Scientists in Schools

"A very valuable partnership"

Evaluation of the Scientists in Schools Project 2011-2012


Taroona Primary School, Taroona, Tasmania

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Executive Summary

The Scientists in Schools (SiS) Project is an initiative of the Australian Government Department of Education, Employment, and Workplace Relations, whose Quality Outcomes Program provided funding to the Commonwealth Scientific and Industrial Research Organisation to manage the project. SiS began as a Pilot Project during July to December, 2007 and its success led to continued funding into 2008 and 2009, and again to mid-2012, this time including a sub-program, Mathematicians in Schools (MiS). The SiS Project has retained its aims throughout these funding periods, which are to

- bring the practice of real world science and mathematics to students and teachers,
- inspire and motivate teachers and students in the teaching and learning of science and mathematics,
- provide teachers with the opportunity to strengthen their knowledge of current scientific practice and mathematical applications,
- enable scientists and mathematicians to act as mentors or role models for students,
- broaden awareness of the types and variety of careers available within the mathematics and science fields,
- enable teachers, scientists and mathematicians to share ideas and practices with other teachers, scientists and mathematicians, and
- increase scientists' and mathematicians' engagement with the broader community, thus raising public awareness of their work and its social and economic importance.

This document reports the independent evaluation of the expanded SiS/MiS project to the end of 2011. The evaluation is based on data collected from four focus groups comprising 4 SiS Project Officers (SiSPOs), 2 assistants and 11 scientists/mathematicians, and interviews conducted by email or telephone with the other 5 SiSPOs, 9 scientists and 14 teachers. Case studies of 13 SiS and MiS partnerships from five states and territories were constructed from data obtained. Online surveys gathered data from 514 scientists/mathematicians and 462 teachers, who came from every Australian state and territory, every school type, and from schools located in capital and regional cities, rural and remote areas. The online survey achieved a proportionally representative sample of SiS and MiS partnerships nationally. In addition, information relating to progress in partnerships was provided by the SiS Project Team from the SiS database and other documentation collected routinely, such as SiSPO reports.

In sum, and based on consistent and mutually supporting evidence from all of the data sources used in this evaluation, the conclusion is that SiS is continuing to achieve its aims. The findings are summarised in terms of the patterns of SiS partnerships, the contribution of the SiS Project Team, the benefits of SiS to participants, and the impact of SiS. Recommendations are made for the future of the SiS Project.

Patterns of SiS and MiS Partnerships

The term "partnership" describes the relationship between one teacher and one scientist or mathematician during the time they work together to achieve the aims of SiS. Partnerships are voluntary. At 28 November, 2011, there were 1456 SiS and MiS partnerships involving 1310 teachers and 1190 scientists/mathematicians in 1118 of Australia's 9581 schools, representing at least one partnership in 12% of Australian schools. Scientists and mathematicians came from 334 organisations Australia wide, covering a very large variety of careers relating to science and/or mathematics.

Over the life of SiS, a total of 3267 partnerships have been made. The median length of those now closed is over one and a half years, and for currently active partnerships, it is close to 18 months at the end of November, 2011, with over 13% longer than three years.

An analysis of the reasons for partnerships being closed (for reasons other than completing its planned activities) or withdrawn was undertaken on 1467 records for which descriptive notes were available. More than half of closures resulted from a change in circumstances preventing the continuation in SiS of one of the partners. Other contributing factors were a lack of communication between partners, and lack of time, motivation, or flexibility to maintain partnership activities. The consensus of data collected is that the converse of these factors is required to support successful partnerships: stable circumstances, effective communication, and sufficient time, flexibility and commitment to make the partnership work. Further, partners need to have informed and reasonable expectations of each other.

The Contribution of the SiS Project Team, Including the SiSPOs

SiS is managed by a Project Team of 3.7 fulltime equivalent personnel in CSIRO Education Headquarters and a total of 5.5 fulltime equivalent SiSPOs located in every state and territory. The SiSPOs are the face of SiS in the field, dealing with recruitment, matching partners, monitoring partnerships, and arranging information and networking events. To undertake their role effectively, SiSPOs need the coordination and support of the other members of the SiS Project Team located in Canberra. The SiS website facilitates online registration in the Project and contains a range of information and support materials for partners. A large database is maintained to keep track of partnership progress.

The Benefits of SiS to Participants

The first three purposes of this evaluation were to assess the perceived benefits to students, benefits to scientists/mathematicians and benefits to teachers. Clear benefits were found.

For students, perceived benefits include the opportunity to see practicing scientists and mathematicians as real people, to experience science with them, and to increase their own knowledge of contemporary science/mathematics. Other benefits were perceived to be students having fun, increasing their awareness of the nature of scientific investigation and of science/mathematics-related careers, and increasing their ability to recognise and ask questions about related issues in the world around them. These benefits are available to many students. Based on data collected, it was estimated that during 2011 the total number of interactions between students and scientists/mathematicians is in the range 140,000 to 190,000, and the total numbers of students involved in interactions with a scientist or mathematician is in the range 42,000 to 50,000. These benefits are currently free to students and their teachers. The immediacy and excitement of personal interaction with scientists/mathematicians sets the SiS program apart from other curriculum support or professional learning packages.

Scientists and mathematicians perceived the most important benefit for themselves to be the opportunity to work and communicate with students, and they also enjoyed working and communicating with teachers. They appreciated opportunities to promote their subject in schools and more broadly to the public, and to interest students in science or mathematics-related careers. Many also found renewed satisfaction in their own career. Scientists' response to a question asking them to rate their confidence in communicating science before and after SiS, revealed changes of around 0.45 of a standard deviation for scientists working in both primary and secondary schools. This is a substantial, positive effect.

Teachers perceived significant benefits for themselves in terms of opportunities to communicate with scientists/mathematicians and to increase engagement of their students in science/mathematics. They enjoyed working with a scientist/mathematician and for teachers of science, especially in primary schools, enhancing the profile of the subject in their school and the ability to update their knowledge and practice were important benefits.

Teachers were asked to rate their levels of confidence in teaching science and their confidence in their knowledge of contemporary science before and after their SiS experience. For primary teachers, there was an increase of 0.59 of a standard deviation in their confidence in teaching science, and for primary and secondary teachers, respectively, increases of 0.66 and 0.45 of a standard deviation in their confidence in their knowledge of contemporary science. These are impressive increases.

Assessing the Impact of SiS

Finding "hard" data to demonstrate the impact of SiS is difficult, because establishing cause-effect relationships in the social sciences depends on building a body of evidence rather than using a carefully controlled experimental design. However, the strong weight of evidence suggests that SiS is a successful program with worthwhile benefits for its participants. There are measurable increases in perceived confidence for scientists in communicating science, and in teachers' perceived confidence in teaching science and being confident of their science knowledge, but although these differences are statistically significant and around half of a standard deviation, not all scientists or all teachers perceived change. Nevertheless, three-quarters of the survey respondents in active partnerships pointed to positive impacts of the program, particularly impacts relating to bringing the practice of real world science to students and teachers, enabling scientists to act as mentors and role models for students, and inspiring and motivating teachers and students in the teaching and learning of science and mathematics. These outcomes are all stated objectives of the SiS program.

Further support for the impact of the SiS program comes from the responses of interviewees who were asked what would happen if funding for SiS were to cease. It was agreed that only a few strong partnerships would be likely to continue until circumstances changed, the majority of partnerships would soon dissipate without support, and most importantly, very few new partnerships would be created because scientists/mathematicians and teachers do not have the time or networking knowledge to go about doing this.

Recommendations

This evaluation has illustrated the continuing benefits of the SiS Project. Over its five years of operation, three evaluations, including this one, have demonstrated achievement of its objectives to an increasingly high level. It is an established program with considerable momentum. Its key strength (and uniqueness internationally) is that it enables students and, importantly, their teachers to experience face-to-face contact with scientists and mathematicians, usually for an extended period of time, and thus experience first-hand the wonder and excitement of science and mathematics as they are practised outside of school. It is a program which has developed efficient and effective management procedures, implemented by dedicated, personable staff. The following recommendations are made with these points in mind.

