. **Section 2.1** presents an analysis of these two themes, drawing upon comments from principals and link teachers.

The reports from most of the schools also highlight a number of 'unanticipated benefits'. These are described in **Section 2.2**, and include the promotion of reflective practice and the creation of a more open culture among science teachers. These outcomes are highly valued. In particular, the principals from two schools stressed that these are the most important influences of the program, extending well beyond the actual visit of the In2science mentor. In addition, staff from four schools included the promotion of science teaching as a possible career path for university science graduates as an 'added bonus'.

Finally, schools reported no 'cost' to their involvement in the program, beyond the absolute requirement to have a committed coordinating ('link') teacher. This is briefly discussed in **Section 2.3**, and elaborated in Chapter 5 which describes the key features of successful programs.

## 2.1 Motivations behind schools' initial participation

### The direct influence upon school students' experience and aspirations

Principals valued the mentors as role models, sharing their passion and enthusiasm for science and science learning with the students in the science classes.

> *I mean it's just fantastic to have young scientists who are currently at university* ***modeling the behaviours of passion for science*** *... great communicators and really coming into our classrooms and connecting to kids* (#23; Principal; S5)
>
> *I think it's about* ***connections to students who are passionate about science****, from the tertiary level, coming to the school environment, to be part of the passion* (#20; Principal; S1)
>
> *Because they come in as students rather than as teachers****, they're also effective in encouraging other students, our students, to become more interested in science****.* (#15; Principal; S3)

The importance of students' early experiences in science was described in terms of motivation and empowerment.

> ***I felt that if we focused in the middle years in junior science we'd motivate the kids then****, and develop the skills and knowledge that they could then take through onto the senior years* (#8; teacher & link teacher; S5)
>
> *I think* ***having students work with students is what empowers kids****. It motivates them towards science, and they can actually, you know, know that they can do it* (#11; teacher & link teacher; S5)
>
> *I reflect back on when I was at school – the study of science had such a negative spin to it ...* (the idea) *that you have to be of a certain level of ability to engage with science ... that, you know,* ***if you had a negative experience that tended to actually reflect on your future choices*** (#22; Principal; S2)

There was also a very explicit desire among principals and teachers to raise students' aspirations for further study, generally, and in science in particular.

> *I think that we anticipated what its potential value might be for us as a learning community. I mean, I have to say we probably moved into this whole* (arrangement) *from a selfish perspective in that* ***we wanted the program to support the motivation of students to continue their study of science****. The data around educational circles at that stage was that there was a decrease in the number of students who are actually accessing science courses at university* (#22; Principal; S2)
>
> ***I wanted the students to connect with science beyond the classroom****. I was the head of science at that stage. I helped to get us involved in the program and I've not regretted it. I felt that at that stage the school was in a good position, and the science faculty worked together to develop a program that was challenging****, yet*** ***we still weren't getting students continuing on beyond VCE*** (#8; teacher & link teacher; S5)
>
> *There's the benefit where students can be talking with the In2science student* (mentor) *and learn about how they got to where they are at this point. And* ***there's enormous value in just having someone talking to secondary school students about their pathway and how got to that point*** (#20; Principal; S1)
>
> *Part of the general philosophy of the school is to try and extend students' interest, to have the connections between universities and school program, to add to our school program, to give students the availability of all the programs that are available. For this cohort of kids, where – in this city of* (name of suburb removed) *– only six per cent of adults are tertiary educated.* ***So one of the philosophies of this school is to have links with universities so that we can help students to be aspirational****.*
> *.... If you have no member of your family – mother, father, aunt, uncle – if you know of no one that's ever been to university, how do you aspire to go to university? So we quite strategically and intentionally seek links with universities' programs, either bringing people into the school or sending our students from the school to the university programs – we do both.* (#28; Principal; S4)

In addition, for schools seeking to increase their 'science focus', involvement in In2science formed part of a broader strategy around the promotion of science learning:

> ***We want science to be much more high profile within this school*** *and we have a reputation for the arts ... that* (arts) *has a high profile, and we really wanted to lift the whole image of science and to attract more students to the science program* (#15; Principal; S3)
>
> *We became a select entry accelerated learning school and we sought all sorts of avenues to provide enhancement activities for those students, and then in exploring avenues with universities for those programs we then became involved and more aware of other programs which were available.* ***We always seek to enhance our curriculum, and our motivation is to take advantage of the opportunity that we saw in this program***. (#29; Principal; S5)
>
> *We won't simply engage with things, we don't have time. Schools are very time poor ... Whatever we do has to aim towards improving student learning and improving student achievement. So when we look at something that's being offered to us, we look at it and say 'well, how does this fit in with our principles of teaching and learning?', 'how does this fit in with our agenda in terms of improving student learning?' and if we don't have an answer to that, then we say 'well, this is not for us'. Because we just can't engage with projects for just the sake of projects, you know. Now,* ***In2science fits perfectly with our strategic plan, because one of the areas for improvement in our strategic plan is improvement of learning outcomes in science and mathematics****. So this fits in very well. You know, we've got people with level of expertise that are coming in, they're mentoring kids, they're working with kids, they're working with teachers, teachers are working with them, so 'why not?', you know. It seems to me like it's a win-win situation all around. So for us it's a really good thing to say 'well, we're not just improving VCE results, we're not just working to improve VCE results.* ***We're working towards maintaining kids in science programs into VCE and out of VCE, and In2science supports that****.* (#22; Principal; S2)

## Mentors as a source of current science knowledge, for both students and staff

The mentors were perceived to have sound – even advanced – knowledge in their areas of science, access to the latest information, and familiarity with current scientific techniques. The importance of this 'currency' in scientific knowledge was a prominent theme in the study. Science had fundamentally changed since many of the schools' science teachers last studied the subject at university, explained both principals and the teachers themselves.

> *I mean,* ***it's an area where knowledge is changing every year, so they bring that sort of, you know, the latest sort of understanding that's associated with them****, which I think is an informal form of professional development for our teachers ..... I mean, obviously within schools ... schools constantly have professional learning happening, so it's not like that they (teachers) haven't been exposed to anything for 25 years or whatever, but I do think it just does bring another level of the newness into their classrooms.* (#15; Principal; S3)
>
> ***An absolute focus on relationships, absolute focus on rigour, and the sort of cross-disciplinary breadth*** *- bringing their prior knowledge and new knowledge together through a really deep rigour ... so I think it has incredible benefits for our students* (#23; Principal; S5)
>
> *Most of the teachers haven't been to the university for a few years and so these undergraduate, and maybe postgraduate students, potentially, would have* ***the opportunity to bring the most recent science into the classroom*** *and therefore the teacher gets a bit of professional development* (#8; teacher & link teacher; S5)
>
> *Look, it's been fantastic from a number of perspectives. I think it's been that the mentoring program has actually worked in a variety of different ways ....*
> *You know, once they've gone into the profession of teaching,* (teachers) *may not have kept up with the current areas of science.* ***Some are saying that they don't go out there and discover new things, to learn new things, but it's made it easier for them to engage in conversations with students*** **(mentors)** *in, you know, 2nd, 3rd, final year of science courses ... to actually have those conversations around what is the most recent technology in biotechnology, and 'what are we engaging with in there?', and to gain that support as well* (#22; Principal; S2)

Capitalising on this potential was contingent upon teachers seeing mentors as young scientists, and not as student teachers. This is a theme that was echoed among teachers, and emphasised by one principal in describing the conditions required to sustain the program in schools:

> ***I think that teachers that are involved in it have to be prepared in to view the university student as something of an 'expert', and to use their level of expertise in the classroom****, and to see them very*

*differently to the way that they would see a student teacher. So I think that's a shift that has to occur in the mind of the teacher because, ultimately, if the mentor is being used as a student teacher, then it's not gonna work. You know, the benefit isn't there.* (#22; Principal; S2)

## 2.2 Unanticipated benefits to schools

### Teachers are inspired and encouraged to reflect on their teaching

In describing the influence of the program on schools, several principals and teachers further emphasised the value of the interactions between mentors and teachers. The benefits to the schools extended beyond teachers' access to current scientific knowledge. In particular, an increase in reflective practice and the sharing of ideas between teachers was attributed to the program.

The relationships between the university students, as mentors, and the science teachers were described as 'partnerships', and reciprocal relationships.

> *You can never get to appreciate the fullness of those benefits until you're actually in the program, until you experience it. .... initially you think, 'okay there is this science graduate ... well, not graduate, but undergraduate ... coming in and working with students in the classroom, and mentoring them'. So you think 'that's really good for our kids'. But then,* ***having engaged in the program for a number of years now, we're actually starting to see that mentoring isn't just the mentoring provided by the university student to the secondary student. It's mentoring provided by the teacher to the university student, and the university student to the teacher as well****. So you're not really cognizant of the full benefits until you've actually experienced the program* (#22; Principal; S2)

> *It's about knowledge base ... there's work they* (the mentors) *are doing that actually will ignite the passion in the teacher. ....* ***Because in the scenario where you've got teachers who've been out for a while, there's benefit to having a young person work with them again****. .... I always pose the question 'Why wasn't science the most exciting subject I ever did?' It's all around us! It's got real life context! ... and there I was, sitting in a classroom with someone reading out of a chapter ...*(#20; Principal; S1)

> ***It was stimulating for me. Quite often as a teacher you tend to get isolated a bit****. It's good to have a bit of outside interaction, because I've been out of that 'study phase' for a long time, and you get sort of bogged down, sort of disconnected.* (#12; teacher; advanced science, Yr10; S5)

> ***Teachers see value in the partnership and see the peer mentor as a support colleague****. They have even requested a peer mentor to assist them in a class that has been challenging. This demonstrates the level of trust between teacher and peer mentor and the program.* (#29; Principal; S5)

Teachers support mentors by creating opportunities for them to interact with students (see also 4.1) and, ideally, to find forms of contribution that best suit the mentors' skills. Through such negotiations, and through general discussions about the teaching, teachers are encouraged to reflect on their own teaching practice. This contribution to the professional development of teachers was recognised and valued by principals and teachers alike.

