School Innovation in Science: Change, culture, complexity

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1. Introduction

'School Innovation in Science' is a model for improving science teaching and learning. It has two major features:

- **The SIS Components**, a framework of effective science teaching and learning (Figure 1), and
- **The SIS Strategy**, a process by which schools can improve their science teaching and learning (Figure 2).

Many writers (e.g. Hargreaves 1994, Hall & Hord 2001) have emphasised that change requires of teachers that they ground new ideas in their own personal experience. Joyce and Showers (1995) argue strongly for the need to site professional development within the school context. They discuss professional development within a framework of cultural change. Contemporary large scale reform projects in a number of countries have worked to incorporate these principles (Beeth et al., 2003).

The paper will focus on the question: what are the critical features of schools' improvement processes? It will describe the various ways in which schools' experiences of change have been researched, and identify key elements and outcomes of the change process.

2. Methods

The research methodologies include experimental research, case studies, document analysis, and action research. The data collection processes include:

- **Development and validation of the SIS Strategy** — progress notes, field notes from project team meetings, questionnaires and interviews with SIS Coordinators;
- **Nature of school initiatives and experience** — structured interim and final reports from schools, field notes, coordinator questionnaires;
- **Nature and extent of the change in school science** — questionnaires for coordinators, teachers and principals, consultant/researcher focus group discussion;
- **Factors affecting change** — consultant/researcher focus group discussion; and
- **Layered nature of the change process** — interviews with selected coordinators, action research involving a small number of SIS schools.

Analysis of this material continues to increase our understandings of the change process, which is fed back as advice and materials for schools.
3. Results

**Validation of the SIS Strategy**

Coordinators were asked to rate aspects of the strategy and support structures. The critical elements were: a process to establish a discourse centred on teaching and learning, and support structures for teachers to examine their practice and take ownership of the change process. The mapping exercise in which coordinators interviewed each teacher to reach an agreed profile based on the SIS Components, was an extremely powerful and generative innovation.

**Nature of school initiatives and experience**

Case studies of initiatives and change issues illustrate the richness and variety of schools' experiences. The science teaching culture in primary and secondary schools is very different regarding the background of teachers, and the very different histories of curriculum provision and organisation. Consequently the project followed different pathways in primary and secondary schools. A focus in secondary schools on individual learning and student engagement reflects an acknowledgement that teacher centred, transmissive methods have dominated practice and need rethinking. A focus in primary schools on meaningful understanding reflects a lack of teacher confidence in science knowledge.

**Nature and extent of the change in school science**

There is compelling evidence of significant change in the practice of science in both primary and secondary schools. The component mapping exercise has shown a significant change on all components over the three years. An open questionnaire of all teachers concerning perceived changes in science in the school, showed both substantial change and interesting differences between primary and secondary schools. Learning how to work collaboratively and purposefully has been a major benefit for secondary schools. Primary teachers focused on increased profile for science, better resource management and better organization of the science area in general.

A consultants' focus group workshop judged 68% of schools to have established an effective platform for substantive improvement. An important part of the analysis, however, has been the identification of factors that affect improvement.

**Factors affecting the school change process**

Analysis of schools' experience identified a set of factors that are particularly critical in determining a school's success in improving science teaching and learning:

- **The Science Coordinator**: status within school, degree of organisation, leadership qualities.
- **School leadership**: commitment to the initiative, actions related to support and commitment.
- **School culture**: a culture of change existing in the school such as a positive attitude and willingness to try things, and the ability to openly share ideas concerning classroom practice.
- **Access to support and resources**: external support and prompting from consultants, local networks to share ideas, available PD, and time release.

**Layered nature of the change process.**

During 2002 we worked with a small number of schools in action research projects to find ways in which teachers could most effectively be supported to further develop their practice. We identified different levels at which change can occur; whole school,
science team processes, unit planning practices, and individual teacher practice. Targeting and monitoring changes in the school at these different levels has been important for providing support and advice to schools, and also for understanding the interactions between them to better model the change process.

4. Conclusion and implications — Understanding the change process

The success of the SIS Strategy is evident in the coherence of accounts regarding the nature and extent of the changes at the classroom and school levels. Analysis of change pathways supports two major propositions: *Change should be seen as inherently cultural in nature.* This is evident from the very different experiences of primary and secondary schools, at the level of teacher knowledge and commitments, core presumptions about purposes, and curriculum arrangements. It is also evident in the very different responses and outcomes in different schools, depending on interactions between the factors identified above. Schools have very different histories, populations, and needs. A change project must ground itself in this reality. *Change within schools occurs at many layers.* Thus, support structures and processes must target these different layers, and attention needs to be given as to how they interact. The SIS Strategy has been progressively developed to reflect this insight. Monitoring of change must also reflect this insight. It is important to distinguish between superficial, and embedded change.

5. Bibliography


Figure 1: The SIS Components of effective teaching and learning in science in classrooms that effectively support student learning and engagement in science:

1. Students are encouraged to actively engage with ideas and evidence
2. Students are challenged to develop meaningful understandings
3. Science is linked with students' lives and interests
4. Students' individual learning needs and preferences are catered for
5. Assessment is embedded within the science learning strategy
6. The nature of science is represented in its different aspects
7. The classroom is linked with the broader community
8. Learning technologies are exploited for their learning potentialities
Figure 2: The SiS Strategy

Teaching and learning core vision

The SiS Components
- Engagement
- Understanding
- Student lives
- Differentiation
- Assessment
- Nature of science
- Community
- ICT

Infrastructure Support

Network support
- Regional consultant team
- Mentor schools
- Network support arrangements

Support Materials
- SIS Handbook
- SIS website
- SIS curriculum resources

Professional Development
- Leading Change Program for science leader
- SIS PD for science team

Research instruments
- Review & monitoring instruments
- Achievement and attitude tests

Supporting Actions within Schools

Committing to organisational support and provision of time
Managing Professional Development
Supporting individuals and groups
Monitoring and evaluating
Reporting and disseminating

Auditing Science in the School
Developing an Action Plan
Implementing Change

Improving Student Outcomes