Continue the SiS Project

This evaluation found that the SiS Project achieves demonstrable benefits for scientists and mathematicians, teachers, and students. Further, the efficiency of management has been streamlined and the benefits are cost-effective. The current SiS Project Team, including the SiSPOs, is fully occupied. Expansion would require increased levels of staffing if quality, efficiency and effectiveness are to be sustained.

Recommendation 1
Funding for SiS should be continued at least at its present level. At the current funding level, supporting 1500 partnerships is realistic and sustainable.

Maintain the Management Structure of SiS

The work of the SiSPOs as the regional face of SiS is essential to the progress of SiS, but they must be supported by leadership from a coordinating central team. Increasing the effectiveness of SiS, particularly in terms of converting assigned to active partnerships, depends on enhancing the process of matching partners, ensuring they get started and monitoring them judiciously.

Recommendation 2
The SiSPOs should maintain their regional focus and give close attention to ensuring that partnerships get off to a strong start. It is important to ensure that SiSPOs are coordinated and supported centrally, both personally and with technology. Face-to-face meetings between SiSPOs should continue both for information exchange and support.

Support SiS and MiS partnerships

Establishing and maintaining partnerships requires a variety of support measures that are appropriate for the stage of the partnership. Networking events and workshop sessions are important for partnerships and for those unable to attend, the website and newsletters are alternative means of keeping up-to-date on current issues, and obtaining ideas to enhance partnership activities.

Recommendation 3
Continue to provide flexible, responsive support for partnerships, including using face-to-face events and online technology.

Support the Implementation of the Australian Curriculum

SiS is currently preparing relevant science and mathematics curriculum support materials for the website and has already delivered a series of workshops nationally that relate to the new Australian curriculum in science. It is important that the SiS Project Team continues to monitor curriculum implementation so that relevant information continues to be provided to partnerships.

Recommendation 4
Continue and expand the focus on supporting partnerships to implement the Australian Curriculum: Science and Mathematics.

Continue to Publicise SiS

The outcomes of SiS are positive and deserve attention by a wider audience. Continuation of efforts to achieve publicity will aid recruiting as well as give support to those scientists, mathematicians, teachers and schools so that SiS can continue to make a difference.

Recommendation 5
Continue to increase awareness and recognition of SiS and its outcomes through the implementation of the Stakeholder Engagement Strategy and associated media plan.

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Background to the Scientists in Schools Project

Scientists in Schools (SiS) is an initiative of the Australian Government Department of Education, Employment, and Workplace Relations (DEEWR), which has provided funding to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for management of the project from its inception in June 2007.[1] An evaluation of the pilot project carried out during Semester 2, 2007 indicated considerable early success and support from schools and scientists.[2] Subsequently, funding secured from DEEWR's Quality Outcomes Program enabled an extension of the project to mid-2009. A second independent evaluation of the project 2008-2009 showed beneficial outcomes from the project in terms of making a significant contribution to the promotion of science learning in schools and a greater awareness of science in the community.[3] The project received further funding to June 2012 and introduced a sub-program entitled Mathematicians in Schools (MiS) which operates in parallel with SiS. Since its inception, 3,267 partnerships between teachers and scientists or mathematicians have been established across Australia. At 28 November 2011, 1,456 partnerships were active in 1,118 schools.

During its lifetime, the aims of the SiS Project have remained unchanged, apart from the explicit inclusion of mathematics: Through the establishment of sustained and ongoing partnerships between scientists, mathematicians and school communities, the Scientists in Schools Project aims to

- bring the practice of real world science and mathematics to students and teachers,
- inspire and motivate teachers and students in the teaching and learning of science and mathematics,
- provide teachers with the opportunity to strengthen their knowledge of current scientific practice and mathematical applications,
- enable scientists and mathematicians to act as mentors or role models for students,
- broaden awareness of the types and variety of careers available within the mathematics and science fields,
- enable teachers, scientists and mathematicians to share ideas and practices with other teachers, scientists and mathematicians, and
- increase scientists' and mathematicians' engagement with the broader community, thus raising public awareness of their work and its social and economic importance.

CSIRO Education manages SiS and MiS. The project's comprehensive website, originally established for the SiS Pilot Project, is a key resource for the Project's operations. Besides setting out the information needed for potential participants to see what SiS and MiS are

[1] The SiS Project was initiated in 2007 by Australia's then Chief Scientist, Dr Jim Peacock, who championed the pilot project, chaired the project's steering committee, and was significantly responsible for the mainstreaming of the project in 2008. Following his retirement as Chief Scientist in August, 2008, Dr Peacock continued his strong support as Patron of the project in his role as Chair, CSIRO Science Team. A videotaped message from Dr Peacock can be accessed from the SiS home page at http://www.scientistsinschools.edu.au/.
[2] Howitt, C. & Rennie, L. J. (2008). *Evaluation of the Scientists in Schools Pilot Project.* ACT: CSIRO. Available online at http://www.scientistsinschools.edu.au/evaluation.htm
[3] Rennie, L. J., & Howitt, C. (2009). *"Science has changed my life!" Evaluation of the Scientists in Schools Project.* ACT: CSIRO. Available at http://www.scientistsinschools.edu.au/evaluation.htm

about, and how to register, there are also resources for getting started, notes on curriculum and ideas for partnerships, such as showcase stories of various activities and testimonials from teachers, scientists and mathematicians. The website facilitates online registration of participants, and this information is used by SiS Project Officers (SiSPOs) to create partnerships by matching teachers with suitable (with regard to subject focus and location) scientists or mathematicians. The SiSPOs, who are based in every state and territory, match scientists and mathematicians with teachers, monitor and assist the partnerships to remain active by keeping in touch with partners and arranging information and networking sessions in various locations in their regions.

Purpose of this Evaluation

The purpose and approach of this evaluation were similar to those of the previous evaluations. In addition, because the SiS Project has been running for a longer time frame, it was practical to perform some analyses of the SiS database to examine reasons for partnership terminations. Specifically the aims of this evaluation were to assess the outcomes of the SiS Project in terms of

1. perceived benefits to students
    a. increased knowledge and understanding of real world, contemporary science
    b. opportunities to experience scientists as role models/mentors
    c. increased awareness of the types and variety of careers available in the sciences
2. benefits to teachers
    a. updated and strengthened knowledge of current science and scientific practices
    b. opportunities for professional learning through communication with scientists and other teachers
    c. increased awareness of the types and variety of careers available in the sciences
3. benefits to scientists
    a. opportunities to communicate with teachers, students and other scientists about their work
    b. increased understanding of the community’s awareness and perceptions of science, scientists and their work
    c. improved methods of communication with students and teachers
4. the procedures used to set up partnerships and monitor participation
5. the contribution to the Project of SiS events, such as networking sessions and workshops, and
6. the impact of the Project in schools with longer term partnerships.

Approach Taken in the Evaluation

The evaluation took place during the second semester of 2011. In performing the evaluation the researcher undertook the following activities.

1. Maintained close contact with the Project Team throughout to discuss progress and arrange for access to SiSPOs and other officers for the provision of data from the SiS database and to facilitate the online survey.
2. Conducted 4 focus group discussions with SiSPOs and 11 scientists/mathematicians.
3. Invited the remaining SiSPOs, plus other scientists and teachers to provide written comments using email, or to discuss questions by telephone.

4. Constructed 13 case studies of partnerships using phone, email or face-to-face interviews with scientists/mathematicians and teachers.
5. Read many general reports of partnership activities available on the website, and all SiS Newsletters (titled *EmphaSiS*).
6. Surveyed teachers, scientists and mathematicians in active and assigned partnerships with an online survey hosted on the CSIRO SiS website. An invitation to participate in the survey was emailed to all partners. It was open for a month and closed on November 28, 2011.
7. Requested and received from the SiS Project Team a summary of notes from the SiSPOs' weekly reports for a recent six-month period.
8. Requested and received from the SiS Project Team a synthesis of data from the SiS database relating to length of partnerships, reasons for termination and numbers of partnerships as at November 28, 2011.

