Improving primary science:

**Schools’ experience of change**

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Introduction

The School Innovation in Science (SIS) initiative is an approach to change based on the science ‘professional learning’ team. It regards improvements in science as a long term process that is embedded in the whole school culture.

This article provides insights into schools’ experience of improving their science within SIS (previously the Science in Schools Research Project). We hope you, the reader, will think about how these insights might apply to your own situation.

Many writers have criticised short term workshops that traditionally count as teacher professional development in science. Many studies have shown these ‘one-shot’ professional development (pd) events are ineffective in promoting changes in teacher and school practices (Hoban 1992, Webb 1993, Levins, Pegg & Creedy 1994). There is almost universal agreement amongst science education researchers that long term pd, sensitive to the needs of teachers and schools, is necessary to support significant teacher development (Eg: Bell & Gilbert 1996). There have been a number of recent initiatives in Victoria based on a whole school approach to change (Hill & Crevela, 1999). Queensland's 'productive pedagogies' is another example of the whole school approach. School Innovation in Science (SIS) is a structured and supported approach to change based around the science team in a school.

SIS was described in some detail in the previous issue (Tytler 2002). It consists of two major elements; the SIS Components which are our vision of elements that contribute to effective teaching and learning, and the SIS Strategy which involves schools auditing their science using techniques developed within SIS, and generating an action plan which reflects their own needs. SIS promotes a layered notion of teacher professional development. It includes this strategic team process, mentoring and collaboration within the school, pd specific to the school's needs, sharing ideas through regional workshops, and teacher attendance at external pd and conferences.

**Schools' experience of the change process**

SIS schools regarded the involvement of all who teach science as a critical part of the project.

From the outset it was decided that the whole school would be involved in the planning and development of the SIS project. … This was incredibly powerful as all the staff became involved and felt that their opinion was valued. The sense of “ownership” for all staff was critical in gaining support for the process of change.

Hall and Hord (1987, 2001) argue that successful implementation of an innovation is affected by how the new program is introduced to teachers, monitored and supported. They stress the importance of teacher discussion and input. In SIS schools, staff developed the action plan as a team, and the process was an essential element. Hall and Hord also point out that not all schools will implement the innovation identically since teacher understandings and school needs differ. Within SIS, each school developed their own action plan and addressed their own particular needs.

The process of auditing and reviewing the current state of science was also critical. For instance, the component mapping exercise in which coordinators interviewed each teacher to reach an agreed teaching and learning profile based on the SIS Components (see last issue of Investigating), was an extremely powerful innovation. It caused teachers to think about what they had been doing in science and what they wanted to do in the future.

The Component Mapping exercise was a very valuable tool … It highlighted areas that needed to be developed and certainly sparked a desire to take on professional development.
The review process created staff discussion that was vital to the process of change. Science teams examined school policy and initiatives. The audit of curriculum made teachers more aware of the lack of balance in some curriculum documents.

All staff agreed that the Scope and Sequence did not adequately cover all the areas of Science and were enthusiastic in developing our own “Big Picture” ideas that would develop and engage the students.

Key resources within the project were the stimulus and support provided by the SIS / Science Coordinator. The strategic use of time for teachers to work together to plan was critical.

(Increasingly) we were asked to come into the room with them or help prepare a unit of work or even collect or order resources that they may have needed … it gave staff more motivation and time to try new ideas.

Providing planning days where teachers were freed to plan units for the upcoming term was most beneficial. They had time to draw upon each other’s expertise… The provision of time… demonstrated that a colleague’s time was valued, the task was important and that everyone was benefiting from the project.

Strategic management of teachers was also critically important. For instance, coordinators found it best to focus their support on staff who were more highly motivated to change rather than insist that all staff take risks. The project has developed training materials and advice that reflects the experience of coordinators in dealing with teachers in the change process, and this is now part of a ‘Leading Change’ program that each coordinator undertakes. The recognition of science coordinators as ‘agents of change’ is an important principle that goes beyond SIS and needs widespread recognition within schools. A number of coordinators spoke in a sophisticated way about change.

We started to overcome this [lack of confidence] by encouraging classroom teachers to start off in a small way and teach some science successfully. We identified areas of interest for classroom teachers to build on…

It must also be remembered that change takes time and not all teachers are going to move ahead at the same pace.

It is not always realistic for all classes to tackle a particular activity because of resource and time constraints… A range of teachers tackled a range of different tasks.

Once staff felt that resources in time and ideas were available, teachers started to try ideas themselves and became more interested in developing teaching strategies. The way we are teaching Science has also changed dramatically … Teachers are far more confident in teaching Science and are well aware of the need to engage the students and are using the SIS components in their teaching strategy.

What was once thought of as a difficult area to teach is now being considered a more ‘teachable’ curriculum area.

Teachers who were initially reluctant in teaching the physics and chemistry sciences have increased in confidence, with the support and encouragement of the SIS coordinator and the power of the group – being swept along with others.