> ***Young people, working with the staff, going 'this is what we're doing' or 'how do you do this?' asking questions of staff. That's really really important.*** *Once again, we get back to reflection. ... the staff have to explain things ... the value in that is that you have to stop and explain why you are you teaching what you are teaching, and often that's a question that doesn't get asked. 'So why <u>are</u> we doing this topic?' So there's the value of payback for the staff in the investment of their time in the In2science mentor* (#20; Principal; S1)

> *We just sat down and had a chat .... Well, initially we talked about the sorts of classes I have ... I don't tend to do the sort of talk and chalk as much as some of the others. I try to get them* (the students) *really hands on, and I'm really careful about the kinds of questions that I ask and I try not to give them the answers.* ***So I talk to her about how I do things in class, and how I try to make the class look*** (#4; teacher; science, Yrs 8 & 10; S2).

> *...* ***you can sometimes get a different perspective, because we usually talk about the lessons afterwards*** *... you know, 'how did that go', and I'd ask them* (the mentors) *what sort of questions there were* (from students), *and I'd get them* (the mentors) *to give me some feedback on how they thought I was doing, so that was good from that perspective*. (#31; teacher; S4)

*There isn't just one formula that works, but I share the different things that I do with my peer mentors and I know some of the teachers have taken on board the different approaches that I've used and they've said to me 'I wanna just do an experiment, give me some ideas'. 'How can I use my peer mentor?' And they feel that they need to try new ways of delivering the subject matter and I think that that's wonderful.* ***So if by having a peer mentor teachers are starting to reflect on their teaching practice and try new approaches, you know. If this is an outcome then I say 'that's wonderful'***. (#8; teacher & link teacher; general science, Yrs 7-10; S5)

## A more 'open-door' culture of teaching is promoted

Hosting a 'young scientist' can initially be a challenge for many teachers. Teaching remains a remarkably private activity. Overcoming fear of sharing the classroom is both a prerequisite for the participation of teachers, and a recognised benefit from the program. It is also one of the main reasons that schools endorse the voluntary nature of the In2science program. All the schools interviewed had been successful at both introducing and embedding the program, and they attributed this in large part to the gradual and voluntary approach taken (see also Chapter 5).

*We just have to see it as something that is very useful for us, for our students, and for the university students. It doesn't really require a lot of work.* ***It just requires you to be willing to teach in front of somebody else, which is what a lot of people aren't willing to do*** (#4; teacher; science Yrs 8 & 10; S2)

(commenting on the characteristics of a successful mentor-teacher relationship) *... a teacher that is enthusiastic, that plans the lesson,* ***that is not afraid of having someone in the classroom helping them out, who doesn't feel that 'oh, this person is going to be judging me or something.'*** *If the teacher's confident, and they want an extra hand, because it is an extra hand, because it's really helpful* (#10; teacher; science Yrs 7 & 9; S5)

*...* ***teachers can be a bit territorial, and not want to open up their classrooms****. Not because they're ashamed of what's going on, but I just think it's the way the culture that has been set ...* ***now a lot is changing, and it's just been wonderful,*** *and so we've been lucky enough to be part of the program, and we make the most of this* (#8; teacher & link teacher; general science Yrs 7-10; S5)

*My advice would be to get teachers to try it, try it for themselves. The opportunity is in having someone else involved.* ***I know that there are a lot of teachers that would hate someone else coming in their classroom****. Their classroom is their own room, and that's it. They don't want anything else. I'm the opposite. I welcome people to come in, because I find that the feedback that I get can improve my job as a teacher, which is to help the students learn.* ***So I would say that having a peer mentor improves my teaching abilities****.* (#31; teacher of 26 years; general science Yr 10; S4)

## Some mentors consider teaching as a result of their experience

Recruiting university students to science teaching is not a core aim of the In2science program. However, at least some mentors volunteer in order to gain insight into science teaching. They see this as an opportunity to experience – or revisit – science learning at school, in order to inform their own decisions about further study and careers. This was true of the mentors interviewed in this study, as it was for 'peer tutors' surveyed for the 2005-6 study of the STAR programme (Harris & Shaw, 2006), where two in five tutors cited 'teaching experience' among their motivations for volunteering.

***My original motivation was because I had an interest in education as a possible career path****. I find tutoring a rewarding volunteering activity and I thought it would be an interesting experience to see highschool from a different perspective* (#25; mentor; S5)

Through their experience in science-based peer mentoring programs such as In2science, some mentors choose to add a teaching qualification to their science degree, and to then pursue a career in secondary school teaching (Harris & Farrell, 2006; Harris & Shaw, 2006). This was not a question specifically investigated in the present study of In2science. However, several principals and teachers described this as an additional benefit to schools, helping to address the recognised demand for suitably qualified science and mathematics teachers in Australian schools.

*The other thing that's also happened where I see this additional mentoring process is that* ***we've had students who've been involved in the program, from the university, who have then started to consider teaching as a profession****. So you know, those who decided 'hey, this isn't a bad job to engage in' and 'I*

*never thought about this until I actually had this experience'. **And I think that's important in term of succession planning in relation to teaching**. We need to have people who are prepared to do a science degree or an engineering degree, whatever it is, and then to say 'well, the area that I wanna go into is teaching'. You know, because that's an area of need too. So it's been very positive* (#22; Principal; S2)

*I know two others* (mentors) *who have gone on to pursue education, and some of them have said to me 'look, we've volunteered because we wanna give back but we also wanna see what it's like in a classroom and then to see whether teaching is something we wanna pursue'. And so, you know, **I'm hoping that we do encourage a few of the peer mentors to enter into the teaching profession*** (#8; teacher & link teacher; S5)

## 2.3 The 'cost' to schools

Schools describe their involvement as essentially 'cost free'. The efforts of the partner universities, and particularly the principal In2science program management from La Trobe University, are both highly valued and considered essential. The contribution on the part of schools is the commitment of a teacher to liaise with the universities and, importantly, with staff in the school. The In2science link teachers interviewed in this study were keen advocates of the program, and considered their time 'well spent'.

***The uni does basically all of the organisational work, until the offer to the school*** *– where they say 'we've got this girl, she's available Tuesday afternoon, does anybody want to utilise her?'. So I think for the uni that's obviously going to take some staffing, some logistics, some coordination, lots of phone calls ... you know, 'is she working those days?', 'does she have class?'. **That's all done over there**. They just call me and say 'these are the people, this is what they're studying, and these are the days they're available'. 'Does that work for you?'. So I just sit down with the schedules and say 'ok, well so and so teaches this class, during this period' ... and so I ask that person 'would you like, in this class, to have a mentor?'. And generally speaking we all need these. John would offer 3 or 4, and they all get taken. **So as long as they keep it easy, they do all the organisation, they just send you the person, why would we we not be involved? They're not asking us to do a whole lot, really, except to host this person and utilise their skills.*** (#3; teacher & link teacher; S2)

***I think if you don't have a link teacher, organizing the administration of it – the program – then I can't see it being sustainable***. *And you do want it to spread to most teachers, not just focusing on one or two teachers because the benefits are for everyone – the students and the teachers* (#8; teacher & link teacher; S5)

***What the school gets out of it, compared to what we're asked to do … I think we come out on top in this one!*** (#15; principal; S3)

# Chapter 3:
# The influence on students' experience of science

*If you ask a kid to draw a scientist, he'll draw an old man with grey hair and beard, you know what I mean. So just for them to see they all don't look that way. To show that anyone can do science if they want to. And kids get a real sense of the different types of university students out there. They're not all in this stereotype. There are all sorts of people doing all sorts of thing.*
(#4; teacher; general science, Yrs 8 & 10; S2)

Promoting students' engagement in science learning is a "fundamental goal for science education" (p.4, VCAA, 2008). Students are most likely to achieve in science if they are interested and motivated, and if they have confidence in their abilities to learn science and to tackle new problems. Such assertions have an empirical basis. Recent, large-scale studies of 15 year old school students show correlations between students' attitudes toward science learning and their levels of achievement (Ainley et al., 2008). 'Self-belief' was shown to be an even stronger predictor of success than 'general interest' in the subject.

'Good teaching' is defined in terms of student engagement and learning outcomes. Therefore, examining the influence of In2science on the quality of teaching provides important insight into the influence on students' experience of science. This is explored in detail in Chapter 4.

This study also included a more direct exploration of students' experience of learning science in the case study schools. The views of students are obviously of importance to this question. The broad themes for this chapter, however, were developed from the collective comments of students, teachers, and mentors. Teachers are in a position to observe student behaviours over time, and mentors provide a complementary perspective based on their direct interaction with students as peers.

**Overview**
In2science influences the experience of students in the following ways:

*Students are encouraged and supported to achieve in science.*

Building students' confidence in their abilities in science is important, as many students consider science and mathematics to be 'too hard', and not for them – **Section 3.1**.

Mentors can help avoid students being left behind in class, by answering students' questions, encouraging them to stay 'on task', providing additional explanations, and giving time to students needing extra assistance – **Section 3.2**.

Equally, In2science can enhance the experience of high achieving students in science. The possibilities for creating more stimulating, and challenging, classes were discussed in Section 4.2. Drawing on their university experience and connections, mentors can meet the needs of students who want to take their science learning beyond the core curriculum – **Section 3.3**.

