



Evaluation of *Science by Doing* Stage One

Science by Doing is a national initiative for the improvement of secondary science education. It is managed by the Australian Academy of Science and funded by the Australian Government. There are three important components of the project:

- Professional Learning Approach
- Professional Learning Resources
- Curriculum Resources

The development of these components is underpinned by a strong research base.

The Professional Learning Approach adopts the simple but profound position that a group of teachers should be responsible for improving the learning of their students. This team approach is supported by project resources but effective leadership is vital. One of the strengths within this approach is that it is self sustaining and cost effective. But does it work? And is it worth further investment? The project was trialled in schools in every state and territory. The evaluation of trialling the project in 2010 answers a resounding yes to both these questions.

The project focuses on increasing the amount of investigation activity by students and decreasing the amount of didactic pedagogy. Previous research suggests the latter is an important reason why high school students are losing interest in science.

Student comment

I liked it better because we got to do it instead of just the teacher telling us.

The following results explain the success of the project in decreasing teacher talk and increasing student engagement and inquiry.

| | |
|-----------------------------------|--------------|
| Students copying notes from board | 70% decrease |
| Teacher talk | 28% decrease |
| Student group work | 56% increase |
| Cooperative learning | 48% increase |
| Open questions/greater wait time | 69% increase |
| Explanation after experience | 52% increase |
| More student investigation | 45% increase |
| More formative testing | 28% increase |
| More diagnostic testing | 39% increase |

Changes in Teaching and Learning

Another project, the Collaborative Australian Secondary Science Program (CASSP), had similar results (Goodrum, Hackling & Trotter, 2003¹) but required every science teacher in the school to attend the CASSP workshops over three days. For *Science by Doing* only the Head of Department, or science coordinator, attended a three day project workshop. So, the *Science by Doing* approach is significantly less expensive. Furthermore, since the professional learning in *Science by Doing* is owned by the staff in the science department, Heads of Department believe it is highly likely that the change in teaching would be sustained.

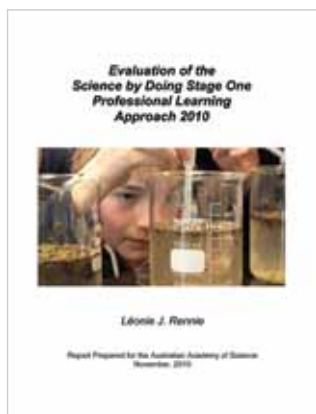


Australian Government



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Evaluation of Professional Learning Approach



The report at left² is an independent evaluation of the Professional Learning Approach by Professor Léonie Rennie of Curtin University. The report is available at <http://science.org.au/sciencebydoing/research-evaluation/>

The enthusiasm for *Science by Doing* of the trial teachers is clearly represented in the independent evaluation. Teachers are sometimes reluctant to engage with new teaching approaches. However, the *Science by Doing* professional learning resources affirm many of their existing practices, as well as providing new ideas and stimulus for discussion within the faculty. This collaborative element ensures that each school will have its own experiences with the resources and is able to tailor the professional learning to their own needs.

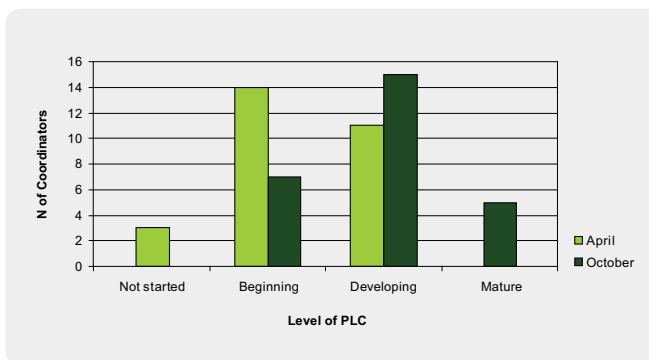
The essence of the Professional Learning Approach is described by the following figure:



Professional Learning Approach

The core is the Professional Learning Community (PLC), in this case the science department. The approach helps science teachers work together as a team to improve the learning of their students. Each of the four components assists in the process.

In April 2010, science coordinators were brought together for a three day workshop. The prime purpose of the workshop was for them to develop an action plan for their school using the professional learning and curriculum resources. After two terms of trialling they returned in October to reflect on their experiences.



A comparison of how science coordinators rated their department as professional learning communities pre and post trial

Science coordinators were asked to rate their sense of the professional learning community within their science department both before and after the trial period. This data is presented above. When asked to rate specific aspects, school coordinators showed significant changes in the perception of their department between April and October, as shown below:

| | Mean score | | | |
|--|------------|------|---------|------|
| | Apr | Oct | t-value | ES† |
| Share a common vision where department is heading | 5.35 | 7.50 | 5.30** | 1.11 |
| Teachers take responsibility for student learning | 5.92 | 7.42 | 4.76** | 0.89 |
| Teachers take responsibility for working in partnerships | 5.15 | 7.00 | 4.14** | 0.85 |
| Collaboration, trust and respect | 6.81 | 7.54 | 3.72** | 0.32 |

Improvement in key features of a collaborative approach to student learning in trial schools
See page 27 of the report for full analysis

Evaluation of Professional Learning Resources

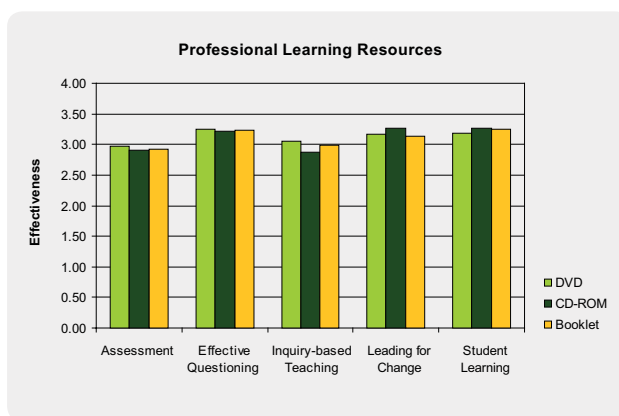


The Professional Learning Resources are designed for science departments to provide a shared experience and common language for professional conversation. Each module comprises a DVD which models the targeted idea, an interactive CD-ROM which provides opportunities for teachers to explore and practise skills and a booklet which provides explanation and supporting information.

