School Innovation in Science: Focusing on leadership in the school change process

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Abstract

This paper will describe the role of subject coordinators as leaders of change in the School Innovation in Science initiative. The SIS 'Leading Change' program has developed from three years of research with 200+ schools, concerning the coordinator's role as change agent; the levels at which they work and strategies to challenge and support teachers. The different dimensions of effective leadership will be described, based on evidence from interviews, field notes, questionnaires and focus group discussion, and related to the program structure. It is argued that SIS promotes a new vision of professional leadership in schools.

Introduction and overview

School Innovation in Science (SIS) is a process for school improvement that was developed and validated by working with more than 200 primary and secondary schools in Victoria, Australia. The project was initiated and funded by the Victorian Department of Education and Training as part of a wider government strategy. The SIS model has two major components; a framework for describing effective teaching and learning in science, and a strategy by which schools achieve improvement in their science provision and outcomes. The model has been increasingly recognised by schools and education policy personnel as capable of application beyond science. A key aspect of the SIS Strategy is the operation of a coordinator in the school to challenge and support staff in the process of change and to manage the components of SIS. Increasingly, over the research phase — the Science in Schools Research Project — the project team came to see the coordinator leadership role as pivotal to the success of SIS, and that realisation has been expressed in the form of a leadership training program, with supporting resources. The workshop and support materials are principally based on research carried out in the project.

The project made an early decision to work through science 'professional learning teams', consistent with the Middle Years and other projects in Victoria. Like these projects, SIS was committed to an evidence based change model. The strategy emphasised the strategic nature of change and the importance of local ownership and control, and this approach immediately placed the locus of control on local leadership. In the developmental phase of the project, evidence concerning the management of the change process was collected through questionnaires, field notes, and interviews with selected SIS Coordinators and principals. The experience of these coordinators was used to construct a framework for describing their role as change agents; the levels at which they operated (whole school, science team, planning group and individual levels), and the way they organised the change process (meetings, resource provision, seeding ideas, managing professional development) and supported teachers (individually tailored intervention, challenge, in-time support), and the dimensions of their expertise.

During the second year of the project this analysis coalesced into a realisation of the critical role of leadership in the change process. A 'Leading Change' program was developed for science coordinators that now underpins the SIS intervention and which has attracted widespread approval.

The whole school approach to change

Many writers over the last decade or more have decried the predominance of 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 (Owen et al. 1987, Commonwealth Schools Commission 1988, Carrick 1989, Hoban 1992). Their ineffectiveness is related to the lack of follow through, the lack of connection with school priorities (particularly when participants come from different schools and regions), or the direct needs and concerns of participants, and the lack of long term and systematic planning (Webb 1993, Levins, Pegg & Creedy 1994). Paige (1994), using interviews and questionnaires with acknowledged competent primary teachers of science, found that these teachers identified longer term pd as having been influential in their professional lives. Similarly, teachers interviewed by Loughran and Ingvarson (1993), identified longer term pd as the only experiences that had an effect on their pedagogical practice. There is thus 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.

There is a well developed literature on the relative merits of whole school and workshop based professional development models. Joyce and Showers (1995), drawing on research from a large number of studies, argue strongly for the need to site professional development within the school context. They discuss professional development within a framework of cultural change, and argue that increased levels of implementation of innovation when teachers are organised into support groups (study groups that engage in peer coaching), particularly with whole faculties involved, derives from the fact that 'when the entire workplace is involved, the colleagueship generated provides powerful social support as people practice teaching strategies that are new to their repertoire or implement the difficult areas of a curriculum change. The small groups from a variety of schools, although they may be cohesive, simply cannot receive the pervasive support or collective sense of purpose that ensues when the whole gang is involved' (p. 14). It is clear however, that there are practical difficulties with the site-based model, in that 'few schools have developed the collegial processes and norms that permit collective decision making to proceed smoothly' (p. 6). Schools need support in this enterprise. These issues and the way they relate to teacher knowledge and teacher development are discussed by Tytler et al. (1999) in a paper comparing the impact of workshop based and whole school pd programs.

There have been a number of recent initiatives in Victoria which are based on a whole school approach to change, and the approach is encapsulated in the design elements of the Hill-Crevola General Design for Improving Learning Outcomes (Hill & Crevola, 1999). These design elements are essentially a description of aspects of the school culture and community that must interrelate and must be taken into account in the change process. The major features of the SIS strategy are related to these elements, and also to the Concerns Based Adoption Model of Hall and Hord (2001).

While the primary focus of the SIS project is on teacher classroom practice leading to student outcomes, the engine of change is the school, and the SIS Coordinator has been increasingly recognised as a critical agent in this process. The SIS Strategy, and through this the support structures and advice the project has provided has been chiefly at the coordinator / science team level. Accountability structures within the project, and avenues for intervention and for reporting, have been managed by the coordinator. This paper focuses particularly on the role of the Coordinator in instituting and supporting the change process.