*Students make connections with science beyond school.*

As role models of young scientists, and through discussions with students, peer mentors can help dispel many of the popular stereotypes of science – **Section 3.4**.

The program also provides students with a chance to learn more about university – the nature of the learning environment, and the pathways to further study and careers in science – **Section 3.5**.

## 3.1 Building confidence

The confidence to engage with science can be a critical hurdle for some students. Science is often perceived to be difficult, a perception that is reinforced if students are unable to reason their way through a significant concept or task. As a practical activity, science can also be rather merciless in exposing failure – a particular challenge for less self-confident students. In addition, if students lack the

confidence to ask for help, or to contribute to discussion, they are unlikely to realise their potential in science. For such students, the experience of science at school may not be a good one.

Students, mentors and teachers described situations where the involvement of a mentor had helped to boost the confidence of students in class. In large part, this was a consequence of the students feeling more comfortable approaching the mentor for help.

> ***Some students just need confidence**. Building their confidence with some of those scientific terms. Let's face it, science is our language, and it's a language students need to learn. If they don't, if they're not comfortable with some of the scientific terms, then that impedes their progress for some topics.* (#8; teacher & link teacher; S5)

> *It* (In2science and the mentor) *gives you more confidence… I just think, you know, **the confidence thing. Like you don't just have to rely on your own knowledge**. You could ask him, and you will expand your knowledge and get more confident ... It's more like, informal in a way. You see Mr X* (teacher's name removed)*, as a teacher, he can fail you or pass you. **The mentor is just there to teach you. I mean he won't mind if you do good or bad*** (#24; students; science, Yr 9; S5)

> *I've got a couple of very shy students. The first time I've actually heard them speak, I thought 'he's got a voice!'. **Some kids are very shy, and it's good to see them come out of their shells and … connecting, and feeling confident enough to actually contribute**. Because these kids are shy, but they are very, very clever. A couple of the girls I'm thinking of ... because they'll never blossom until they can break out of that barrier* (#12; teacher; advanced science, Yr10; S5)

> *I was touched at the end of one semester when the students all signed a card for me. They said things like "thanks for being nice", "thanks for helping me learn about xyz". **I think that perhaps being that extra person in the classroom means the quieter kids, or those less involved in their science class, means that they don't get so shy about asking the mentor if they don't understand.** I think the card shows they thought I wasn't an ogre, and perhaps having had at least one semester of science class in high school, where questions are ok and help is more available, means you won't quit science just yet. It probably stops them being turned off science, for at least one more semester. Some of them were also impressed and excited by the job I got – thanks to a science degree – and perhaps that will help them stick with science.* (#16; mentor; S3)

> *A lot of students don't want to put up their hands to ask a question because they don't want to be seen as stupid. But if there's a person sort of nearby that they can just come and say 'look can you explain that to me again', or something like that. And that will help them. As I said, in one of the classes that* (the mentor) *was helping with this year, there are a number of kids that are sort of on the low side of achieving, and **they're very reticent about asking questions, and he was able to explain things to them and their test marks actually showed that they had some improvement in their knowledge. I'll credit that to*** **(the mentor's)** ***influence**.* (#31; teacher; general science, Yrs 8-9; S4)

## 3.2 Reducing the risk of being left behind

In several ways, mentors were able to help students 'keep up' with the progress of the class.

Mentors provided alternative explanations, and students found this valuable.

> ***What I like is she had different ways of explaining it than the teacher**, because she was younger, she knows how to explain it better to us I guess* (#14; students; VCE biology; S3)

> *In science this year our mentor walked around a lot, and **explained things thoroughly but made it easy to understand** … Well, I think, it made it more interesting because he explained it more thoroughly, and was in depth in his explanation* (#24; students; science, Yr 9; S5)

> ***I was able to explain things differently than the teacher and get through to some kids who otherwise would have been left behind** (large classes with little time).* (#26; mentor; S6)

> (student A) *It made me more interested …* (student B***) just made it easier and less confusing*** (#17; students; general science, Yr9; S2)

Mentors, as an extra, knowledgeable person available to the students, were able to provide additional help and to reduce the 'down time' of students awaiting assistance.

*I reckon it was better with her instead of just* (the teacher). *It was better when the mentor was there, instead of just always* (the teacher) *so then* ***more people could be helped*** *… the teacher said that if we needed any help, or had questions, we can ask her and she'll answer us as well* (#13; students; general science, Yr 8; S3)

*Sometimes it meant they wouldn't just sit there spacing out in science class. I would check they were doing their work, and found if they weren't* ***it was often because they were stuck, so I would help them figure it out. … This at least meant they did the required task, and didn't fall behind in that lesson****. Though this is a very small thing, I think being engaged in the one lesson meant that for that lesson they didn't feel disengaged from science in general* (#15; mentor; S3)

***Well, with the mentor it's kind of easier to get a work done****. Mr X* (teacher's name removed) *is only helping with other kids and we just asked him* (the mentor) *for help, and he will normally give you the right help. So it's always good.* (#24; students; science, Yr 9; S5)

*So the peer mentor can support students by being there, and* ***so the student's not waiting a long time to get support****. And also for the students that are challenged by the curriculum, and they need that extra support. The peer mentor and the teacher can work together to offer that support* (#8; teacher & link teacher; S5)

Mentors were also able to keep students on task in practical classes:

*We did a prac, dissecting a sheep's heart. And it was really helpful to have* (the mentor) *there, so there was* ***another person supervising to help the students that were a bit reluctant, you know, unsure where to cut the heart, and to help them see what they were looking for****. The whole goal of the prac was that we each have a look, and see what we've seen. So that's really helpful having her there to assist the students.* (#6; teacher; science Yr 8; S3)

## 3.3 Extension for advanced students

The mentors were seen as highly credible sources of scientific knowledge, and so an ideal source of 'extra information'.

***Often the teacher would double check with her*** (the mentor) *to make sure … just to get those new findings and things, to double check* ***to make sure that what she was teaching us was valid.*** (#14; students; VCE biology; S3)

*Indeed, at the other end … if there are students that are not struggling, but are instead disengaged because the work is too easy, then the peer mentor can extend them* ***… provide that extra engagement for the students that are coping with the work and who feel, perhaps not bored but who want to be extended****. So because of their extra knowledge, they can extend them.* (#8; teacher & link teacher; S5)

*Like,* ***she could give more practical kinds of examples because she's worked in labs*** *and stuff … Yeah, like with textbook kind of theory stuff, she could actually say 'well, once we did this experiment'.* (#21; students; VCE biology; S1)

***I also get to contribute something that is a bit beyond their year level, which I hope gives them a bit of a taste for the kinds of ideas they can expect to encounter, especially if they are relatively advanced students****. I once facilitated an excursion to see the University Zoology museum, and another time I showed some time-lapse video of microbiological organisms.* (#25; mentor; S5)

## 3.4 Role models breaking the mould

Teachers stressed the value of students seeing scientists in a 'form' they could relate to. In the view of some teachers, having female mentors in science was important, particularly if the mentors were studying in traditionally male-dominated fields.

(in response to a question about whether the program has any influence on students' further science study).
*Yes. The two peer mentors that I've had were very positive role models. Male, female, I don't think it makes terribly much difference, but if they* (the students) *can see someone that's in science, that's enjoying what they're doing, they're possibly not a geek, so to speak.* ***They can look at them and say 'that person looks normal', 'they're doing science' and 'they obviously enjoy their science'****. And that comes through in how they* (the mentors) *explain things.* (#31; teacher; general science, Yr 10; S4)

*A lot of the students have no idea what they want to do when they finish high school. And I think maybe* ***it's interesting for them to see somebody who hasn't yet gotten the job but is, if you will, on the way … on a career path****. It's also interesting to see those people and to talk to them. I had one girl who was a mentor and there were several girls in my class who really developed a strong bond with her and* ***I could see that the mentor was a bit of a role model for them in terms of what they want to do when they reach her age.*** (#3; teacher & link teacher; S2)

*There was one female mentor, and I thought it would've been good because I had a lot of girls* (students) *last year. I thought it would be a good role model for the girls****. I think she*** **(the mentor)** ***was actually in engineering or something. A sort of non-traditional girl's role, and I thought it might be a good example for the girls****. Because a lot of our girls see the sciences as something inherently difficult. Even if they've got talent themselves, they say 'oh, maybe I shouldn't do physics', and I thought it might have been a good way of sort of encouraging or giving them a bit of a good role model to take it up.* (#12; teacher; advanced science, Yr 10; S5)

*She was really good, especially with the girls. It's really good having a female science student in there with me****. If you've got a female university student talking with young females … who gives them a bit of idea that this is a career option for them, instead of hairdressing*** (#7; male teacher; junior science, Yrs 7-8; S3)

For students from communities or schools that were under-represented at university, meeting a successful university student who was 'like them' was seen to be an important factor in broadening and raising students' aspirations.

***I think he's providing us a sort of good role model, too, because of his background. I've got a few Lebanese kids in this group, and he's helping out with them.*** *He's providing a bit of a positive role model and he sorts of interacts pretty well. These kids were really surprised that he (the mentor) got into Melbourne Uni, and that he's doing so well … It's good to have some success story so that they can see 'oh, gee, maybe that is achievable'. And especially if within their own family groups, maybe, if they've got no positive influences there … and maybe that could* ***show them some sort of pathway, to attempt something that maybe hasn't been attempted within their family group before****.* (#12; teacher; advanced science, Yr 10; S5)

Mentors also illustrate the diverse character of a future in science – that not all scientists are school teachers or professors.