The researcher received approval from the Curtin University Human Ethics Research Committee for the approach taken in the evaluation. The Ethics Approval number is SMEC 20070045.

Preparation of the Instruments and Data Collection

The researcher had been involved in both the Pilot Project evaluation and the 2008-2009 evaluation of SiS during which a number of instruments were developed and used successfully. To facilitate comparisons between the outcomes of this and earlier evaluations, it was appropriate to use similar instruments for this evaluation, particularly the online survey, which was able to collect data from a wide sample of participants. The online surveys for scientists and teachers were modified for use in the current evaluation. Other instruments were mainly interview schedules which were tailored according to who participated in the interviews and whether it was conducted face-to-face, by telephone or by email. The survey, interviews and other methods of data collection were designed to reflect the SiS Project aims and to detect any unexpected outcomes. The online surveys were examined by the SiS Project Team, and the researcher subsequently made small edits to improve the instruments. The construction of the instruments and purpose of data collection are described in the following sections.

Focus Group Discussions

Focus group discussions were conducted to obtain information about SiS from SiSPOs, who were asked about their experiences in the role, their challenges and solutions, and their goals. Each SiSPO was asked to invite some scientists/mathematicians who had been in partnerships for at least a year to attend the discussion if they were able. Usually these participants arrived partway through the meeting. They were asked about (1) the nature and length of their partnership, (2) what they considered to be the benefits for them of the project, (3) what effects they thought they were having on teachers and students, and whether they had any "hard evidence" (such as enrolment changes) of this effect, (4) what they considered to be the criteria for a long partnership, and (5) if funding ceased for SiS/MiS, what would be the effect on schools, students, teachers, scientists and mathematicians. The focus group discussions were led by the researcher and took between one and two hours. Field notes were taken during the discussion.

Focus group discussions were conducted in Brisbane, Canberra, Melbourne and Sydney, involving 4 SiSPOs, 2 assistants, 9 scientists and 2 mathematicians. It was intended to hold further face-to-face discussions with other SiSPOs and scientists/mathematicians, but an injury to the researcher prevented further travel so the remaining SiSPOs were "interviewed" by email as described below.

Interviews by Email and Telephone

Email and/or phone interviews were conducted with 5 SiSPOs and several scientists and teachers.

The researcher contacted the remaining SiSPOs by email with a series of questions to be answered by email or phone. These questions asked (1) what SiSPOs regarded as the benefits of SiS/MiS for any of its participants and whether or not there was any hard evidence of this, (2) what SiSPOs believed are the main criteria for a long partnership, (3) because SiS is different from most similar programs internationally by having partnerships, not just a single visit by a scientist, what were the benefits, if any, of having multiple visits from a scientist/mathematician, compared to just a single visit, and (4) if funding ceased for SiS/MiS, what would be the effect on schools, students, teachers, scientists and mathematicians. All SiSPOs responded by email.

Three scientists who had been invited to participate in the focus discussions but were unable to attend had offered to communicate with the researcher by phone or email. In addition, several scientists were contacted who were partners of teachers who communicated with the researcher and they provided data by phone or email. Teachers who were partners of the scientists and mathematicians who had provided data were also invited by email to provide information about the partnerships. As many of these scientists and teachers would already have responded to the online survey, the questions in the invitation email were described as supplementary to the survey. The questions asked of both groups were (1) about how long is your partnership, (2) what specific benefits has it had for you and/or the students, and (3) SiS is different from most similar programs internationally because there are partnerships, not just a scientist visiting a school once off. In your view, what are the benefits to both schools and scientists, if any, of having multiple visits (or contacts) from a scientist, compared to just a single visit? These email/phone contacts resulted in responses from 9 scientists and 14 teachers.

Case Studies of Partnerships

Thirteen case studies of partnerships of at least one year in length were constructed from data obtained from partners separately, by face-to-face, phone or email interviews, as described above. The information was used to support or refute the trends relating to partnership outcomes and longevity that became evident from the online survey. The evaluation report carried out for the 2008-2009 stage of the SiS Project presented 12 case studies which conveyed the variety of types of partnerships, so it seemed unnecessary in this evaluation to focus on a detailed description of partnerships and more important to focus on the factors affecting longevity and the nature of the outcomes for participants.

Online Surveys for Scientists, Mathematicians and Teachers

Parallel online surveys for teachers and scientists had been used effectively in the two previous evaluations of the SiS Project. They provided a "big picture" view of SiS and in the 2008-2009 evaluation, case studies and other teacher and scientist data collected by focus groups and interviews provided a fine-grained view of SiS. Now that SiS was into its fifth year, it was considered important to again obtain the kind of big picture of SiS that a survey with several hundred respondents could provide.

The surveys used in the earlier evaluation were revised in collaboration with the SiS Team. Care was taken to ensure clarity in wording, delete unnecessary questions and several questions were revised to make them easier to answer. New questions were added to obtain descriptions of the numbers of students with whom scientists interacted and to try to gain access to any information respondents might have that could provide quantitative evidence of effects of the SiS program, such as increased student enrolments in science. A new question was added to ask respondents whether they were involved in the SiS or MiS program. Copies of the surveys for scientists and teachers are included in Appendices 1 and 2, respectively.

Consideration was given to creating separate surveys for scientists and mathematicians and for teachers involved in SiS and those involved in MiS, however a choice of four surveys online could be confusing. Replacing the word "science" with "science/mathematics" and "scientist" with "scientist/mathematician" was also considered, but it was thought that would make some questions too cumbersome. It was decided to ask mathematicians to complete the scientist survey, and teachers to answer the SiS survey if they were involved in MiS. It was hoped that these respondents would simply replace the words "science" and "scientists" with "mathematics" and "mathematicians" as they read. However, written comments on several surveys indicated that some mathematicians found this to be frustrating.

The survey contained seven sections and parallel versions were prepared for scientists and teachers. Because anonymity of responses was assured, respondents did not provide identifying data and therefore it was not possible to match the responses of partnership pairs.

Sections A and B were identical on both surveys. Section A requested demographic information to describe the school involved in the partnership. Section B requested data to describe the partnership, determine whether it was a SiS or MiS partnership and to identify partners' reasons for their participation. A matrix of year levels and potential subject areas of interest was used to identify the focus of the partnership. Respondents were asked whether or not this was the first partnership in which they had been involved, the length of the current partnership, whether or not the respondent had participated in any SiS events, and whether or not activities in the partnership had begun. Respondents who had not begun activities were asked to skip to Section F, thus ensuring that the sets of data collected in remainder of Section B and in Sections C to E were about partnership activities that had actually occurred.

The next part of Section B was designed to elicit the contribution of the scientist in the partnership and nature of scientist-student interaction. Respondents were given a list of nine possible contributions of the scientist to the partnership, and requested to answer "often" "occasionally" or "not used", according to the contribution. Other contributions could be added if appropriate. The following questions asked how many times the scientist interacted with students during the last year, the nature of the group and how many students it contained.

Section C was almost identical on both surveys. Ten possible benefits of the partnership to students were listed, and respondents answered yes or no to each benefit according to their perceptions of SiS outcomes. They were also asked to describe any other perceived benefit. The one difference was that scientists were also able to indicate if they were unsure of any benefit to students.

Section D was unique to each survey as it asked about the benefits of the partnerships to scientists or teachers, personally. Scientists were offered ten, and teachers were offered nine, possible benefits and both were asked to describe any others. In an open-ended question, both scientists and teachers were asked what, in their view, was the most important factor determining a successful partnership. Next, scientists were asked to rate, on a four-point scale, with ends labelled “not very confident” and “very confident”, their level of confidence in communicating science to others before and after their participation in the SiS program, that is, at the time of completing the survey. Teachers were asked two similar questions: They were asked to rate their level of confidence about teaching science and also their confidence about their knowledge of contemporary science before and after involvement in the SiS program.