These teaching strategies initially dealt with what the teachers could do and then later started to focus on how the teaching impacted on the students, a sequence described by Hall and Hord (1987). Not all schools reached this stage, however. The change process takes time and teachers need to progress at a rate with which they feel comfortable.

The process of developing the strategic plan took a little time to get underway; there was a need to allow an introductory settling period to take place before a direction became evident. It needed time for me to come to terms with the project, and the rest of the staff needed to feel comfortable and not threatened by the concept of change and the concerns that the project may create regarding their individual roles within the school. We have a number of staff members who have been at the school for some time and a project like this can create some anxiety and uncooperativeness if not handled in the right way.

Our school is now heading towards refining various aspect of our program planning and looking closely at the improvement dimension of our teaching. There is still a need to revisit and to develop what we do. We have discussed and made changes to the integrated curriculum in respect to including the SIS components and the content of our units. There is still a need to embed important aspects of good teaching practice and what we want our children to learn. It is good that we have recognised these needs and that we have the desire to improve, rather than accepting that what we do is good enough.

Outcomes of the Project in Schools

Evidence from end of year reports

In their end-of-year reports, schools were asked to identify outcomes resulting from the Project. These provide insight into what the major issues facing primary school science are.

The changes included:

• A greater profile for science in the school itself, and the local community. This was particularly associated with the institution of events such as family science events.
• More time spent on science was claimed by most schools. Science was accorded time substantially in excess of previous reports in Victorian primary schools (a mean of 3.0 hours per week). The change was achieved by both increasing the number of science based units, and by linking science more strongly to other KLA's such as language.

• A more coherent and thorough representation of science in the curriculum — the curriculum audit uncovered major gaps for many schools.

• Increased access to resources, which encouraged an increase in hands-on activities.

• Improved attitudes, particularly confidence, concerning science teaching.

• Some explicit mention of changes to the approach used in teaching science, such as an increased variety of activities, including open-ended investigations.

• There were a number of stories of increased uptake of science by initially reluctant teachers. The change came about by either individual encouragement and support by the SIS Coordinator, or the establishment of a group ethos of change that swept reluctant teachers along. Change was supported particularly by positive responses to new strategies by students.

In 2000, the primary school reports did not refer to teacher change in terms of increased knowledge, or even very much about changing strategies, but focused more on confidence and a willingness to talk about science and incorporate it into their classroom practice. The focus was primarily on an increased quantity of science and its acceptance as a mainstream responsibility, and better planning for the teaching of science. In 2001, the primary school reports increasingly stressed that while teachers' confidence improved, they were now endeavouring to change teaching strategies and increase their knowledge. Schools in their second year were proportionally more likely to report that assessment was used to monitor student learning.

**Teachers' Open Responses from the component mapping survey**

As part of a questionnaire, teachers were asked to comment on changes to science in the school as a whole, without any structure imposed on their responses. Teachers described, on average, two major changes in science at their school and these open responses were analysed, and sorted into nine major categories. Figure 1 shows the percentage of respondents who mentioned each type of change. Showing both primary and secondary responses highlights the different change focuses and exposes interesting differences in emphasis.

It can be seen that the changes claimed are substantial, and almost completely positive. This result, taken overall, is a remarkable vindication of the project, with overwhelming positive, indeed enthusiastic comments.

**Discussion — Understanding the change process**

Interviews with coordinators during 2001, and analysis of reports of phase 1 and 2 schools, also provided insight into the way change proceeded within schools. The experience of most schools indicated that the initial stages of reviewing science in the school was frustrating, and teachers were anxious to get down to the real business of implementation. However, retrospective reflection clearly indicated the value of putting time into that first stage. Over time, schools shifted from broader planning and the beginning of a range of initiatives, to a more focused action plan in the second year in which a major agenda became the embedding of SIS teaching and learning practices into the ongoing school program and practice of...
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teachers. For primary schools this usually meant moving from single engaging activities to a more coherent and considered sequencing within unit planning.

The complexity of the change process, and the different pathways it has taken in different schools, vindicates the flexibility of the SIS Strategy in providing room for local control of the details of the change process. One size does not fit all in planning for improvement in science teaching and learning.

References

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Teachers wanted

To share their experience by disseminating materials/ideas on science teaching to Investigating Primary and Junior Science Journal.

What is needed?
Short articles up to 1500 words on a specific unit of work/teaching approach.
A description of a science activity.
Notes about a useful web-site.
A sample of a record sheet and description of how to use it.
Anything that you believe other teachers find useful, when teaching students aged between 5 and 15 years.
Feel you have no writing experience? The editorial team (Yvonne Zeegers, Kathy Paige, Simon Langsford, Belinda Baker, Sharon Russo) are happy to help, by reading drafts, suggesting ways to present ideas etc.
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