*It was good to have someone that was not a teacher, in a completely different field, a science field, giving us their knowledge, and in their specific area … she would tell us what she was doing now, and what she remembers doing, instead of a teacher who has to recall a lot of information.* ***So it's interesting to know that what you're learning about is used in an actual profession****, and stuff. … to hear what she had experienced, and sort of learn from there.* (#21; students: VCE biology; S1)

*I think I was occasionally able to get them to think about science on a different level.* ***Get them to see that science is used in a lot of different professions, not just as "scientist"****.* (#26; mentor; S6)

*Also, I gave them some ideas about the ways in which science, with a focus on geology, was not only interesting, but could also lead to employment. Finally, I think that bringing focus to National Science Week and Earth Science Week* ***helped them engage with science, by noticing that it took place outside of the classroom, all over Australia, and for more than a few hours per week****.* (#16; mentor; S3)

*It gives them another dimension to what they're doing there, in science. You're not doing science just to get a grade in science, so that you can move on to Year 10 science, Year 11 science, whatever. You know,* ***actually this is a direction where people actually head in, where they do it by choice, not because they have to****. So she* (the mentor) *was very young and very comfortable with them and 'cool'. She was a great role model, I think.* (#4; teacher; general science, Yrs 8 & 10; S2)

Mentors do more than represent and explain their own interests in science. They also seek to help students make connections between students' individual interests, and the related science.

*My contributions include helping students to understand concepts and being able to spend a bit more time interacting with the students and talking about what they like or what careers they are interested in.* ***It is good to be able to relate what they are doing in the classroom to their interests*** *… I think being able to go a bit outside the curriculum, and to tie what they are learning about to other things - their interests, potential career paths, things they see in every day life – it's helpful for keeping them interested. I*

*sometimes also tell stories about lectures and experiences that I've had learning science, that I hope helps them to remember and be interested in the ideas and skills that they are learning ….I think that scientific skills and knowledge are very important and I hope that I've helped to promote an interest in further scientific study. For example**, I was talking to a student interested in sports about all the different scientific concepts and techniques used in sports science - different muscle types, scientifically informed training programs, physiotherapy, etc**. I hope this is the kind of thing that will at least leave the student valuing the ability to think scientifically and understand scientific concepts, if not to go on and study something scientific.* (#25; mentor; S5)

*I tried to engage the children to think of science on a different level. Giving them examples of where different scientific processes are used, how widely used, etc. I often tried to engage them to think about how science is involved in the career that the student has in mind.* ***I had a conversation with a female student about nutrition – as she wanted to be a nutritionist – and how that involves minerals, vitamins, how the body uses energy, and the scientific processes that are used to determine the composition of food****.* (#26; mentor; S6)

## 3.5 Insights into further science study and careers

The In2science program provides students – and their science teachers – with insights into science study beyond school. School students may be exposed to life at university as a science student, to pathways into science study, and to career possibilities beyond university.

Some mentors hosted school visits to their university, while other trips were arranged by the In2science manager.

***We went to Melbourne Uni. We went through the mentors' area. It was organised by the students*** **(mentors),** ***through the head of that particular department, and that worked really well****. That was terrific because none of the kids had been into Melbourne Uni before. Well, I think taking them to the Uni, at year 10 in particular, was my idea of getting them to start thinking about what they would do. But also, I always get the mentors to tell the students who they are, how they became interested in science, what they're doing at Uni – giving them their personal perspective about how they got involved in doing science at university level, which was always really good.* (#7; teacher; junior science, Yrs 7-8; S3)

***Because a lot of the kids would never have set foot on campus, they wouldn't know anything about it and they just think 'ooh, I don't want to do more school', but I've seen a totally different response when I took my class of Year 10 down there.*** *We did an activity in the morning in the biology department, an activity in the afternoon in the chemistry department, and in the interim they were at the student union. They loved it. Actually John introduced me to somebody … so we did a genetics activity in the morning, then we all went to the student union, and I told them 'you have one hour and be back here'. They all went everywhere. You know and they loved it because suddenly they saw 'ooh there's all these cool people here, freedom, independence'. It's not like high school, there's no teacher shouting at you the whole time. They get to be a little bit free and roam around.* ***So I think that changed their minds. I think for a lot of kids they kind of went 'ah, well you know, maybe I won't write it off just yet'*** (#3; teacher & link teacher; general science, Yrs 7-10; S2)

***This year actually we went to La Trobe once on an excursion, and my mentor finished her classes and then she came in and we went to La Trobe Wildlife Sanctuary.*** *And so she met us there and spent the afternoon with us. I think it's good for the kids to see somebody who's not a teacher. I think that here, in this school, there are a lot of kids who don't come from backgrounds where they go to university … I know that in my own way I would like some of them to go to university. Because university <u>is</u> study, but university is also a lot of other things that for these kids, they may be missing out on.* (#3; teacher & link teacher; general science, Yrs 7-10; S2)

***Others have planned excursions to university, to the microbiology labs, or to the physics lab. ... So we've taken our students, and they've shown them their world.*** *You know, and the kids ... they performed experiments in a university lab, and so the students have been linked in and connected with the peer mentor in that way. So ... there are many, many different ways in which peer mentors can add value or interest in the classroom, and so the students can see that science has many possibilities.* (#8; teacher & link teacher; S5)

Students, particularly senior school students, valued these kinds of opportunities.

> ***I think it would be good to go, once every fortnight, to their university, to take a look at what they're doing, not necessarily participating but just maybe to have a look****. Maybe they could then give us some more information about what they're doing.* (#21; students; VCE biology; S1)

Mentors also brought 'uni to school', by introducing examples of their own university work into the class.

> *There was one particular incident where we were looking at cells and cell division in biology, and the student* **(mentor)** ***had actually done some experiments*** *recently where they were looking for immune cells that were actually dividing, and* ***she had some photographs*** *… we actually haven't shown the students yet, but she said we could actually use that to show the students because she does a project at University.* ***…. I could probably access similar images from the internet, or from some other source, but it doesn't have as much power as the mentor themselves saying that they have done that experiment****.* (#1; teacher; VCE biology; S1)

> ***I think it could be really beneficial for us, as Year 12 students to just have access to actual visual and touchable things that are from university****, because then we can make a sort of connections to those sort of things with the actual objects.* (#21; students from the same class as above; VCE biology; S1)

> (in describing the contribution of the mentor to a practical dissection class)
> *It created interesting discussions, and also around the ethical issues that came up with the students.* ***When we did that rat dissection, she also brought in her own dissection drawing, which were so beautiful.*** *She was also a pretty good artist.* (#5; teacher; VCE biology; S3)

> *With the pictures of animals she showed us once the different things she'd dissected in university classes, and that was interesting …* ***showing us the stuff that she did in class, to give you an insight of what they do in university****.* (#14; students from same class; VCE biology; S3)

In their interactions with small groups of students in class, mentors share their university experiences with interested students.

> ***Also, because she was doing a similar course, if we wanted to do that in uni, she'd be able to give us an insight of what that was like****. Whereas our biology teacher would have done one quite a while ago, and would have done different things … you have her coming in, and explaining 'this is what I do at university', and 'I think it's really interesting, what do you think guys?'.* (#14; students; VCE biology; S3)

> ***With some of the older kids, they ask the mentors what they do, and 'why did you do that?' 'is it good?' 'is it boring?' 'is it fun?'****. We're very lucky here, as we have a high number of kids that do science. We have 6 physics classes at VCE, and a lot of schools struggle to get 1. So, in terms of our science uptake, we've got a lot of kids doing science.* (#11; teacher & link teacher; S5)

> ***I also thought I would be able to spark some enthusiasm in maybe one or two kids.*** *When I was at high school I had no I idea what sorts of things science might include, I wanted to be able to help others.* (#19; mentor; S2)

> *Also, what's available as employment in science****. They*** **(the mentors)** ***often talk about their pathways*** *– where they came from, and where they are heading, science-wise.* ***That also demystifies science as a career for lots of the students here.*** (#27; teacher & link teacher; S3)

> *Yeah, like, she knew what she was talking about. So if you needed help, she definitely knew what was going on, that sort of helped too … well,* ***I did actually ask her about the course she was doing. She was doing biology****.* (#18; students; science, Yr9; S2)

In addition to the informal discussions about their university studies, many mentors were encouraged by teachers to give presentations to their class.

> *I made presentations during National Science Week, and Earth Science week. During these presentations I taught a little about geology, and handed round some rock samples.* ***Geology is my background, which is one of the reasons I chose to talk to the students about it, but also because geology is not taught in many schools, or it is very limited****, such as just being a unit on earthquakes and volcanoes. I hoped I helped them understand what geology was, and how broad it was too. I also sourced resources such as posters from Geoscience Australia, making sure that there was something left in the classroom that could help even after I'd left.* (#16; mentor; S3)

Teachers, too, learn more about the career and study options in science.

***Teachers learn about new/possible career pathways in science through their interaction with peer mentors**. Both the teacher and peer mentor can share these with students.* (#29; Principal; S5)

**In2science provides a contribution, not a guarantee**

Teachers and mentors recognise that students are unlikely to identify a single factor as setting or overturning their study and career aspirations. However, as part of the broader context of students' experience of science at schools, In2science may be making a valuable contribution.