Sections E and F were similar on both surveys. In Section E, respondents were asked what they considered to be the main impact of their partnership. The next question was designed to elicit possible evidence for the impact. Scientists were asked, if they were at a training institution had they noticed any change in enrolment patterns or interest in science-related careers that were attributable to SiS. Teachers were asked if they taught secondary students whether they were aware of any change to enrolment patterns in science. Section F simply asked all respondents to make any further comment they wished.

All scientists, mathematicians and teachers in active or assigned[4] partnerships were sent an email containing an invitation from the researcher to participate in the survey. This email was sent by the Project Team on October 24, 2011, the day the surveys went live, and contained a link enabling them to access the survey on the SiS website. A reminder email was sent out on November 17, and the survey was closed on November 28, 2011.

Technical support from the SiS Project Team was used to extract the data submitted into spread-sheets which were subsequently converted into data files and the quantitative data were analysed using IBM SPSS Statistics. The surveys elicited usable responses from a total of 976 respondents, comprising 452 scientists, 62 mathematicians, 420 teachers in a SiS partnership and 42 teachers in a MiS partnership.

Information from the SiS Project Team

Information was requested from the SiS Project Team to obtain an overview of the progress of SiS in terms of partnerships formed and maintained throughout the Project. This information included a spread-sheet of all partnerships which had been closed or withdrawn since the inception of the Pilot Project in July 2007, together with short notes from SiSPOs about the reason for termination. These reasons were clustered into themes, coded and analysed. A second spread-sheet was provided showing the length (in 6-month blocks) of all closed and active partnerships. Thirdly, a set of summary statistics was provided, showing the numbers of partnerships, their geographic location and type of school, and the numbers of individual scientists and teachers involved at November 28, 2011, the day the survey was closed. These statistics were used to determine the representativeness of the sample that completed the online survey.

Other data provided by the SiS Project Team included a set of reflection sheets completed at the annual team workshop in November, by request of the researcher, who was unable to attend. In addition, a member of the SiS Project Team prepared a summary of notes taken verbatim from the SiSPOs’ weekly reports over the six months April to October, 2011. Finally, the researcher obtained copies of all of the SiS Newsletters published thus far.

[4] Assigned partnerships were recently matched partners and were likely to be still planning activities.

Data Analysis and Reporting of Results

In the following sections the results from each stage of the data collection are reported and described. The first section provides an overall picture of the current status of the SiS Project, using information obtained from the SiS database and provided by the Project Team. This section provides context for the reporting of new data collected by the researcher. The next section reports results from the focus groups and interviews, and the findings from the online surveys. Attention is also given to evidence for the impact of SiS. The outcomes of all of these sections are used to draw conclusions and frame recommendations about the SiS Project.

Current Status of the Scientists in Schools Project

Administration of SiS

The administrative centre of SiS is located in CSIRO's Corporate Centre in Canberra. It is managed by a centrally located Project Team comprising a Project Director, Deputy Director, Senior Project Officer and an Administration Officer. From July 2008, regionally based SiS Project Officers (SiSPOs), who are mostly part-time, have been employed to assist with matching scientists and mathematicians with teachers, monitoring the resulting partnerships and other activities, such as organising information and networking meetings and other events to promote SiS and support partnerships. Close contact between SiSPOs and the central Project Team is essential for SiS to run smoothly, and a particular challenge is keeping the database as up-to-date as possible, so that the recorded status of partnerships is accurate. Major tasks for SiSPOs are to follow-up and keep in contact with partnerships. There is a procedure for regular reporting and an annual workshop (in November 2011, this was a three-day meeting) to enable SiSPOs to share experiences and ideas face-to-face. A flowchart of the staffing of SiS overall is shown in Figure 1. The effectiveness of the management of SiS was recently subject to a separate, independent evaluation and so this aspect is not part of the current evaluation.

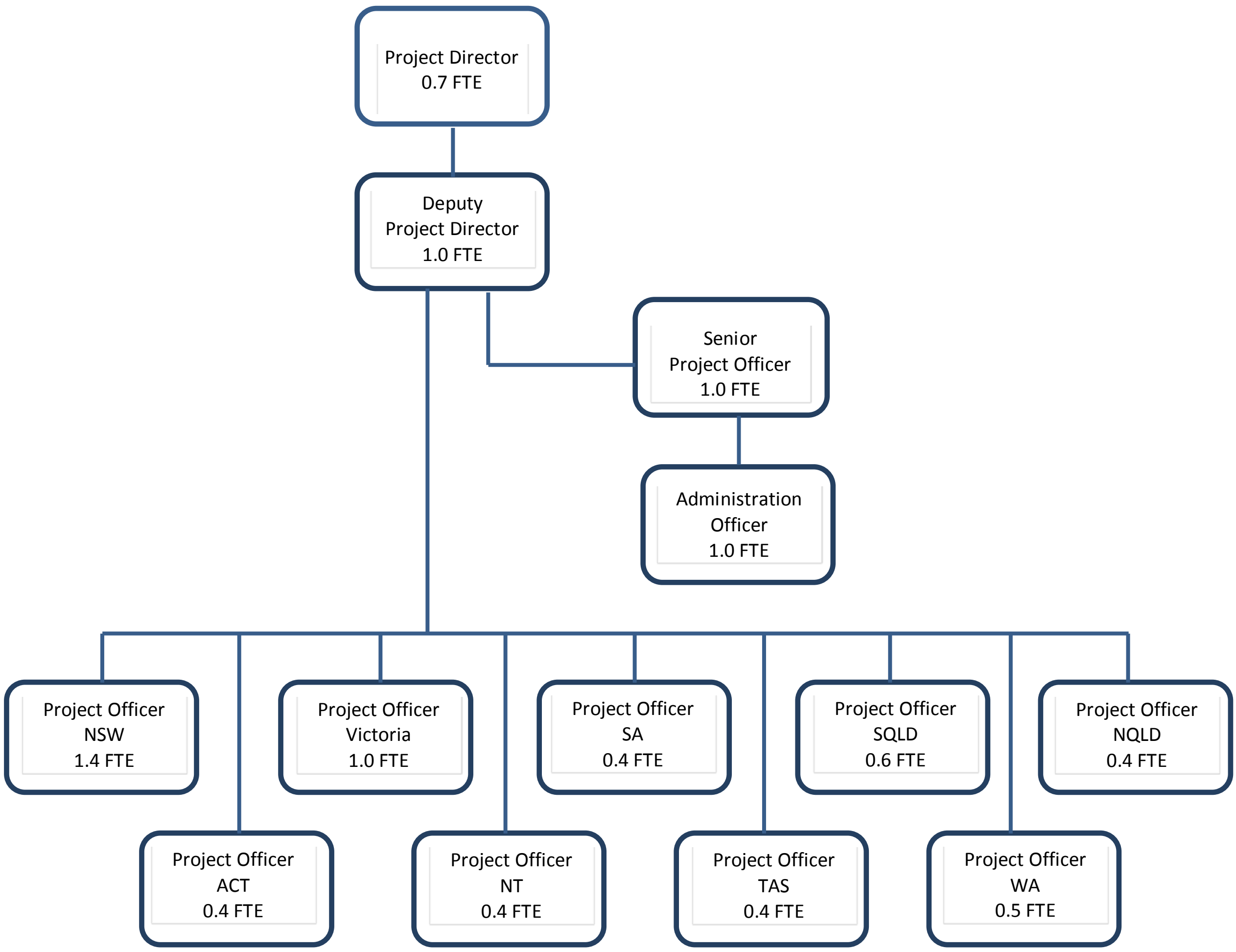

Figure 1. Organisational Chart for Scientists in Schools, November 2011

Patterns of Partnerships

An overall picture of how SiS manages the partnerships upon which SiS is based and the trends in these will provide helpful information to place this evaluation in context. Table 1 provides an overview of the numbers of partnerships in the SiS Project at 28 November, 2011, by jurisdiction. It is important to understand that the term "partnership" describes the relationship between one teacher and one scientist or mathematician. Some teachers and some scientists/mathematicians have more than one partnership, consecutively, or simultaneously. Thus, although the total number of partnerships reported in Table 1 is 1456, the numbers of teachers and scientists/mathematicians is smaller. Further, there is sometimes more than one partnership in a single school, so the number of schools is also smaller than the number of partnerships.