The SIS Strategy and leadership

The SIS Strategy is represented diagrammatically in Figure 1. The central core of the strategy, represented by the middle line describing the action planning process, is the sequence of events and actions taken by teachers, working as a team, to improve science in the school. The SIS Components are central to this — they inform what is focused on, and are a reference point for talking about teaching and learning, and clarifying goals and initiatives. As implied by the name, the change process is strategic. An ***action plan*** is generated that takes into account particular school conditions and goals. In the planning process teachers focus their attention on teaching and learning, and agree about what should be done.

The planning phase is critical to the success of the project in the school. Developing an Action Plan requires considerable thought and attention, and for most schools takes most of the first term in the school year. The main steps in developing the Action Plan are:

Auditing science in the school: A range of information is collected from student tests and surveys, teacher interviews, analyses of the school curriculum and resources, science team processes, and relevant policies and initiatives in the school. This information will focus discussion on appropriate directions to take..

Reviewing and Prioritising: Analysis of the key issues, and identification of initiatives and goals

Developing and writing the Action Plan: The Action Plan specifies initiatives / actions to be taken and details how this is to be done, by whom, over what time scale, and how they are to be monitored.

The ***supporting actions*** are actions taken by the coordinator and the science team that are essential for the planning and implementation of change initiatives to be successful. These have been derived from previous research accounts but refined by experience of schools within the project. A comprehensive set of ***project support structures*** have been developed to support schools in the change process. Within the project, support for teacher development occurs at a range of levels; individual PD attendance, group sharing and planning, school initiated workshops, and project managed network meetings and PD.

The role of the coordinator and science team

From the beginning SIS used a change model that emphasised the importance of school ownership of the change process, and sensitivity to local conditions in planning for change. The project advice was at the level of teaching and learning principle (the SIS Components), and how best to manage science team change processes (the SIS Strategy). From the beginning it was realised that having a change agent in the school, to act as a conduit for the support process coming in, and the evidence and accountability requirements going out, was crucial. Thus the role of the SIS Coordinator was always central in our thinking, and our communications. Indeed, evidence from all sources throughout the duration of the Project indicated that the leadership provided by the SIS Coordinator in the school was critical to the success of the Project. Different 'models' were used from school to school. Many schools had two SIS Coordinators who shared the task, and one had three. There was wide variation in the teaching experience, age and other characteristics of the SIS Coordinators. From the 2001 interviews, Principals, in interview, described the selection of the SIS Coordinator as critically significant to ensuring the success of SIS in their schools.

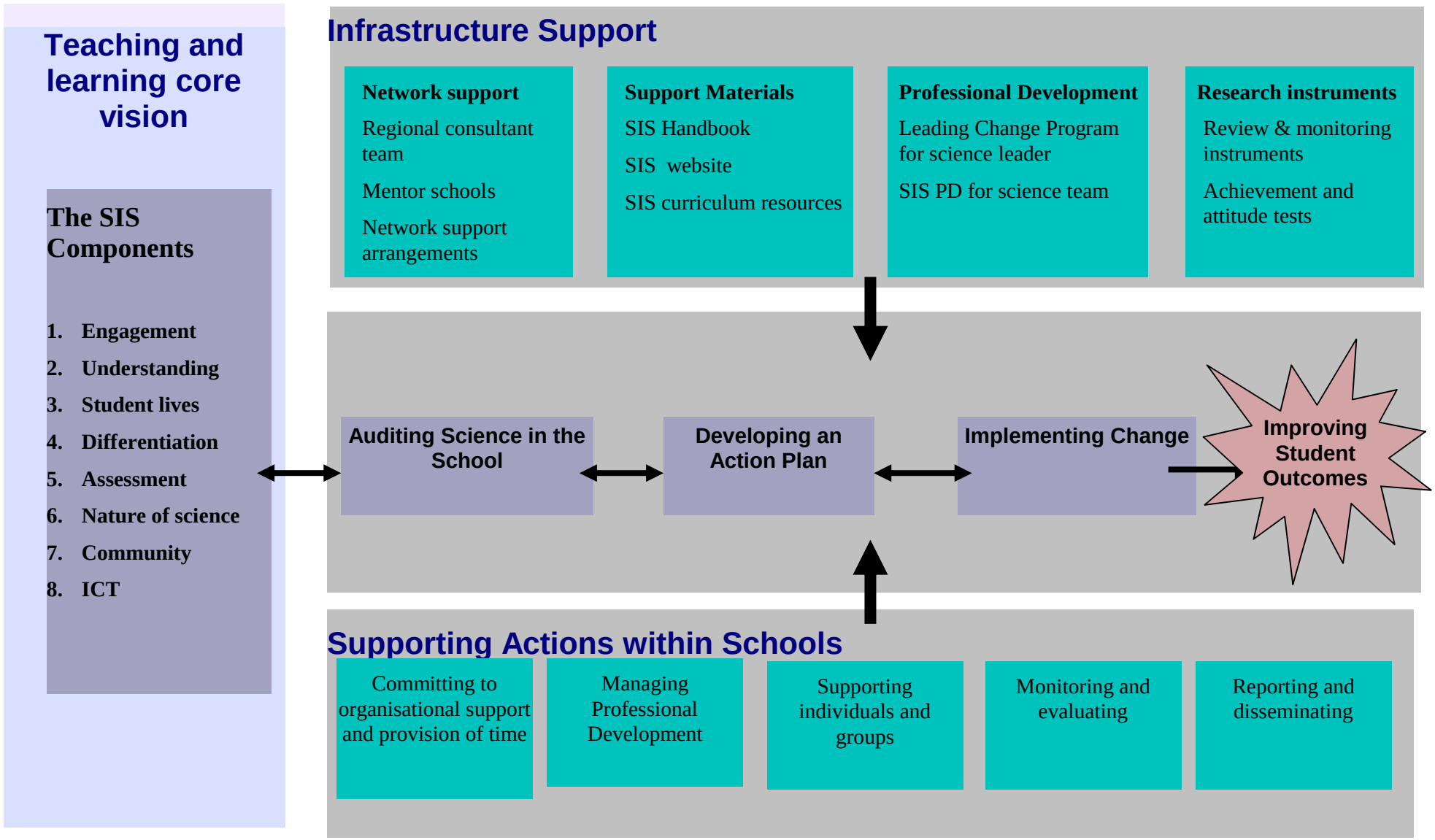
Development and refinement of our conception of the role of the coordinator