In the trial the most common approach was to view the modules as a science department, but teachers also interacted with the resources individually and in small groups.

The Likert scale ratings of the effectiveness of each component of the modules (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree)

indicated a very positive response from trial teachers as shown below.



Effectiveness of professional learning resources

Comments from trial teachers

Reflects the classroom well and shows better ways of learning. Teachers can relate well to all presented.

I enjoyed working through the module and feel it has real value. It left me wanting to try and put more pre-thinking into my planning.

The module helped all by encouraging reflection about practice, with a focus on what students do.

Fantastic resources.

Reminder of lots of things we already know and some interesting alternatives.

Excellent, thought provoking and some useful strategies.

Good resources upon which to reflect.

Raised many ideas and stimulated staff to reflect and improve their practice.

An important resource with excellent potential.

Good practical based resources.

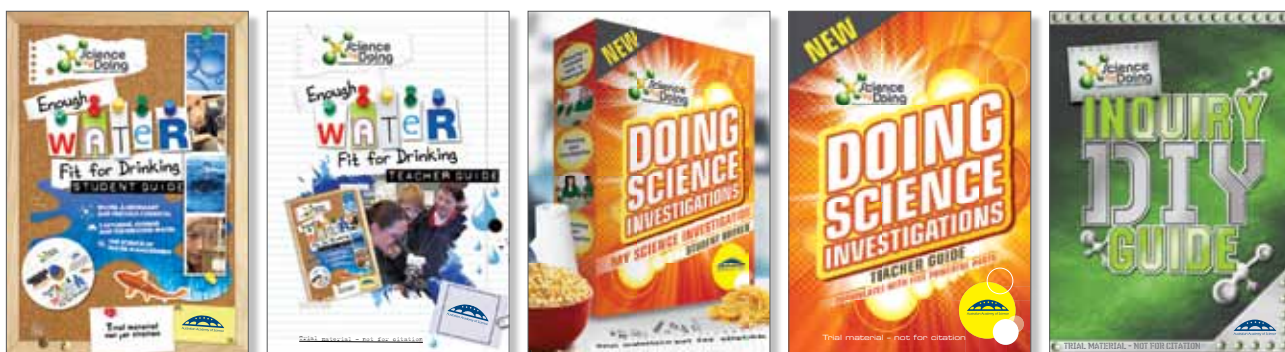
Resources brought an awareness of working together within the science faculty.

Great for faculty discussion.

The resource prompted a great discussion and provided opportunities for personal reflection.

Would be excellent for pre-service teachers.

Evaluation of Curriculum Resources



Science by Doing curriculum resources will be used to help teachers implement the new Australian Curriculum: Science. Three *Science by Doing* curriculum resources were trialled in 2010. Each was well received, with positive feedback for the student guides, teacher guides and digital resources.

Doing Science Investigations is a resource to help students develop their science inquiry skills, as outlined in the Australian Curriculum: Science, so that they can undertake investigations. Trial teachers described how they adapted the unit to their class and used different contexts for the investigation.

The *Inquiry DIY Guide* is a step-by-step guide to assist in adapting existing resources towards an inquiry-based approach. Teachers appreciated the acknowledgement that there are different types of inquiry.

Enough Water Fit for Drinking is an inquiry-based exploration of contemporary issues associated with water. It focuses on the role science plays in sustainable water management. It has a strong digital component. Trial teachers appreciated that they could adapt the unit to the learning needs of their students. There was opportunity to include information about water management in their local area.

Students also enjoyed the unit, with many saying they liked the unit better than their usual science classes. They particularly liked the digital and hands-on aspects which included animations, interviews with scientists, footage from ABC TV and interactive digital experiences.

There was considerable evidence that teachers and Coordinators believed that student learning was enhanced. Most teachers firmly believed that students were more engaged, more enthusiastic, and asked more and higher level, questions when using the SbD resources. Many of these teachers believed this resulted in greater learning and improved work quality. (Rennie, 2010)

Teacher comments

A fantastic resource that I will certainly use again.

Using the resources established positive attitudes towards hands-on learning, academic engagement and effort.

Student comments

It was more fun and made me want to go to science.

It was better [than normal science] because it was active learning and not just copying things from the board.

It was very useful! I live in an area where we live off water tanks and now I know how my water gets clean enough to drink.

I learned a lot – I never knew water was so interesting!

I think this was one of the funnest units we have done in science.

I enjoyed doing the water unit. It taught me lots and the book was very helpful.

It is a great way to learn about water and how it's recycled.

- 1 Goodrum, D., Hackling, M., & Trotter, H. (2003) *Collaborative Australian Secondary Science Program: Pilot Study*, Perth. Edith Cowan University
- 2 Rennie, L.J. (2010) *Evaluation of the Science by Doing Stage One Professional Learning Approach 2010*, Canberra. Australian Academy of Science

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