Table 1. Distribution of SiS and MiS Partnerships Nationally at 28 November 2011

	Total numbers involved in SiS and MiS partnerships				National totals	
State	Teachers	Scientists/ mathematicians	Partnerships	Schools	Number of schools	% schools with SiS
ACT	60	70	71	39	132	30%
NSW	333	310	382	309	3107	10%
NT	33	25	35	24	185	13%
Qld	266	232	302	216	1715	13%
SA	110	93	116	97	803	12%
Tas	88	72	96	55	279	20%
Vic	275	262	299	249	2292	11%
WA	145	126	155	129	1068	12%
Totals	1310	1190	1456	1118	9581	12%

Note: Data provided by the SiS Project Team as at 28 November 2011.

The final two columns of Table 1 report the number of Australian schools nationally and the percentage of them which contain at least one SiS or MiS partnership. It can be seen that the "penetration" of SiS into schools has an unweighted average of 12%, which is an impressive figure. The percentage of partnerships is highest in the ACT where there is a higher concentration of scientists/mathematicians due to the number of scientist-rich locations, such as CSIRO and the Australian National University.

Table 2 reports the total number of partnerships over the life of the SiS Project by jurisdiction and by type of partnership – SiS or MiS – at November 28, 2011. There are many fewer partnerships in MiS, partly because it is a more recent program, and also because few scientists refer to themselves as mathematicians. In Table 2, partnerships are described in five categories. *Active* partnerships are those which are currently running activities. *Assigned* describes a partnership where a scientist or mathematician has been assigned to a teacher in a school and they are in the process of planning their activities. Assigned partnerships are contacted within 6 weeks by SiSPOs to determine whether they can be reclassified as active, or if other assistance is needed to get underway. *Closed* partnerships are those that have been active and achieved some outcomes, but are no longer active. *Dormant* partnerships are currently in hiatus by mutual agreement, for example, one partner may be having a particularly busy period, or be absent on extended leave, but the intention is to resume activities at a later date. Partnerships are classified as *withdrawn* when the partnership has not, after a reasonable period following the assignment of partners, engaged in any activity.

When a partnership is terminated for whatever reason, the partners are often assigned to new partnerships, so some participants can have several partnerships, either simultaneously or sequentially.

Table 2. Overview of all SiS Partnerships Since Its Inception

Type	State	Active	Assigned	Closed	Dormant	Withdrawn	Total
SiS	ACT	44	8	53	6	26	137
	NSW	249	92	181	4	201	727
	NT	19	9	13	5	12	58
	Qld	192	82	182	19	214	689
	SA	75	24	84	10	37	230
	Tas	75	10	43	7	18	153
	Vic	229	36	254	32	122	673
	WA	103	39	83	5	78	308
SiS totals		986	300	893	88	708	2975
MiS	ACT	17	2	7	1	1	28
	NSW	24	17	8	-	17	66
	NT	3	4	-	1	1	9
	Qld	15	13	8	6	10	52
	SA	14	3	9	1	-	27
	Tas	7	4	-	-	-	11
	Vic	30	4	27	3	13	77
	WA	10	3	4	-	6	23
MiS totals		120	50	63	12	48	293
Total of SiS and MiS		1106	350	956	100	756	3268

Note: Data provided by the SiS Project Team.

Length of Partnerships

One of the outstanding features of the SiS Project is the notion of continuity. Instead of a single visit from a scientist, as in most other programs around the world, SiS works on repeated visits between partners over a period of time. The SiS Project Team provided information about the length of 956 closed and 1106 active partnerships in 6-month blocks, and the distributions of the lengths of these partnerships are graphed in Figures 2 and 3 respectively.

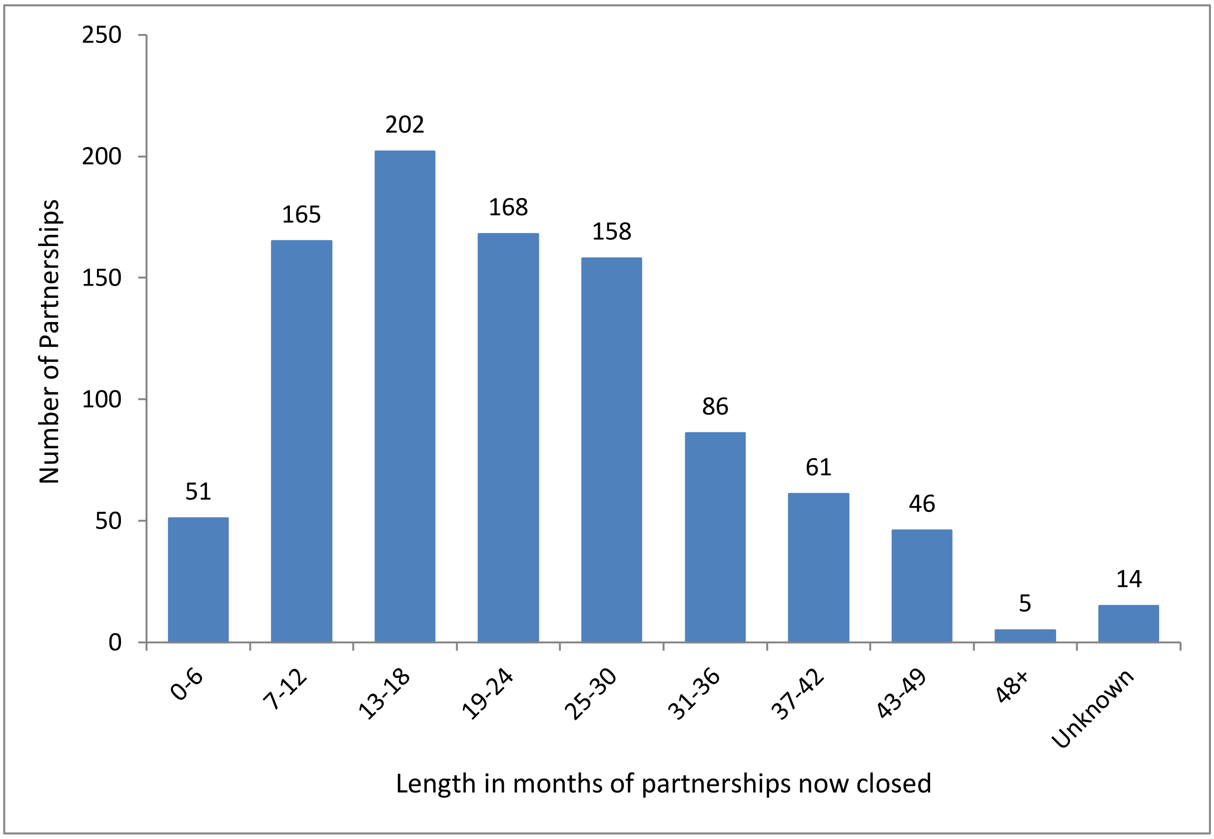

Figure 2. Distribution of length of closed partnerships

Figure 2 shows that the majority of closed partnerships had lasted between 7 and 30 months. The large majority (726 of the 942 partnerships of known length) had lasted for at least a school year, with 112 lasting for more than 36 months, or 3 years. Figure 3 shows the distribution of active partnerships as at 28 November, 2011. These partnerships were active at the time of the online survey closure and nearly all would be expected to last to the end of 2011 and most into 2012. There are 146 partnerships that are greater than 3 years in length, including 73 which are longer than 4 years, and another 242 of at least 2 years in length. These figures demonstrate that many successful partnerships are enduring relationships.

Recall that these data are for partnerships of specific teacher-scientist/mathematician partnerships, and not estimates of how long particular teachers or scientists/mathematicians have been involved in the program. Many have had several partnerships, so these data underestimate the time the "average" partner has been involved in SiS.