During the initial development phase of the project the research focused on building up insights into how different features of the model contributed to the change process, including the role and actions of coordinators, and ways of translating successful practice into project processes. Coordinators who were operating effectively and were able to articulate the nature of their roles were used in an advisory capacity in workshops at the end of that year, thus conferring a sense of ownership of the project to these coordinators and a developing sense of tradition. The appointment of Regional Project Officers in science, whose task it would be to act as SIS consultants and oversee the management of networks and arrangements generally, f urther accelerated the transfer of control of project implementation away from the research team based at Deakin. The RPOs became very influential in determining the nature of the project, and supporting and acting as advocates for coordinators. As the project progressed and further understandings developed of the conditions under which the project operated effectively in schools, the realisation of the role of leadership coalesced around the coordinator particularly, but also the principal, and this increasingly became a focus. Figure 1 describes the key events in this process.

Figure 1: Timeline of events concerning the developing conception of coordinator roles

May 2000	Workshop to introduce SIS Coordinators to the SIS Strategy and Components and to discuss their role.
Semester 2 2000	Working with SIS Coordinators, via visits and network meetings. Team meetings to discuss progress and review the coordinator and school progress. Focus group discussions based on field notes and coordinator progress notes.
December 2000	Workshop for 100 new schools in which selected coordinators presented to incoming coordinators the nature of the process, and effective support strategies. Regional Project Officers (RPOs) for science were appointed.
March – June 2001	Interviews were held with selected coordinators recognised as particularly effective, concerning the process of change and the nature of their role. A focus group discussion with selected primary, and secondary, coordinators was videotaped for PD purposes.
July–August 2001	Selected principals were interviewed concerning their response to the project, including the role of the coordinator.
December 2001	Workshop for coordinators and principals in 100 new schools and existing schools, focusing on the nature of SIS. Experienced coordinators presented at this.
February 2002	A more focused workshop for incoming coordinators, on the nature of SIS and of their task, including advice on how to execute their roles. This latter session was presented in each region by experienced coordinators. This program was rated very highly by coordinators in a questionnaire.
August-November 2002	Questionnaires were given to coordinators, principals and teachers to evaluate SIS and various aspects of the Strategy. This included questions on the coordinator role. Plans were made for the roll out of SIS more generally, including the planning of the leadership training program.
February 2003	After schools had applied to join SIS, Coordinators attended the first two of a three day 'Leading Change' program to train them in SIS and the role of the coordinator as a leader of change.

Figure 2: The SIS Strategy



Research Methods

The development and refinement of the SIS Strategy during the first year was supported by a variety of research methods sitting within an action research like framework. These included field observations of schools in process, focus group discussions in which these observations were discussed and used to produce principles and ways forward, coordinator and consultant journals, field notes from coordinator sessions in which they shared their experience with new coordinators, and consultant focus group meetings. Early in the second year interviews were conducted with selected coordinators and principals, concerning the progress of SIS and the factors that supported successful implementation. The questions included:

1. What has changed — what is different now, compared to the beginning of 2000? Can you give examples?
2. How has change happened? What sort of things (key events) have led to change?
3. How have teachers' attitudes to the project and to science changed over time? Have more gradually come on board? How has that happened?
4. How has the principal and leadership team viewed the project, and supported it?
5. What sort of blockers have occurred at times, and how have you got round them?