*I know with my Year 10 group, I've just finished with my peer mentor now, and the connection that he had with the students … some of them were not thinking of continuing on with biology, and his* (the mentor's) *major was in genetics and evolution, and that's what we were covering in class. And **a few of the students have said to me 'I didn't really think that I would be interested in pursing something in biology, but now I think I might'.*** (#8; teacher & link teacher; S5)

*I mean I know some kids who are very good at science, whether you have the peer mentor there or not, they're still good in science and they still want do science. **But to encourage one kid who hates science to do science, that's very hard. That's the hardest thing. And to do it within one semester, you can't do it in one semester**.* (#10; teacher; science, Yrs 7&9; S5)

***I don't know whether anything I said made massive career changes in their minds, but hopefully they had a greater appreciation for how wonderful science is**. I went to one school where education wasn't the children's priority, so just to have some interaction in the subject was good.* (#26; mentor; S6)

*I had a very weird experience … I was at a pub near my house, and there was a boy I had in VCE biology, maybe 3 years earlier. **And to be honest he wasn't a very good student. I said 'what are you doing', and he said 'I'm studying wildlife management' at uni.** I went 'What!'. He said 'yeah it turns out I really liked that', and, like, well, bloody hell … that was pretty good you know.* (#3; teacher & link teacher; S2)

# Chapter 4:
# The influence on teachers and their teaching

*The staff loved it. That's the feedback that I get. They're really always in a bit of a competition to have them in their class.*
(#15; Principal; S3)

The principals from participating schools valued the program in terms of its influence upon their students, and upon the 'strength' of their science teaching staff and programs. It is, however, the teachers themselves who are best placed to comment on how the program influences them and their teaching practice.

This chapter concentrates on the contribution of In2science to the teaching of science in schools. Such an emphasis on the quality of teaching is considered important for two reasons. First, effective teaching will, by widely accepted definition, engage students in their learning. A corollary is that if students are engaged, their experience of learning will be a more positive one, and they will therefore be more likely to consider further study. Second, improved teaching – again by definition – will lead to improved learning outcomes.

This chapter describes the various ways in which In2science influences science teaching in the case-study schools. The themes were derived from the interviews with teachers. Most of the teachers had been involved in the program for several years, and had hosted several mentors in that time. Typically they described their experiences in general science classes at year levels 8-10. Just two of the teachers interviewed had worked with mentors in VCE classes, and another three teachers described experiences of mentor placements in advanced or specialist Year 10 science classes.

**Overview**

One of the most prominent themes to emerge from this study was the role of the In2science program in promoting practical activities and interaction in science classes. Successfully hosting a mentor, in many ways, requires that the class incorporate opportunities for students and mentors to interact. The 'chalk and talk' lessons, as some teachers described their more 'theory-based' classes, provide fewer opportunities for mentors to make a contribution of the kind most valued by teachers.

It is possible, at least in part, to separate teachers' views on the value of the program from an analysis of the influence of the program on their practice. For example, when teachers were asked to describe what they wanted and valued from the program, they described the access to assistance and knowledge, and the contribution of the mentors as role-models, inspiring students through their combination of knowledge, youth, enthusiasm, and 'beyond-school' experience. These themes are described in **Section 4.1**.

Teachers were also asked to describe how they worked with mentors in class, and to give specific examples of events which, in their opinion, worked very well. From this data, three broad themes emerged regarding the influence of the In2science program on teaching practice: 1) lessons were designed to be more interactive; 2) teachers were encouraged to innovate and experiment; and 3) students were exposed to different ideas, insights and experiences. These themes are described in **Section 4.2**.

Several of the themes in these two sections are correlated. For example, the 'assistance' that teachers valued (Section 4.1) played a role in supporting more interactive classes (Section 4.2). Similarly, the 'knowledge' that teachers sought from mentors (Section 4.1) was utilised in teaching 'innovations' (Section 4.2). Despite this, the distinction between the sections in this chapter was deemed useful in that Section 4.1 highlights the attributes (of the program and of the mentors) that teachers most value, while Section 4.2 focusses on the influence on teaching practice.

## 4.1 The contribution of the program, from teachers' perspectives

### General assistance in promoting student learning

Teachers were unanimous in their view that In2science mentors provided them with valuable assistance in class. They described the value of these 'extra hands and eyes' in two ways. First, mentors were able to 'share the load' in working with students, individually or in groups. The value of this additional help is described in more detail in Chapter 3, drawing upon interviews with students and mentors, in addition to teachers' perspectives.

Second, teachers stated that having the mentor there to assist in the supervision of practical activities meant that they could run activities that would have been very difficult, if not impossible, without the extra assistance.

> *...certainly,* ***with a prac class, it certainly helps to have another person wandering around, answering questions, helping to set up equipment****. A lot of the time the equipment they're* (the students are) *using is new and so they're not exactly sure how to set things up. So it helps in that respect, that there's another pair of hands* (#31; teacher; general science, Yr 10; S4)

The program was also attributed with creating an impetus for more interactive lessons. This is a theme described in Section 4.2 as an influence on science teaching, and throughout Chapter 3 in describing the influence on student learning.

### Access to knowledge and fresh ideas

Access to **current knowledge** of science was a prime motivation for schools' involvement in In2science, according to the school principals (see Section 2.1). Teachers too described the importance of the program in terms of helping them stay 'up to date' with developments in science.

> *There's a teacher at the school who went to uni, I think she went to into Melbourne or LaTrobe on a biology excursion with her kids, and it was the first time she'd used ... um ... is it like an electronic pipette. She'd never used one, she'd never knew that they existed.* ***Now, how do you teach your kids when you don't even know what's out there?*** *So to have university students say 'oh we use this all the time' or 'actually now, did you know that you can...' That's what's really helpful* (#4; teacher of science, Yrs 8 & 10; S2)

There were also other ways in which teachers valued the access to knowledge and ideas afforded by the program.

One in three of the teachers interviewed described the **complementary knowledge** base of mentors, when asked to describe the benefits of the program to them as teachers. The mentors' disciplinary backgrounds were often quite different to those of their host teachers. This was seen to be a benefit, as the mentors were able to provide a source of science expertise which complemented that of the teacher. This was particularly relevant in the 'general science' classes of years 7 to 10. Teachers might be teaching an aspect of science, such as chemistry, when their own disciplinary expertise was actually biology, for example.

> *... in terms of knowledge, because she was a chemistry student, or biology student. Her knowledge is ...* ***because I didn't do a science degree … so her knowledge on some stuff was really very good, and that was helpful to have in the classroom, and in conversations afterwards***. (#4; teacher; science Yrs 8 & 10; S2).
>
> ***If I don't know the answer to some stuff – particularly because I'm biology background, and we were doing physics and chem last year*** *– she was, you know, a lot better at that time* (#9; teacher; advance science Year 10; S5)
>
> *...often t****he mentors bring knowledge of science, from the university, and fill gaps in what the teachers don't know*** *sometimes* (#27; teacher; S3)
>
> *...* ***his expertise, I have to say, is in evolution and genetics. I'm a physics-chemistry major, so I've learned a lot from him***. (#8; teacher & link teacher; S5)

Principals, too, recognised this as a benefit of the program.

> ***Teachers with limited background in an area of expertise can have the support of a peer mentor sharing his/her knowledge with both the students and the teacher***. (#29; Principal; S5)

Equally, teaching integrated and problem-based science was a recognised challenge for teachers whose own science background was more narrowly focussed. Having mentors with a complementary or, as was sometimes the case, a 'broader' disciplinary base was valued by teachers of general science.

Several teachers described the value of the 'fresh ideas' that mentors could inject into the classes and activities. Sometimes these ideas would stem from the mentors' university studies, sometimes from their experience in other classes, and sometimes simply based on their own creativity.

> *I said 'look we're doing this particular topic. Can you think of something that you might be able to do'. And* ***she came up with that particular prac, and I was quite happy with that. She sort of ran that past me, and I said 'yeah, not a problem, go for it'***. (#31; teacher; general science, Yr 10; S4)

> *Last year – it was really interesting – again it was this topic 'evolution'. It wasn't planned, but I had my laptop and was linked on to the internet, and the peer mentor and I were looking at 'adaptations'.* ***He said 'I've just been to this lecture, and our lecturer showed us this slide on Youtube of this movie. Do you want me to show it to you?'*** *He looks at the black pepper moths, and I said 'oh, great'. So he just quickly showed that to the students and spoke to them about it. I haven't found I had a peer mentor where it hasn't worked.* (#8; teacher & link teacher; S5)

## Showcasing science beyond the classroom

Teachers valued the opportunity for students to see that science is not just about school and science classes. The program was seen to demonstrate the 'real' nature of science, and that it involves 'real people', not 'just teachers and professors', and that those people work in a wide range of environments.

> ***I wanted the kids to interact with someone who is involved in a science outside the school****. So their only interaction with science people are science teachers and teachers are a bit, they sort of see us as teacher as being a bit we're kind bit over there you know what I mean, we're not part of the world or somethin' d'you know what I mean. So they have someone from outside come in who's just doing a science degree or whatever interest,* ***interact with them on a purely science level as opposed to a teacher level*** *you know. That is why I thought it would be an interesting thing for kids and to then talk to them about you know what it's like doing science at uni and you know where they might be headed you know in the future and that sort of thing.* (#4; teacher; science Yrs 8 & 10; S2)

This is a theme echoed by mentors and students in Chapter 3.

## Young people sharing their enthusiasm with students, as fellow learners

One of the 'attributes' of mentors most highly valued by teachers was the ability of mentors to 'connect' with school students. Teachers described the importance of the rapport that was possible between mentors and students, attributing this to a combination of closeness in age and the fact that the mentors, too, were still learning.