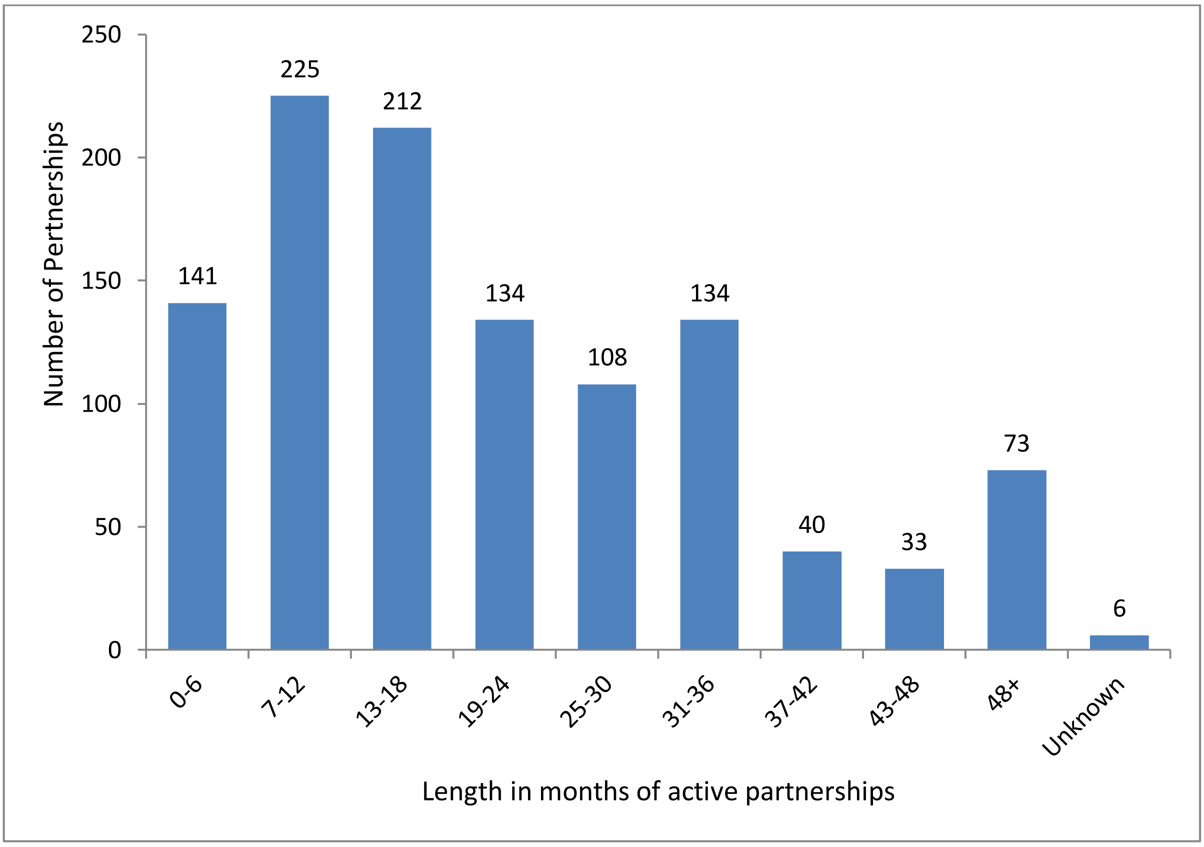

Figure 3. Distribution of length of active partnerships, 28 November, 2011

Reasons for Closing or Withdrawing Partnerships

An analysis of the reasons why partnerships were closed or withdrawn would be expected to throw some light on the conditions that were likely to affect partnership longevity. A spreadsheet was obtained from the SiS Project Team containing a cumulative database of partnerships that had been closed or withdrawn from the beginning of the program in 2007 until the end of September, 2011. This date was chosen to allow sufficient time for SiSPOs and other Project Team members to comment on the results. The database contained 1631 partnership records, of which 900 were described as "closed", meaning that the partnership had, at some time been active, and the remaining 731 described as "withdrawn". The intention was to analyse the reasons for termination, based on the notes written by the SiS officers that were included on the database. It is important to note that the unit of analysis is the partnership, that is, the pairing of one scientist/mathematician with one teacher, until that partnership was either closed or withdrawn. Many teachers and scientists are involved in multiple partnerships over time, so although the database listed 1631 partnerships, it contained reference to 1218 individual scientists/mathematicians and 1374 individual teachers.

The database was analysed in the following way. During discussion with the SiS Project Team, earlier in the year, and based on their experience and on the results of previous evaluations of the SiS program, a set of nine reasons was formulated to capture the key reasons for termination of partnerships. These are reported in Table 3. Following examination of the information available in the database, another 5 reasons were added. These are also shown in Table 3 numbered 10 to 14 inclusive. "Distance to be travelled" was used to describe termination when a partner considered the distance involved to travel for activities was too far to be sustainable. In addition, there were four categories where it was not possible to identify a reason for termination: the notes had been archived, and thus not available (13 closed and 2 withdrawn partnerships); there were no notes available (7 closed and 17 withdrawn partnerships); the notes contained insufficient information to determine a reason for termination (29 closed and 15 withdrawn partnerships); and in 11 cases, the partnership had been made in error, usually due to misunderstanding, and withdrawn. As no useful information was available from the 94 records coded for these last four reasons (5.8%), they were not considered for further analysis. In addition, another 70 of the closed partnerships were coded as having achieved their intended outcomes and they were not included in subsequent analyses. The remaining 1467 records were analysed to prepare Table 4.

Table 3. Classification of Reasons for Termination of Partnerships

Reason for Termination of Partnership	Number
1. Change of circumstances - scientist (movement, change job, leave, retirement, illness)	338
2. Change of circumstances - teacher (movement, change job, leave, retirement, illness)	307
3. Incompatibility with partner	128
4. Lack of communication from partner	309
5. Lack of motivation or commitment	133
6. Lack of support from institution	24
7. Lack of time	153
8. Partnership achieved its outcomes	70
9. Police check not current for scientist	49
10. Distance to be travelled	26
11. Archived record	15
12. No information	24
13. Insufficient information	44
14. Made in error	11

Note: Based on data provided by the SiS Project Team

Table 4 provides a breakdown of the reasons for closing or withdrawing partnerships. By far the most common reason for termination was a change of circumstances for one or other of the partners. Not surprisingly, this was more likely to occur in closed (52.8%) compared to withdrawn partnerships (34.0%), where more time had elapsed with activities underway. Further, it was a little more likely that the scientist was the one whose circumstances changed. That just over a third of assigned partnerships were withdrawn before they started due to change of circumstances underlines just how difficult it is for partners to plan a long time ahead.

Table 4. Analysis of Reasons for Closing or Withdrawing Partnerships

Reason for Termination of Partnership	Closed	Withdrawn	Total
Change of circumstances - scientist (movement, change job, leave, retirement, illness)	221 28.3%	117 17.1%	338 23.0%
Change of circumstances - teacher (movement, change job, leave, retirement, illness)	191 24.5%	116 16.9%	307 20.9%
Lack of communication from partner	135 17.3%	174 25.4%	309 21.1%
Lack of time	69 8.8%	84 12.2%	153 10.4%
Lack of motivation or commitment	59 7.6%	74 10.8%	133 9.1%
Incompatibility with partner	62 7.9%	66 9.6%	128 8.7%
Distance to be travelled	17 2.2%	9 1.3%	26 1.8%
Lack of support from institution	13 1.7%	11 1.6%	24 1.6%
Police check not current for scientist	14 1.8%	35 5.1%	49 3.3%
Totals	781 53.2%	686 46.8%	1467 100.0%

Note: Based on data provided by the SiS Project Team

The next most likely reasons for closing or withdrawing partnerships related to a lack of communication between partners, accounting for about a quarter of withdrawn partnerships. Often the SiS notes indicated that there had been attempts to facilitate communication, but in these cases, to no avail. Coupled with lack of communication are lack of time and lack of motivation to continue or begin the partnership. Sometimes these factors worked together, with time pressures preventing communication, and motivation and commitment subsequently drifting. Overall, these three factors accounted for a third (33.7%) of active partnership closures, and nearly half (48.4%) of assigned partnership withdrawals. This difference suggests that it requires sensitive assessment on the part of a SiSPO to determine which assigned partnerships are worth persisting with to bring to an active state, compared to effort exerted in keeping active partnerships alive. It also suggests that some partners enter SiS with insufficient understanding that time and effort are required to get an effective partnership working.