There were also two focus group discussions with primary, and secondary coordinators with a track record of success, held mid second year, and this was videotaped and analysed informally for professional development purposes.

At stages in the project questionnaires were completed by principals, coordinators, and teachers. These were evaluative questionnaires but some questions dealt with the change process including the role and importance of the coordinator. Interviews with principals were held in the second year. Focus group discussions were held at various points during the project, focusing on different aspects, and involving different people.

Taken together, then, the insights into the role of coordinator leadership in SIS has been generated from a wide range of sources, allowing ample opportunity for validation through triangulation.

Findings

The findings concerning the role of the Coordinator are presented here as they were developed from three sources; consultant field notes and journal entries in the first year, interviews with selected coordinators during the second year, and a focus group discussion within the core project team at the conclusion of the third year.

Coordinator roles and strategic actions

In a focus group discussion within the project team (most of whom acted as consultants to the 27 schools) late in the first year of the project, field notes and observations concerning the role of SIS Coordinators were used as the basis for refining our understandings of how SIS Coordinators were working to successfully support the change process. Out of consultant journals and notes taken at this focus group discussion a list of Coordinator actions and comments on their effectiveness were refined and grouped into categories representing significant dimensions of strategic action to support change. This was then included in more detail in the SIS Manual as advice for incoming coordinators. The manual was conceived of as a 'here's how to do it' support document and included audit instruments for group meetings and teacher interviews, as well as more general advice.

Coordinators worked at a variety of levels with staff - with the whole staff in meetings, with groups working on particular initiatives or in year level planning meetings, in concert with an 'inner circle' (or a colleague if there in those cases where there was more than one coordinator) and with individual teachers. The task involved operating effectively across these different levels to support teacher development. The dimensions on which the strategic actions were grouped are:

Team building— encouraging a common agenda

Includes being deliberate in involving all teachers, perhaps using all day planning sessions or workshops; ensuring a productive atmosphere; making regular contributions at normal science meetings to keep SIS on the

agenda, getting teachers working together on initiatives; in primary schools making sure science is embedded in the planning process; ensuring staff report back to the team.

Supporting groups of staff working on initiatives

Includes arranging for and encouraging groups of staff to meet; encouraging the setting of deadlines, continuing to meet with groups, encouraging revisiting of action plans, providing ideas; prompting action and offering support.

Supporting individual teachers

Includes working with teachers on development of activities; helping/ modelling with practice; providing ideas and resources such as website lists; alerting teachers to outside programs.

Encouraging innovation and involvement

Includes encouragement of experimentation and risk taking; helping teachers develop confidence to try new ideas; celebrating successes.

Allowing for individual focuses

Includes using the mapping interviews with teachers to ascertain interests and strengths, basing initial tasks on teachers' interests and immediate needs; supporting tasks that will provide initial success; seeding each planning team with an experienced teacher with imagination; using individuals' expertise and building on this.

Working with less-than-enthusiastic teachers

This was an initial concern with most coordinators and special advice was developed around the notion of developing a team ethos and public profile; being patient with slow starters and putting in effort where it will bear fruit; working to know the particular teachers; using enthusiasts to generate an atmosphere of change and working on public profile using reports, displays, to further this; ensuring the support of the principal to generate expectations.

Case descriptions of strategic principles developed from interview.

From the interviews held with selected coordinators early in the second year, insights into the change process were used to draft strategic principles. A selection of these are given below, supported by quotes. From these interviews, further insights into the role of the coordinator and the nature of the change process were generated, which were translated into advice at workshops and in the project manual.

The need to allow time for momentum to build (Barry: secondary)

We did the component mapping, the student testing, and then…people had to reflect on their … there's a time where people take on what's going on and (think about) "am I ready to get involved". They need to be able to have reflective time to think, "well, what do I want to do? Oh yeah, ok". And there was a time when people were ready to (act) … I think we've picked people up because we allowed time when people were ready to sort of have a go at it.

During that time I was running around just trying to get people doing stuff they had said that they wanted to do in their teacher interviews. I started some people by saying things like: "You said you wanted to improve this stuff in your teaching. Now, you're going to do that Term 3 aren't you? Well, do you want today to work with so and so?"

Creating impetus and ownership (Heather: primary)

We did the science team audit tool, looking at the needs of the whole school and that was a really important step because from that we were then able to develop a strategic plan and an action plan and that was very important. Everybody in the school had a commitment and that was done before we started teaching but the need for PD had been established.

You have to get people onside. It's no good me saying it'd be really nice to do a Science project. You have to convince people of the need. The interpersonal interviews are great for that but I wouldn't have had everybody on staff if we hadn't had the science team audit. So for me that was really the point.