> ***I think having students work with students is what empowers kids, and motivates them towards science****. ...the distance between students and teachers is often enormous, whereas the difference between students and university students and the mentors is usually small. It helps bridge the gap.* ***Students can actually see that it's not a million miles away from where they could be, and these people aren't really miles away from where they're at.*** *And it's really good for the students,* ***and I really like working with people that are passionate about science and also passionate about enthusing students****. I was really happy to have an extra body in the room that is passionate about science, and could also answer kids' questions with up-to-date things. I've seen them engaging during the practicals. I've seen students interact and engage, whereas sometimes they feel that, when it's the teacher, they're really shy and they won't speak.* (#11; teacher & link teacher; general science Years 8 & 9; S5)

> ***Peer mentors are closer in age to the students, so the students can more closely identify with them****. They seem to connect at a different level with the peer mentor, and listen carefully, almost as a peer, to the science explanation and also the advice provided by the peer mentor.* (#29; Principal; S5)

> ***Even though I may treat the peer mentor as a student teacher, their role as far as I'm concerned is different and I explained to the students that it's <u>not</u> as a student teacher*** *– they're not training to become a teacher, they're actually someone trying to help you … as in, to understand maybe what I'm saying, or the science work, or whatever. 'Treat them as another classmate' or something like that. Any problems, you know, speak to them about it. The two* (mentors) *that I've had so far have been tremendously approachable and friendly – fantastic skills.* (#31; teacher; general science, Yr 10; S4)

Teachers also cited the ability for mentors to identify with students' learning, as the mentors themselves had not long ago worked through similar challenges.

> *They're very, very helpful.* ***They're very often aware of the subject matter, and so just what kinds of things kids are having difficulties with****. … It's just good having kids, a science student, in the room who can – you know, even if they're chemists and we're doing a physics practical, they're still aware of how to set things up, and what problems kids might have.* ***Because they're not like us,*** **(it's not)** ***some 20 years since they've done it, you know****.* (#11; teacher; general science Years 8 & 9; S5)

Teachers stressed the importance of mentors' enthusiasm and 'passion' for science and science learning. While all teachers reported positive experiences, they also highlighted the implications this has for the recruitment and selection of peer mentors. They cautioned that a single experience with a disengaged peer mentor might be enough to discourage teachers from participating in the program – such was the importance they placed upon this characteristic and contribution of the mentors.

> *I think that's the key.* ***The peer mentors, if they are enthusiastic, and they want to do it, then they put in a lot of effort and they get a lot out of it. You see the interaction with the kids in the classroom****. It's just fantastic.* (#10; teacher; general science Yrs 7 & 9; S5)

Likewise, students and mentors describe the importance of enthusiasm and rapport, a theme that is included in Chapter 3.

> *It's in the topics and the way main message is conveyed. I think that makes you enjoy the subject as well* ***… if someone is enthusiastic about the subject,*** *then they can really* ***… it really makes you feel like it's really an interesting subject.*** (#21; students; VCE biology; S1)

## 4.2 The influence on science teaching

### More interactive classes

Teachers recognise the value of interactive and practical activities in promoting students' engagement with science. For example, when asked to describe the conditions which promote engagement among students in Years 9 and 10, one teacher commented:

> ***… practical activity, some sort of prac or investigative activity where the kids are applying knowledge that they have learned earlier****, but they also have another adult, just to talk them through it, and give them the confidence to do things. …. such as what we've done with the projects* (a particular curriculum initiative)*. So that there's lots of hand-on practical activities, so* ***it's investigative work, so it's applied science as much in anything, so it's not theory based.*** *Because they get enough theory in Years 11 and 12, anyway****. So that they may become curious about what's behind the applied science, I think that's the most important thing.*** (#27; teacher & link teacher; S3)

In terms of promoting more interactive science teaching , the influence of In2science extends beyond the **enabling** of interactive class design, described in Section 4.1. The program was also described by teachers as being a **driver** of change.

While teachers were motivated to participate in In2science primarily in order to improve the experience of their school students, it was also important to them that there was value in the experience for the mentors. For this reason, teachers felt an obligation to plan classes which would enable the mentors to be involved with the students. Some teachers described this in terms of simply arranging their teaching schedule such that practical activities coincide with mentors' visits. However, for many teachers, the program provided an incentive to create more interactive classes than they otherwise would.

> ***Whenever I know that I have a mentor in that class, I try and create a lesson or a lesson plan and practices which involve certain group work, or where there's more one-to-one interaction between the teacher and the student****....The teacher certainly can use their help and support, and just having one more person there to share their knowledge, to just make it less teacher centred, you know. The focus is not on the teacher. It actually helps to make it a more discussion type scenario, than giving a lecture or giving a talk.* (#1; teacher & link teacher; VCE biology and maths; S1)

> ***I try to always incorporate something that's going to utilise their presence****, so I try always to do laboratory activities or some type of work where the mentor can get involved, assisting the students.* (#3; teacher; general science Yrs7-10; S2)

> ***It makes me conscious of using them as a resource, so that I'm more likely to do pracs****. I mean, I always do a lot of pracs, but it makes it easier to run pracs, and* ***so I make a concerted effort to find a prac that's suitable for the topic that we're covering at the time****. Because it's one thing for the students to be sitting in the class, if I'm just doing theory, but it will be really boring for the mentor to come all the way out and to be sitting there while I'm, you know, doing questions from the book. The bad things that I have organized, that haven't worked, or when I haven't used the mentor effectively, was when I'm conducting a theory class where it's mostly me talking and students answering questions. It's a waste of their time, so they're probably bored, and the students would be probably looking at the mentor and thinking 'we're bored, you must be bored'. But sometimes in teaching you just have to do that. So those are classes that I've just wasted a resource, wasted his time. But things have been different in the pracs. Those sort of activities, where the students are discussing open-ended questions and things like that. So I suppose it makes me use those teaching methods more regularly.* (#9; teacher; advanced science, Yr 10; S5)

> *Because they* (the mentors) *are only available once a week,* ***I try and make sure that that lesson is perhaps one of the 'fun lessons', like a prac class or something like that. And that way they have the opportunity to, you know, show their skills****.* (#31; teacher; general science; S4)

> ***I've been trying to make those lessons a bit more interactive for the kids. More sort of open to discussions and things like that, and experiments.*** *So we've been doing small activities, which lead to analysis type of questions, and things like that. I think you have to be lucky with who you get, but he* (the mentor) *is providing an interesting insight to a lot of things, and it's just someone to see things from a different angle. ...Well, for a start it gets me thinking about it a bit more. I think about it in more detail, because I want to take more advantage of the situation. ...So it actually makes you plan a little bit more thoroughly, and try to get the maximum benefit out for the kids. ...* ***I think that having someone like that really promotes the teacher to try to do things a little differently, gives them a little bit of extra stimulus to do that.*** *It seems to be working well.* (#12; teacher; advanced science, Yr 10; S5)

Such classes often involve group activities, and therefore students are interacting not only with the mentor, but with each other, and with the class teacher in small groups.

> *And also teachers need to plan activities that actually engage the mentor. It involves a little bit of planning****. You can't sort of do your standard teaching practices. You actually need to modify them, to be able to use the mentor. In a traditional class you may not do as much group work, you may not do as much one on one.*** *You may not do activities, such as where you're doing a concept map amongst 2 or 3 students. Those are things that teachers have to actively incorporate into their practices, so that they're involving the mentor more.* (#1; teacher & link teacher; VCE biology and maths; S1)

## Encouraging innovation

In addition to encouraging the planning of more interactive classes, teachers also described situations where having a mentor had encouraged them to experiment with novel activities. This was sometimes as a result of ideas sharing with the mentor (see also Section 4.1), and sometimes sparked by materials that the mentor could provide. And sometimes it was simply because the teacher had the assistance and support of the mentor that they were encouraged to experiment with their own new ideas for a class.

> *Well, it ensures that I try and use innovative approaches rather than just talking textbook. Not that that's what I do .... but* ***having an extra person in the classroom you can try more things than you would if it was just yourself*** (#8; teacher & link teacher; S5)

> *It's just great as,* ***sometimes I might change the activity to be a bit harder, to just be a little bit more challenging*** *because you have an extra hand in the class.* (#10; teacher; general science, Yrs 7 & 9; S5)

> ***She*** **(the mentor)** ***wrote an activity called 'what gas is that?'. She came up with the experiments to decide what gas was released from the reaction, and then she actually took the class****. That really stood out … She was fantastic. She was a natural teacher. She really had the strength in front of the class, and they listened and respected her.* (#27; teacher & link teacher; general science, Yrs 9-10; S3)

The contribution of mentors in terms of providing input into class activities is also discussed in Section 3.6, relating to ways in which In2science provides students with insights into further study in science.

# Chapter 5:
# Key features of successful In2science partnerships

This study, and others, have identified the benefits of university-to-school peer mentoring programs, particularly in supporting science education. There are benefits for the peer mentors, as they develop confidence in their knowledge and communication skills (Harris & Shaw, 2006). Teachers value the assistance from knowledgeable young scientists, and are encouraged to be innovative in their teaching. School students are supported to achieve in their science classes, and develop awareness of science beyond the classroom. And schools benefit, as science teaching is energised and the outcomes for their students enhanced.

These benefits, however, can only be fully realised if programs are well structured and coordinated, and – importantly – if they become sustainably embedded within the teaching culture of schools. One of the principal aims of this study, therefore, was to identify the key features of successful, sustained partnerships between In2science and participating schools.

Collectively, the case-study schools had 23 years involvement with the program. Two schools had been involved since the launch of In2science in 2004, and all five schools had at least three years of experience. The study sought to understand the basis for these sustained relationships. In addition, it was reasoned that teachers and principals with such extensive and long-standing involvement would be well placed to comment on the critical elements of a successful program.

This chapter represents a slight departure from the previous 'findings' chapters (Chapters 2 to 4). The approach taken in this chapter is present a summary 'guide to effective practice'. Themes from the interviews with principals and teachers are presented as 'key features' in this chapter.