A factor accounting for around 9% of terminations was incompatibility with partner. Occasionally this seemed to be an instance of personality conflict, but usually it resulted from a lack of fit between what the teacher could fit into their curriculum planning and what the scientist had to offer once they had begun communication or activities. Sometimes, one partner had unrealistic expectations of the other's capabilities, competencies or commitment.

Lack of a current police clearance for the scientist was an inconvenient irritation for all concerned. Invariably, this resulted from administrative delays rather than ineligibility. Finally, two minor factors, the distance between the scientist and the school and lack of support from either the school administration or the scientist's line management, accounted for 1.8% and 1.6% of terminations, respectively.

A table similar to Table 4 was presented to the SiSPOs during their workshop in November and they were asked for their comments on the patterns of reasons for termination. Several SiSPOs thought that the proportions for lack of time and lack of motivation would have been higher. One suggested that lack of motivation might be hidden, politely, in "change of circumstances", and another reported deliberately making fewer partnerships where distance could be an issue. Otherwise, little surprise was expressed at the patterns in the table.

Findings from the Focus Group Discussions, Interviews and Documentary Evidence

Four focus group discussions included 4 SiSPOs, 2 assistants (one who assisted a current SiSPO and one who spent a year relieving as a SiSPO and was now working on revising the support material), 9 scientists and 2 mathematicians. Follow-up email "interviews" were completed with the other 5 SiSPOs. In addition, each SiSPO and assistant wrote a reflection (of about one page) on their experiences as part of the SiS Project. Phone interviews occurred with 2 scientists and emails were exchanged with 7 other scientists. Contact was initiated with 19 teachers of science and 2 teachers of mathematics, resulting in 13 email exchanges and 1 phone interview. Thirteen of the teachers were involved in the partnerships for the longitudinal case studies discussed below.

Analysis of Data from Focus Groups, Interviews and Documentation

The field notes from the focus group discussions, phone interviews and the contents of the emails and SiSPO reflection sheets were read carefully and summaries prepared. The questions asked in interview or email served as a guide to keep reporting focused, but the researcher remained alert for new or unexpected ideas and information. Additional information obtained from documents such as the SiS newsletters and summary of SiSPO reports was used to assist interpretation. Further, considerable light was thrown on some interpretations by the open-ended comments offered in completing the survey. All of these sources of data were used to prepare the following summary of the case studies and the subsequent sections synthesising the findings.

Overview of Case Studies of Partnerships

Thirteen case studies were constructed from data collected from teachers by email or phone, and scientists/mathematicians via focus groups, phone or email during October and November 2011. Each case study focused on one scientist/mathematician-teacher partnership, although one scientist was partnered with two teachers in different schools. An overview of the case studies is provided in Table 5, which also reports the location of partners and the type of school. Other information obtained from the case study partners has contributed to the findings in the following section.

Table 5. Overview of Case Studies of Partnerships

Case	Location	Sector	Type	Overview
1	ACT	Catholic	K – 12	4 years. The scientist worked mainly with senior students with their major projects. He believes a major benefit is "real-life practising scientists putting realism into the application in the school science curriculum". The teacher has been provided with a working knowledge of industry and how science works "at the coal face", which is also a great advantage to students.

2	ACT	Gov't	K – 6	2 years. The scientist, who is also a parent at the school, is employed part-time and visits school a day a week to work with Years 5-6. She endeavours to find resources for teachers who have limited time to search. It gives her teaching experience and also time to think about her own work. Teachers benefit from lesson supplements to extend every day lessons.
3	NSW	Gov't	K – 6	5 years. This is a remote school which the scientist visits once annually but keeps in touch with students emailing questions. A wide range of activities has occurred, including a community astronomy night. The teacher has gained in confidence, and now includes CREST[5] and other science programs in her curriculum.
4	NSW	Indep't	K – 12	5 years. The scientist judges the Year 10 science expo annually and talks about his work. The teacher finds him a great advocate for science in the community.
5	NSW	Indep't	K – 12	2 years. The scientist worked on microbiology with Year 6 students. He was invited by the teacher (a friend) to come for this specific purpose, who now contacts him when it is possible to include him in the curriculum. The teacher thinks it is "great that real scientists can go into classrooms to enhance student learning".
6	NSW	Gov't	K – 6	4 years. The scientist helps in Years 5-6 in a range of activities, rocks, eye dissections, electricity. She feels welcome and comfortable in school. The teacher values the ongoing relationship, that scientist is young and doesn't look like a "comic book scientist", and the teacher doesn't hesitate to ask her advice.
7	NSW	Catholic	K – 6	1 year. A retired mathematician spends at least half a day each week focusing on problem solving with able students from four different classes. He aims to improve maths teaching. The teacher finds him "a breath of fresh air", motivating and challenging to both students and teachers. A great rapport has built up between them.
8	NT	Gov't	7 – 12	3 years. This is a low SES school, where many students have little idea about science as it is so distant from their background. The scientist's aim is to get them interested in science and a possible career. He has developed a Year 12 course together with the teacher, and outcomes include 7 students achieving their results early, increased engagement and school attendance and more students are taking science in Year 11.

[5] CSIRO's CREativity in Science and Technology Awards program which supports students to undertake open-ended science and technology investigations

9	Qld	Gov't	1 – 10	1 year. Here, distance education students are involved in 5-week science units. Teleconference and a follow-up visit from the scientist were very successful. The scientist is looking forward to progressing the partnership in 2012, and teacher appreciates the involvement over the whole unit which helps build rapport with students who don't have a lot of contact with "outsiders".
10	Qld	Indep't	1 – 12	4 years. The scientist works with 7 classes of Year 9 students on a 5-week immunology unit aiming to assist students to develop investigative skills and communicate their results to their class. The teacher says students love hearing the perspective of a scientist. Students surveyed annually about program with very positive responses to activities and science.
11	Qld	Indep't	1 – 12	3 years. A forensic scientist assists with chemistry in Years 10 and 12, talking about her work (showing "great photos", according to the teacher) and helps teachers with technical questions. This teacher would like more contact with the scientist but her timetable is tight. The scientist "demolishes" stereotyped ideas about science and scientists.
12	WA	Gov't	K – 7	3 years. The scientist does a range of activities which are repeated with different classes. She believes students are now much more interested in science and she has developed better communication skills with people with limited knowledge. The teacher finds SiS helps to make the most of human resources that can benefit the students, who love to learn and share their ideas with other students.
13	WA	Gov't	8 – 12	2 years. The scientist fits in school visits between his travels to work with senior students on a project to develop a product or do research. The teacher believes it is "necessary for students to be exposed to real-life science as opposed to text book science". As this scientist is from another culture, he is able to demonstrate that science is international.

Synthesis of Findings from Discussions, Interviews, Case Studies and Documentary Evidence

The findings are reported based on five key themes: the role of the SiSPOs; the benefits for participants in the partnerships; the effects a continuing partnership has on scientists, teachers and students; what are considered to be the criteria for a long partnership; and, if funding ceased for SiS/MiS, what would be the effect on schools, students, teachers, scientists, and mathematicians.

The Role of the SiSPOs

Since their introduction in mid-2008, the SiSPOs have become a significant part of the SiS Project. Some of them have backgrounds as scientists or science communicators and others as teachers, so together they provide a diverse and knowledgeable resource for partners. Essentially their role is to promote SiS, recruit scientists/mathematicians and teachers to the program, match them into partnerships, assist them to get started, monitor partnerships to ensure they remain active (or remake them if that is the best option to maximise outcomes) and keep accurate, up-to-date records.