Providing resource support (Laura: secondary)

And the other thing, too, is to get booklets of teaching and strategies for them so that they have got them at their fingertips – everyone has got their own copy rather than just having a book in the department that everyone would have to find and share, and then they can take it away and use it, because a lot of people do a lot of work at home. They need to be able to have it accessible and user friendly.

Dealing with problem phases in the process of change (Jim: primary)

I think that there was a little pain for them at the beginning. First of all there may have been a little bit of suspicion in regards to, 'what's the project going to do to me? How's it going to affect me? Is it going to require me to do more? Is the project going to require me to change everything that I do?' And of course the answer is no, they were always doing some of those things but we just need to add onto them. And once they'd sort of realized that, that suspicion went.

We had some people who were afraid of failure, 'I'm not going to do this, it mightn't work. If I knew what I was doing and what to expect that would be better.' I still have people saying, 'I'm unsure about that', or 'I don't really feel comfortable teaching this so I won't'. And to let them know that it's ok that it doesn't work. That that in itself is a lesson that they can take further with the kids in saying … "Ok well what changes do I need to make to make it work, where did I go wrong?" And that will hopefully lead to better teaching all round.

The need to understand and cater for individual differences in teachers (Barry: secondary)

I've decided that a KLA team is just like a classroom; you've got to cater for individual differences. There's no formula. You need to recognise where everyone is. The component mapping … I learned more about all the teachers there than I knew before that. I mean before I did that I would've known most of them for two years … Probably those teachers who have been here 30 years I learned more about than I had in the 2 years prior and that also increased my respect for all the other teachers — it went up as a result of this process. It was interesting that the process moved you from judging teachers to recognising the many little bits of how they think.

It really is valuable getting to know the people you're working with and to learn their strengths and to try and operate on them. Really with people who are reluctant, what they wanted to say was really a key I think, to getting them started.

Scaffolding for independence (Jim: primary)

One thing that I wanted to make quite clear and became quite determined at, was that I didn't want to be looked at as the expert, the person with all the answers. I didn't want to become the person who they would come and see and say, 'Oh, can you go and get this, where's that?' I want them to stand on their own two feet to some degree and be responsible for their own thinking and their own actions and how they're going to go about that. So in some regards I've stepped back a little bit and allowed them to really say, 'well what have we learned so far? and 'what do I need to consider to have this happen?' So by standing aside to some degree and letting them really say, 'well, yeah, I understand that now and I can go and do that'.

Describing the successful SIS Coordinator

The following notes concerning the SIS Coordinator's role were compiled from a panel discussion within the SIS Project Team, held at the end of the third year. The discussion focussed on actions and strategies that differentiated successful aspects of the roles of SIS Coordinators, consultants and principals in supporting the SIS approach to improving science in schools. It included behaviours and factors that were enabling of the change process, or were impediments to change. The discussion drew on the considerable experience accumulated by Team members through visits to schools, attendance at Regional and state-wide meetings and workshops, examination of reports from schools, regular contact with SIS Coordinators and consultants, and access to commentary from a variety of Project personnel. Notes taken from the discussion were refined and ordered to pull out major themes that emerged, and the analysis checked with the group and further refined. Three major areas of understanding demonstrated by successful SIS Coordinators were identified, that have assisted their effectiveness in promoting and supporting change. These are:

Understanding of teaching and learning

SIS Coordinators who were able to develop a familiarity with and commitment to the principles underlying the SIS Components were able to support and challenge teachers to develop new practices. Effective coordinators were able to report with some insight into the Component Mapping process for individual teachers. They made judgments about the state of the curriculum and were able to develop suggestions when teachers were in need of ideas. Coordinators with a superficial understanding could not develop the coherent program of change that is required by SIS, and tended to 'settle for less' in describing and writing about what their schools were doing. Different levels of insight were often apparent in Regional workshops.

Understanding how to deal with staff

SIS Coordinators who knew the beliefs, practices and needs of individual teachers were able to develop the flexible support strategies that are characteristic of an effective change agent. The more experienced and committed coordinators talked about the need to know where staff 'are coming from', and the need to deliver 'just in time' support that is matched to individuals. There were cases where coordinators were able to reverse the attitude of recalcitrant teachers by suggesting special projects centred round their interests and expertise, in some cases creating 'flagship' initiatives and passionate commitment to the project on the part of the teacher.

Understanding how to operate strategically within the school environment

Effective SIS Coordinators worked closely with the school leadership team, and often the school council, to tap into sources of support including funds for equipment and special projects. Some coordinators nominated for school council, most provided regular updates on the Project to the various levels of the school community, many worked with small groups to promote new initiatives, and many also managed publicity to raise awareness of successful initiatives.

Factors limiting the effectiveness of SIS Coordinators

Several factors were identified as being associated with lack of effectiveness of the SIS Coordinator. Most of these related to the position of the coordinator in the school, and consequently involved issues of status, power, and commitment. Others were personal factors.