**Overview**

There are three key groups involved in establishing an effective and embedded program in schools:

*Schools* (Section 5.1)

There are several dimensions critical to the successful introduction of the program in schools. Arguably the most critical of these is that there be at least one science teacher willing to both champion the program among colleagues, and manage the coordination within the school. School leadership becomes very important in sustaining the program, as several of the principals emphasised.

*Universities* (Section 5.2)

The universities – or at least the university-based In2science program managers – play the central role in recruitment, selection, and preparation of mentors, and liaison with schools. Schools view the administrative function of the universities as critical to the effectiveness of the program. They also look to the university partners for support beyond mentor placements. The program provides opportunities for school teachers and students to connect with university science, and schools seek university support to capitalise on these opportunities.

*Peer mentors and their host teachers* (Section 5.3)

Schools emphasised the importance of diverse approaches to mentor-teacher partnerships. There is no single formula, and therefore flexibility, communication and negotiation become important. Mentors do, however, have responsibilities as ambassadors of science and university. It is essential that they be enthusiastic and positive about science learning, that they seek to understand the priorities of the school and the teachers they work with, and that be willing to take the initiative in supporting students in class.

Alongside the text for each of the three sections is a series of related quotes – 'voices of experience' provided by participants in this study.

## Voices of experience (5.1)

**The importance of an identified benefit**

*In our faculty meeting we talked about it. We talked about our commitment. We talked about the opportunity. We always say 'let's try it', 'let's give it a go', 'who wants to do it?' Seek volunteers. Like any sort of change process, we always believe there needs to be a compelling reason to think differently, and for us the compelling reason is we want to engage kids in science. We want them to be aspirational and career focused, and in that way we want them to grab all the opportunities that are available. In that way, we initially got staff involved in volunteering and now they're falling over each other, and they want to be part of the program* (#23; Principal; S5)

**Supporting the link teacher, and introducing the program gradually**

*The whole initiative came from the passion and the interest of the science teachers, of the science staff ... Most certainly, in my conversation with anybody who would want to know about the program, and the benefits – my response to them would be very very positive. Okay, I think what I could ask them to be prepared for is that they have to have a very strong commitment from the staff and the teachers that ultimately you know when there is a requirement that the lead contact person needs to attend some in-service some information sessions and so on that is supported through the school ... It needs to be supported for it to be effective so really planning and get you know most passionate teachers involved and using them to engage in the program and then to sell the program to other teachers who may not be as passionate at the start. We began with one or two teachers. We didn't begin with the whole cohort ... So my suggestion to any school wanting to come in is that, first of all, I would speak very positively about the program but in terms of their preparation I would be saying really get teachers who are passionate about their subject area, who are prepared to make the commitment, and make sure that the school was prepared to support the commitment that is made by these teachers ... with some time, giving them the opportunity ... to attend whatever they need to attend and to actually coordinate the program in the school. And to think about, and to plan, on how they want to use the university student in the school.* (#22; Principal; S2)

**Even gradual introduction can make a difference**

*In schools that are not really into a science focus, you need people to start igniting passion in other people to make it happen. And you don't get that unless you create an impetus. So the In2science program has the potential to create impetus to make most people say "yes". And even if you just recruit one science teacher ... they start doing really interesting work in class ... and 3 kids get excited about science. You've got to talk about what a measurable outcome that is straight away – 3 kids who know science isn't boring. And science is more than us doing an experiment, cutting up a rat, making some compounds. There's way much more context for it. And 3 can become 6, and 6 can become 12. You know, it can grow exponentially from that.* (#20; Principal; S1)

**The program became self-sustaining**

*Oh, I personally can't speak highly enough of it. I think it's really really great. As far as I'm concerned I'd love to continue having peer mentors. I work in a school where there was just two, initially. We like to have quite a lot here, because we are a large school. The staff love working with the peer mentors. I've never heard a bad word. It was really all positive. I don't think we need to promote it in this school, because it promotes itself. It's very popular. Teachers love having peer mentors, and nobody ever says no.* (#11; teacher & link teacher; S5)

**Leadership support alone is not enough**

*My staff is very keen, so we remain involved in In2science. One of my teaching areas is science, so I'm not a hard sell. I'm a maths teacher by trade, with some science, so I saw the value. And, more importantly, I saw the value when I provided the information to my staff. They saw the value. They wanted to follow through with the initiative. It's no good if the only person in the school who wants to be involved just the principal.* (#28; Principal; S4)

**Keeping school leaders informed**

*Sometimes I think things do get a high profile if the leadership is fully aware of what's happening in those programs. At least, just to make sure that they do at least know what's happening, to meet with the teachers and the mentors who are involved, and at least hear about the kinds of things that are happening in the program in a little more detail. Because at the moment, it's only if I have met somebody, perhaps at morning tea, you know.* (#15; Principal; S3)

**Alignment with the school's mission statement**

(the school) *is firmly committed to creating links and partnerships with the community, university and the world of science. There must be a belief in the tremendous value of such links and partnerships.* (#29; Principal; S5)

## 5.1 On the part of schools

**Introduction of In2science is most successful when there is:**

*An enthusiastic teacher in the role of In2science link teacher*

The role of the link teacher is not onerous, but it is critical.

*Voluntary participation*

While advocacy from teachers and principals is helpful, teachers need to be able to opt in, rather than opt out.

*Gradual introduction*

Over the space of a year or two, more teachers nominate as they hear of positive experiences from their colleagues.

*Support from the leadership of the school*

The principal plays an important role in endorsing participation, and in integrating the program into other school initiatives.

*Alignment with the school's mission*

The role of the mentor needs to align with the particular mission of the school, and this needs to be a shared understanding between the Principal, the teachers, and the mentors.

**The program will be sustained within the school when:**

*Mentors become an integral part of science teaching*

It is possible, over time, for peer mentors to become part of the fabric of science teaching within a school, with teachers taking advantage of mentors' potential without adding to the demands on their own time.

*The role of the coordinating teacher is recognised and supported*

To ensure the continuing commitment of the coordination teacher(s), their role need the support and acknowledgement of the school community.

*Teachers have time to engage with the program, outside their classes*

The benefits of teachers spending some time outside class on In2science-related activities has benefits for the teachers and for the school. For example, this may involve: talking with mentors and colleagues about their teaching; meeting In2science management and other university contacts; planning activities, for inside or outside the science classroom.

## Voices of experience (5.2)

**The importance of the relationship with university-based coordinator**
(commenting on what is involved in sustaining the schools' involvement) *Maintaining a collaborative working relationship with the Peer Mentor Coordinator overseeing the delivery and the integrity of the program (John McDonald).* (#29; Principal; S5)

**The role of universities and mentor recruitment in sustaining the program**
*Really, the school can sustain it. The way the program is constructed, I don't see any issue for the school in sustaining it. It really is whether the university can sustain it, whether the university can keep providing the mentors. We acknowledge that as we are on the fringe of Melbourne, there are some transport issues. These sort of practical issues may make it more difficult for the university to keep providing the mentors. But I don't see any other impediment to us in staying in the program.* (#28; Principal; S4)

**Representing disciplinary diversity**
*A variety of students, with a variety of expertise … you know, that we don't just concentrate on people that might come from the engineering faculty … even within the sciences, ensuring that we don't have all mentors that come from a chemistry background. Ensuring that there is a broad range of science students that engage in the program. For the university to think about 'how can we in fact make it more accessible to a range of students?'.* (#22; Principal; S2)

**The selection of mentors**
*If you screen them out, then you know the type of peer mentor that are coming in. You don't to actually send dud ones to the school. Because if you send one bad one to a school, they will say 'this is bad, I don't want another one', and there goes your whole program. You know, but so far I think none of the teachers who've had a peer mentor have had a bad experience.* (#10; teacher; S5)

**Requesting support in curriculum development**
*I don't know whether this would be asking too much, but, for example, we're looking at introducing, into the curriculum, the 'emerging sciences' – all schools will be, once a national curriculum comes in. That is an area where, for our staff, I know that there's some gaps in the knowledge. So … just asking if it's possible … do you have someone who's pretty knowledgeable, who could come out to work, in these classrooms, in those particular areas?* (#15; Principal; S3)

**Requesting specialist expertise to represent specialist subject areas**
*In Year 10 we have nanotechnology, and we've got biochemical or biomedicine, and forensic science. And so if we could get people in those areas, that would be really good because it's specific. Because general science is good, but also where we teach specific things, and if the mentor's in those Year 10 classes … kids are interested in it, they've choosen to do it … and they're like, 'oh, this person is actually doing that course that I'm interested in'.* (#10; teacher; S5)

## 5.2 On the part of partner universities

**In2science management's support for participating schools**

*Support is continuing, responsive and appropriate to the needs of the school*

Personal communication is highly valued, and concerns or issues need to be addressed as they arise.

*Guidance is provided for teachers new to the program*

There is value in providing teachers with examples of the range of ways in which mentors might be involved in their class, and in assuring them that there is no single formula. The message for teachers is that the key is negotiation and communication between the teacher and the mentor, and a wiliingness on both sides to be flexible.

**The role of In2science management in the 'provision' of mentors**

*Mentors are recruited from a range of science disciplines*

Schools value involvement with mentors with diverse disciplinary backgrounds.

*Mentors are students of science, with a developing knowledge base*

The fact that mentors are 'still studying' plays an important role in establishing rapport between students and mentors, and also contributes to the empathy with which mentors engage with students.

*Mentors are enthusiastic about science, and have a positive attitude toward learning*

Universities screen mentors to reduce the risk of schools having a negative experience with the program.

*Participation in the program is voluntary, not a university requirement*

Mentors are in school because they want to be there, whatever their individual motivations.