- *Competing administrative roles.* The SIS Coordinator has a heavy administrative load separate from teaching and learning commitments.
- *Small schools.* Small schools present some problems for the SIS approach, in the lack of opportunity to build a collaborative environment.
- *Junior staff.* Having junior staff as SIS Coordinators presented problems in some schools, where the teacher did not have the necessary status and/or political acumen, to promote change.
- *Low level of interest.* There were a small number of cases where a SIS Coordinators was appointed without having a special interest in science or in promoting change, resulting in a lack of progress. However, there were also examples where the SIS Coordinator was initially unenthusiastic but became enthusiastic and committed over time upon experiencing success and witnessing positive changes.
- *Attitude.* Attitude to change and to problem solving was an important issue. In a few instances the SIS Coordinator was negative towards change, unwilling to address difficulties, and unwilling to think laterally to solve problems.
- *Institutional factors.* In a few cases the change process was undermined by institutional factors involving unexpected, substantial change. Examples included in this category included: amalgamation of schools resulting in distrust amongst new staff of existing initiatives, major staff changes, and changes to curriculum structures.

SIS Coordinators' views concerning their role

During the Project, SIS Coordinators shared ideas and experiences concerning their roles, in workshops and in discussions with SIS Consultants and Project Team members. Many coordinators expressed considerable professional satisfaction with the role. These matters were further examined in part of the November 2002 SIS Coordinator questionnaire, where they were asked to indicate the extent to which each of the listed modes of

working had been an important feature of their work as a SIS Coordinator. The mean responses for primary and secondary SIS Coordinators in Phase 1, 2 and 3 schools are shown in Table 1.

Table 1 SIS Coordinators' ratings of modes of working as features of their work

	Prim.	Sec.
a. Conducting whole staff planning meetings	1.97	2.07
b. Working with planning teams on particular units at particular levels	2.41	2.36
c. Organising time for staff to plan and attend PD	2.50	2.36
d. Acting as a resource person for staff, collecting ideas, equipment and resources	2.76	2.50
e. Working with individual staff in a mentoring role	2.01	2.00
f. Promoting and publicising the project through newsletters, school meetings	2.45	2.06
g. Liaising with the principal/leadership team on the progress and management of the project	2.42	1.93

The scale used was: 1: A relatively minor feature, 2: An important but not central feature, 3: A major feature.

While all modes of working were rated as important, the predominant modes of both primary and secondary SIS Coordinators were reported to be working with planning teams, organising time for staff to plan and attend PD, and acting as a resource person. Two other dominant modes for primary teachers, but less so for secondary teachers, were promoting and publicising the Project, and liaising with the principal and/or leadership team.

SIS Coordinators' personal responses to the role were probed by asking them to indicate the extent of agreement or disagreement with four statements. The percentages of SIS Coordinators agreeing or strongly agreeing with each statement are shown in Table 2

Table 2 Percentage of all SIS Coordinators agreeing or strongly agreeing with statements concerning their role

Working as a SIS Coordinator:	Prim % A or SA	Sec % A or SA
a. has been a professionally rewarding experience for me	98	95
b. has given me greater insight into how to support teachers in developing professionally	98	84
c. has taught me a lot about teaching and learning	92	85
d. has been an enjoyable experience	74	84

As can be seen from the table, this is a very positive result. Both primary and secondary SIS Coordinators clearly valued their roles highly. The results are in accord with extensive anecdotal evidence gathered during the Project, concerning the professional benefit SIS Coordinators believed they gained from their participation in SIS. A number of coordinators were promoted, at least partly as a result of their SIS work.

Changes in science team processes and culture

A major role of the SIS Coordinator was to support the development of a science team ethos and processes for working collaboratively towards a shared end. We present here evidence that this aim was substantially achieved across the project schools. One of the major outcomes of SIS, and one recognised by principals, coordinators and teachers, has been the improvement in science team processes, including the promotion of collaboration and the construction of a team vision as a central part of the change process. For secondary schools in particular this was often seen as a renaissance in teachers' professional lives. For primary schools it was frequently a powerful way of harnessing existing processes in the service of a previously neglected part of the curriculum.

In the November 2002 questionnaires, SIS Coordinators and teachers were asked to indicate at which level the science team in the school was operating for each of the operational aspects listed. They were asked to select from: 1: A low level; 2: A fairly low level; 3: A moderate level; 4: A high level; 5: A very high level. They were also asked to make separate judgments about this for the current situation, and the pre Project situation. Table 3 shows the percentage of Phase 1 and Phase 2 Coordinators judging the science team in their school to be operating at a high or very high level, prior to the Project, and currently (after one or two years). Shown (Table 4) are the corresponding results for Phase 1 and Phase 2 teachers. (Phase 3 schools were omitted from this analysis as they had been involved with the Project for less than one year.)

The tables show the quite dramatic changes that SIS Coordinators and teachers believe science in their schools have undergone as a result of their planning and working together in SIS. Especially notable are the very large increases in the ratings of the team-related items concerning: regular discussion, shared vision, shared view of effective teaching and learning, planning together, and supporting each other. Also critically important are the very high ratings for aspects forming part of the objectives of the Project: the focus on improving learning outcomes, and commitment to ensuring students find science interesting and relevant. These results are indicative of a strong cultural shift in the way science teams worked together, and the way teachers related to each other professionally. It showed that the emphasis placed within the SIS Strategy on the science team as the engine of change was appropriate. It also shows the success of the focus on the SIS Coordinator leading change in the schools, since so much of our observational, interview and written data supports the contention that this leadership was a critical factor in each school.

Table 3: Percentage of Phase 1&2 SIS Coordinators judging the science team to be operating at high or very high level

	Prim.	Prim.	Sec.	Sec..

	N=48	N=48	N=41	N=41
The science team in our school:	Pre-project	Current	Pre-project	Current
a. Regularly discusses science teaching and learning issues	2	64	15	78
b. Has a shared vision of the purpose and direction of science in the school.	4	89	9	68
c. Has a shared view of effective classroom teaching and learning in science	7	81	9	65
d. Is focused on improving student learning outcomes in science	10	87	26	74
e. Is committed to ensuring that students find science interesting and relevant	20	94	28	90
f. Has an agreed process for assessment of student learning in science	2	44	22	46
g. Plans together effectively	14	85	12	68
h. Has a coherent staff PD program focused on teaching and learning	18	73	13	59
i. Support each other in teaching and learning strategies	27	83	22	85
j. Promotes science effectively within the school community	5	79	8	65

Table 4 Percentage of Phase 1&2 SIS teachers judging the science team to be operating at high or very high level

	Prim. N=298	Prim. N=298	Sec. N=221	Sec. N=221
The science team in our school:	Pre-project	Current	Pre-project	Current
a. Regularly discusses science teaching and learning issues	47	70	28	59
b. Has a shared vision of the purpose and direction of science in the school.	12	80	25	64
c. Has a shared view of effective classroom teaching and learning in science	14	77	21	58
d. Is focused on improving student learning outcomes in science	20	85	37	79
e. Is committed to ensuring that students find science interesting and relevant	28	92	38	85
f. Has an agreed process for assessment of student learning in science	8	59	26	45
g. Plans together effectively	17	75	25	63
h. Has a coherent staff PD program focused on teaching and learning	18	76	19	49
i. Support each other in teaching and learning strategies	25	83	40	80
j. Promotes science effectively within the school community	13	86	26	62

The view that teachers of science were operating together more effectively was also strongly held by principals. Comments such as the following, arising from interviews and questionnaire responses were not uncommon:

> The SIS Project made science teachers question their approaches to teaching and learning, reflect on practice, and most importantly, work together in teams. (Secondary principal*).*

Development of the 'leading change' focus

Near the end of the second year a focus group review session was held in which the RPOs and the research team joined together to generate insight into a) what it meant to be a successful SIS school, b) how the individual schools lined up in terms of their degree of success in these terms and c) what factors led to successful implementation of SIS.

This exercise was repeated the following year, and Table 5 is the refined version arising from this meeting. Only the top four factors are shown. Other factors related to school size, the nature of the school charter, and regional commitments. It can be seen the importance placed on leadership, both from the SIS Coordinator and from the School Leadership Team.

Table 5: Critical success factors for SIS

Coordinator:	Status within school, degree of organisation, leadership qualities.
School leadership:	Leadership commitment; and actions related to support and commitment
School culture:	A culture of change existing in the school A positive attitude and willingness to try things The ability to share ideas and be open with each other concerning their classroom practice
Access to support and resources:	External support and prompting from consultants, Networks: other schools to share ideas, available PD, Access to physical resources Time, CRT* support, direction and project materials/advice

*Casual Relief Teacher

This meeting included a discussion on some of the difficulties new coordinators faced at the beginning of the year in coming to terms with such a challenging project and learning to work with teachers in a role they were not accustomed to. This happens in a short time scale since the project needed to collect data and encourage the generation and refinement of action plans in the first part of the year. It was decided to run a special session immediately at the start of the school year (January) that introduced coordinators to the program and their role within it. There were two critical elements to this coordinator workshop; learning about the nature of the project and the processes they would be managing, and discussing their own roles in the project and the issues they would need to address in working with teachers. For the latter purpose particularly, experienced coordinators from previous years gave a presentation and led discussion on the role, and strategies that had proved successful for them.

Given the expansion of the project in that third year, it was no longer possible to provide consultancy using RPOs and project team members. In each region, therefore, 2-3 experienced coordinators were released part time from their teaching to provide consultancy advice to other schools. At the present time, therefore, we have in Victoria a growing band of cadres experienced in teacher and school change, who we are seeing as the key to supporting further roll out of the initiative.