*Mentors are fully informed about their roles and responsibilities*

The In2science management fully brief the university students, prior to their first visits to schools, on the aims of the program, and on their role as mentors.

*The program encourages mentors to develop a relationship with their host school*

Where possible, there is continuity in mentors' placement in particular schools, in order to encourage a relationship between the mentor and the school community.

**Broadening links with universities and university science**

*Opportunities are created for teachers and students to experience university science, on campus*

Mentors' description of university life is 'made real' by visits to the campus

*Possibilities for universities to provide materials and information relevant*

Materials and information provided by universities is highly valued by teachers.

*Schools are able to access science expertise in universities to inform the development of school curricula*

Schools look to universities to support the development of school curricula.

## The voices of experience (5.3)

**Providing mentors with information in advance pays dividends**

*I met with the mentors and I gave them our term planners, and I also gave them my lesson plans for the unit of work we're doing. And I used to email them. When they get to came in I would tell them what I'd be doing next week, because you have to book equipment and things, and so you know ahead, in science, where you're going to be. And when it's only one double period a week, you tend to know that you're going to be doing big practicals, so you can give them the heads-up, and you can work together. They're very, very helpful. They come in knowing what's going to be happening and, you know, they'll listen.* (#11; teacher & link teacher; general science, Yrs 8-9; S5)

**Negotiating involvement to suit mentors' skills**

*We were starting with mitosis, and I started talking about what happens when things go wrong in that division. And so the students wanted to know a bit more about it. She* (the mentor) *said that this would be something that she would be interested in researching for the class. So, I asked her what she wanted to do in a class and if she wanted to present some classes. But she was very shy and didn't feel that she would like to do that, which was fine. And so, she felt that she would rather work, with the students on one on one basis.* (#5; teacher; VCE biology; S3)

**The importance of flexibility, and of communication between teachers and mentors**

*I don't believe I really helped any students engage more fully that they would have before … I feel that I have not really made any specific contributions in my placements. I seem to have been put into really disruptive classes that would not pay attention to their teachers, so I perhaps took pressure off the teacher in a small way. I have been involved mainly in assisting the teacher. Answering students questions, helping to set up experiments. I have not been as involved as I had originally hoped or expected.* (#19; mentor; S2)

**The need to be alert to the messages conveyed**

*It's like a six year course! It was like four years, and then two years. He was talking about how broke he was and stuff. Eating off noodles, that kind of stuff.* (#24; students; science, Yr9; S5)

**Communication between teachers**

*The success at our school, I think, is because we've been able to model different uses of the peer mentor in classrooms. Teachers can then identify, or get ideas, on how they can use their peer mentors. And you have one person coordinating it, so teachers know that if there are any issues, they can meet and talk to that person.* (#8; teacher & link teacher; S5)

## 5.3 On the part of mentors and teachers

### Understanding the role of the mentor

*Mentors are young scientists, not teaching aids*

Teachers and mentors look for opportunities to capitalise on the science-related skills and knowledge base of the mentor. Mentors provide assistance to teachers and students in a way that draws upon the mentors' experience as science students.

*Mentors are fellow learners, not trainee teachers*

Mentors are peers of the school students, but with more knowledge and wider experience. They are not training to be teachers. While the program provides opportunities for mentors to experience the environment of science teaching in schools, it is not means of gaining 'teaching' experience.

*There is mutual respect between mentors and teachers*

Mentors have science knowledge that is complementary to teachers. It is not 'better', just different. Teachers also have critical pedagogical knowledge, based on their own formal education and on their experience.

### Communication and negotiation

*Familiarity with the school culture*

The teacher introduces the mentor to the culture and philosophy of the school. The mentor understands that the school may be quite different in character to schools they have experienced before.

*Communicating plans*

The teacher provides the mentor with information about the objectives of the class, and they discuss how the mentor might contribute.

*Flexibility*

Mentors are able to adapt to a diversity of teaching environments. Teachers seek to understand the particular strengths of the mentor, and accommodate this within their teaching.

### Fostering interaction

*Teachers support opportunities for interaction between mentors and students*

Teachers include practical and discussion-based activities in class, in order to take advantage of the presence of the peer mentor.

*Mentors build rapport with students*

Mentors capitalise on their closeness in age and the fact that they are not teachers to develop a rapport with the students that facilitates interaction.

*Mentors initiate interactions with students, as appropriate*

Mentors actively seek opportunities to interact with students in ways that support the particular type of learning environment the teacher is seeking to create in the class.

### The mentors' responsibilities as role model

*Mentors share their enthusiasm for science, and demonstrate a positive attitude toward science learning*

# References


Ainley, J., Kos, J. & Nicholas, M. (2008). Participation in science, mathematics and technology in Australian education. *ACER Research Monograph* No. 63. The Australian Council for Educational Research. Camberwell.

Barrington, F. (2006). *Participation in Year 12 Mathematics Across Australia 1995-2004*. International Centre of Excellence in Mathematics and the Australian Mathematics Sciences Institute. Melbourne.

Department of Science, Education and Training (DEST). (2003). *Australia's Teachers: Australia's Future: Advancing Innovation, Science, Technology and Mathematics*. Commonwealth of Australia, Canberra.

Education and Training Committee (ETC). (2006). *Inquiry into the Promotion of Mathematics and Science Education*. Parliament of Victoria. Melbourne.

Farrell, K. & Harris, K-L. (2006). *Independent Evaluation of the In2science Program*. Centre for the Study of Higher Education, University of Melbourne.

Harris, K-L. & Jensz, F. (2006). *The Preparation of Mathematics Teachers in Australia; Meeting the demand for suitably qualified mathematics teachers in secondary schools*. Report for Australian Council of Deans of Science. Centre for the Study of Higher Education, University of Melbourne.

Harris, K-L., Jensz, F. & Baldwin, G. (2005) *Who's Teaching Science? Meeting the demand for qualified science teachers in Australian secondary schools*. Report for Australian Council of Deans of Science. Centre for the Study of Higher Education, University of Melbourne.

Harris, K-L. & Shaw, J. (2006). *Longitudinal Evaluation of the STAR Peer Tutoring Programme*. Centre for the Study of Higher Education, University of Melbourne.

Hughes, B. & Rubenstein, H. (2006). *Mathematics and Statistics: Critical Skills for Australia's Future. The National Strategic Review of Mathematical Sciences Research in Australia*. Australian Academy of Science, Canberra.

Jensz, F., Carroll, S. & Gibson, E. (2005). *The Future of Chemistry Study: Supply and Demand of Chemists*. Royal Australian Chemical Institute, North Melbourne.

Victorian Curriculum and Assessment Authority (VCAA) (2008). *Victorian Essential Learning Standards: Discipline-based Learning Strand – Science*. State Government of Victoria. Available at: http://vels.vcaa.vic.edu.au/essential/discipline/science/index.html (accessed 19 August, 2009)

# Appendix

## The participating schools

All participating schools had been participating in the In2science program for at least three years. The schools were otherwise diverse, in terms of their histories, structures, priorities and missions. The following is a brief summary of school characteristics potentially relevant to this study.

The following data was sourced from the schools' websites (e.g. year of establishment; year level and subject offerings; statements of school mission); from the interviews with school principals (e.g. statements of school mission; description of facilities); and from In2science management (history of involvement with In2science).

Coburg Senior High School

- established in 2007
- offers years 10-12 (year 12 started in 2009)
- associated with In2science since 2007
- specializes in maths, science, ICT, performing arts, and visual arts
- offers chemistry, physics, biology, robotics, and plastics; science and technology rooms are also designed to meet the educational outcomes of these traditional and new courses
- a 'different' school, as it features flexible learning spaces with the provision of group areas in an 'open, workplace-like' school architectural plan (eg., science laboratories feature demo benches to aid teaching and group areas to support collaborative learning)
- "a wide range of academic and vocational pathways are on offer consistent with the frameworks of VCE, VCAL, VET, VELS and ASBAs"

Eltham High School

- established in 1926
- offers years 7-12
- associated with In2science since 2004
- strong focus in engaging with community, particularly in providing opportunities for the school to be involved in science and the arts
- recognizes science as an educational pathway and currently 'lifts the profile of science' for students to consider future careers in science
- similar to Northcote, Eltham HS is a pioneer in its association with In2science

Footscray City College

- established in 1916
- offers years 7-12
- associated with In2science since 2005
- strong focus on developing students in maths, sciences and the arts
- developed a Futures Centre program for Year 9 and 10 students using an inquiry and project based approach to learning, with an emphasis on 'real life' problems and issues. This, plus the extensive use of multimedia to support learning, has enhanced classroom science-based initiatives
- there are specialist laboratories for physics, biology, and chemistry, and general science to support teaching and learning in science

Gleneagles Secondary College

- established in 1995
- offers years 7-11 (year 12 in 2010)
- associated with In2science since 2007
- recognizes the importance of establishing links with universities, with the aim of developing school programs and enhancing curriculum
- aims to develop aspirational students, exposing them to opportunities beyond school and for them to consider tertiary education and help lift the profile of its city (Casey)

- features an accelerated learning options for high-achieving students to pursue VCE subjects, including science, at middle years.

Northcote High School

- established in 1926
- offers years 7-12
- associated with In2science since 2004
- the vision of NHS is to "create a community of confident learners" through promoting student personal growth, learning, and achievement
- In year 10 and VCE science, it offers advanced science, biotechnology and forensic science, medical science, nanotechnology, VCE psychology and VCE biology
- shared strong science focus among staff with strong commitment to various science initiatives
- science initiatives go beyond classroom and welcome the participation of school staff, students, parents, including In2science mentors
- a 'pioneer' in its association with In2science