The Leading Change Program

During the third year of the research project the nature of the general roll out of SIS was planned, under an environment where schools and regions would take increasing responsibility for the management and funding of SIS. The insights we had gained into the coordinator leadership role, coupled with the reduced resource base available for each school, convinced us that framing the project around leadership training, supported by focused teacher professional development, would best ensure the continuing life of this very successful project. The ongoing initiative was renamed ‘School Innovation in Science’. SIS requires of participating schools that more of the support for time release must come from their own budget lines.

The manual was thus reconceptualized as a Handbook for SIS Coordinators, and became associated with a 3 day 'Leading Change' program for coordinators, now described as 'Science Leaders'. The program rests on a presumption that the Science Leader's school has committed to the SIS process and to a level of support for this process in terms of resources and time release. Elements of the program, however, are suitable for leadership under any conditions. We are arguing that such a leadership program, and such a perspective on the role of coordinators of any kind in schools, provides a way forward to more innovative schools and programs.

The program itself takes place over two days initially, at the start of the project in schools, and is followed by a further day, two months later, in which progress and experiences are discussed. It is assumed that this process is supported by consultant visits, and that considerable activity takes place in the school across this time span. In preparing for the program, consultation with a leadership training professional led to refinement and in particular the inclusion of self reflection on the part of participants as to their particular leadership approach. Thus, as was evident in any case from our case descriptions, leadership is presented as having many faces.

The general structure of the program is shown in Figure 3, which is an excerpt from the introduction to facilitators' notes.

Figure 3: Excerpt from facilitator notes for the *Leading Change* program.

This program provides a complete package for science coordinators who wish to reinvigorate the science in their schools. Arising for the successful Science in Schools Research Project, it offers a wide range of resources, ideas and tools to support the change process.

The program focuses on:

Developing a science vision. Using a component mapping process, participants will be shown how to encourage their teachers to reflect on the quality of their own teaching and learning.

Strategic planning to implement change. A range of useful and well-tested auditing and action planning tools is provided.

Effective leadership. Participants will explore the nature of science in their school and their role as a science leader.

Teamwork and collegiality. How to create an effective science team.

Professional Development. Advice on the selection of SIS modules to support the change process.

Networking. How to elicit support from the school leadership team and school community. How to benefit from the SIS Regional and cluster networks.

Monitoring the implementation. Student achievement and attitude tests are available.

Conclusion

SIS has been a very large and successful project that has resulted in substantial change in the organization and teaching and learning of science in schools. Within SIS, the critical focus on teaching and learning was a new and challenging notion to secondary teachers who were accustomed to discussing organizational matters and handling teaching strategies largely as individuals, and to primary teachers who had limited experience in implementing a coherent science program. Yet the project by its nature required that teachers work together as a team to review quite fundamental presumptions about the nature of science teaching and learning, and to plan a way forward that was sensitive to local beliefs and conditions.

Thus, the leadership of the SIS Coordinator became crucial in managing a strategic process and encouraging and supporting teachers to reflect on their individual and group practice. Data collected during the project showed clearly the critical importance of the coordinator in providing leadership, and also generated numerous insights into the actions and strategies that were effective in promoting and supporting change. The particular characteristics of successful leadership in this instance included:

1. Energy and the ability to manage a complex process

2. Understanding at a deep level, the nature of the teaching and learning framework represented by the Components.
3. Understanding of and sensitivity to individual teachers' beliefs, strengths and needs.
4. Understanding how to operated strategically in the school environment.

As the project team became increasingly sensitive to this notion of leadership, processes evolved to effectively support new coordinators in their role as change agents. For most coordinators the notion of leadership in a science teaching and learning teams was a new experience. It was a highly rewarding experience, if challenging, and in many cases led to a change in professional direction.

Most PD is aimed at teachers, and that which is aimed at science coordinators tends to focus on management of resources, curriculum and safety issues rather than the provision of leadership and the management of people. Our experience within SIS is that this restricted sense of the role of a subject coordinator is consistent with most current science team practice; that coordination tends not to extend beyond practical matters such as laboratory and resource management and broad brush curriculum planning, and that meetings tend to focus on matters such as equipment delivery and test administration.

Our vision is of a Science Coordinator leading a team toward a shared vision of fundamental purposes, and promoting collaborative team practices. This parallels, at least for secondary teachers, a changed view of teachers' roles as professionals, as interconnected through the development of an agreed set of beliefs about teaching and learning, and a shared responsibility for group practices in teaching and learning. We are calling for this vision to be centrally incorporated into the thinking of science teacher organizations and teacher professional development providers. There is a need for leadership in the leadership area.

We are now extending SIS to other subject areas, and to an initiative supporting improvements in Middle Years practice more generally. While the role of coordination in these settings will be different in scope and administrative context, the focus on leadership will continue to be a prominent aspect of the way the initiative is framed.

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