Effective, functioning partnerships are fundamental to SiS and, not surprisingly, most of the SiSPOs' time is devoted to this end. One SiSPO described it this way:

> I spend two days a week touching base with current partnerships; it is flagged by "the system" when to get in touch. I contact new partnerships 6 to 8 weeks after assignment to see what's happening. If they are active and going well, I set follow-up for 12 months, if they are active but struggling, I set it for 3 to 6 months. When partnerships start, I make sure activities are planned, and ask them to explain, to make sure what they are doing is fine. The next follow-up is after 6 to 12 months. You "get a feel" for ones that are going to go well. The monitoring role is finding a balance between the importance of a partnership actually working and the flexibility of the program to allow independence. It's important to know how competent partners are so you know when to leave them alone. There is no guide book, so many partners have difficulty knowing how to start and what is doable and realistic. Some partnerships close because although they think it is a good idea to be involved, they don't really know how to collaborate, and some have unrealistic expectations of what their partner can do and these need to be resolved.

Another SiSPO pointed out that the administration involved in following up is very time-consuming. "You don't want to hold people's hands, you need them to be independent, but you also need to know what is going on". It is the SiSPO's job to be there to help: "phone any time". It is their job to be bothered, and they can help, often very quickly.

Finding teachers and scientists that could be matched in the same location was often a challenge, and some SiSPOs were frustrated trying to find scientists for waiting teachers. Remote partnerships were difficult to make because many scientists prefer face-to-face contact, and Skyping was often disallowed by school firewalls. Sometimes mathematicians were harder to match because teachers are less accustomed to using them in their classrooms.

There was agreement that getting started was the hardest part of a partnership, particularly when partners had not previously met and were uncertain of each other's needs and capabilities. Confident science teachers, particularly in secondary schools, could use their scientist as someone they could bounce ideas off, and move along constructively with their scientist able to complement the planned curriculum. Other teachers, particularly in primary schools, who were not confident in science and did very little of it, needed the SiS scientist to support them and offer ideas to increase the amount and quality of science in their curriculum. Both types of teacher can be successful once they get started and have a scientist who is complementary to their needs.

Networking events were an important part of the SiSPO's role, used for informing and partner networking. Their location was varied both geographically and by type of venue. Successful events were described as beginning with a short description of "where SiS was at", followed by a tour of the facilities at the venue (if it was interesting) or a presentation of pervasive interest (for example, about the national curriculum), and then about an hour for "chat"; partners sharing what they were doing, and general networking.

One issue that arose several times was the police check required before scientists could enter schools. SiS pays for this, and although it is not difficult to obtain, delays were often time consuming and this caused considerable frustration when partnerships were keen to get started.

Overall, SiSPOs are dedicated professional participants in SiS. One summed up the SiSPO experience by reflecting:

> It's been a wonderful opportunity to be part of that rare thing – a program where seemingly everyone benefits. At its best the scientist inspires and enthuses both the teacher and the students, and often to the surprise of the scientist, the scientist is truly inspired back! I've seen (many!) primary school teachers who were timid and unconfident about teaching science (who would avoid it if possible) completely transformed by their SiS experience. Science has become a non-negotiable part of their schedule and experiments and analytical thinking have been incorporated into other areas of their curriculum also. And secondary teachers have had a real buzz working with active researchers – after all, it is why they themselves studied science.

Benefits for Participants in SiS and MiS Partnerships

There was no shortage of ideas from interviewees and others contacted by email about the benefits obtainable from SiS and MiS partnerships. Scientists were often enthusiastic about how much fun they were having, particularly enjoying the "ah ha" effect experienced by students and the appreciation from teachers for their support in areas where teachers feel less confident. Challenging talented students, making them think, and seeing their excitement when problem-solving, was the reward for one mathematician whose efforts were greatly appreciated by his teacher. One scientist in a long term partnership who visited the primary school frequently for a science club still has her partnership, but now visits less often because the teachers are now sufficiently skilled to run it themselves.

One SiSPO mentioned the building of scientists' communication skills: "Scientists need to talk to people and some do so very badly, albeit with great passion." A scientist in this focus group agreed, pointing out the need to explain their work into everyday language. "If you can explain it to a Year 4 student, you can explain it to a jury", said this scientist who is often called as an expert witness in trials. Other scientists mentioned unexpected benefits, such as getting ideas for their own work while researching ideas for school activities, or just doing something other than their own work.

Teachers mentioned the benefits of having a scientist who had "become a friend of the school community". Another teacher considered that "the benefits are endless – I have learnt so much from [my scientist]. She has supported my programs with advice, evidence, actual samples, taught concepts I did not have the confidence or knowledge to teach … she has links with labs and is able to get specimens for dissection".

Benefits for students included working with real scientists doing real science, demolishing the common stereotypes of scientists by finding out that they are ordinary people who can be somebody's neighbour or parent and wear almost any kind of outfit. Much greater interest in science as a career, particularly by primary students, brought concern from teachers who found they did not know the pathways to such a diversity of careers.

An important benefit of the SiS Project that was pointed out by one SiSPO, is that "it doesn't cost schools", thus making it accessible to low SES schools. Some scientists were keen to work only in such schools because they believed they could be of more benefit there.

The Effects of a Continuing Partnership

One of the defining characteristics of SiS is that it is built on partnerships. Interviewees were asked: “SiS is different from most similar programs internationally because there are partnerships, not just a scientist visiting a school once off. What are the benefits, if any, of having multiple visits from a scientist/mathematician, compared to just a single visit?” All responses to this question indicated benefits of long-term interaction between scientists and students. Many of these related to the building of comfortable relationships and the ability to plan longer term units or projects. One SiSPO captured most of the points made in a response reported verbatim in Box 1, where the key effects have been bolded.

(a) the benefits are enormous – **it is what makes this program work**. Only once the teacher/scientist or mathematician can relate to each other as individuals do these partnerships really take off. They need to spend time together figuring out what their respective roles are, for the scientists to figure out what level of ability the students are at (most scientists have NO IDEA of the different levels of schooling and what they do), and for teachers to work out the best way to “use” their scientist’s skills and understanding. Partnerships that consist of only 1 visit per year work in some circumstances, but generally a great partnership needs to have 1-2 interactions with the students/or teacher each term. Obviously there are some exceptions. Provided the two individuals are happy with their arrangement, anything is possible. I try and get an indication from the scientist early on about how much time they have available, actively encourage them to “start small” in terms of time committed (it can always increase), and make sure the teacher gets an idea of what they might be able to expect. A lot of teachers register and request a scientist to come in every week..... in an ideal world maybe...

(b) **partners gradually get to know each other better**

(c) **students gain confidence in interacting with the scientist/mathematician** and are more likely to ask more questions. The scientist also gains confidence about handling students and attempting to answer their questions - and learning to say “I don't know but let's find out together” or “how would you go about testing that”. Their knowledge of the curriculum would also continue to increase, especially if teachers were actively helping this process.

(d) **high school students** see a lot of “once off” visitors - careers talks/demonstrations/ presentations, etc. By having a regular scientist/mathematician visit their class they **will be able to engage with them on a much more personal/mentoring level** and will ultimately be able to ask them far more succinct questions about further study/careers/workplaces/experiences, etc.

(e) **ongoing PD for the teacher** – by having the scientist/mathematician around more often they continue to learn and build on their own knowledge. They might also visit the scientist at work during the school holidays to get a first-hand appreciation of what the scientist does.

(f) **it becomes less of a “whizz bang science demonstration”** of which there are plenty, and more about understanding how you do science, and think scientifically. Scientists can help teachers to guide students through class/individual projects. This is especially helpful for primary teachers who generally have no formal science training.

Box 1. A SiSPO’s summary of the benefits of continuing partnerships

A teacher remarked more briefly on similar points and those comments are in Box 2. Another teacher made similar points, adding the very pragmatic point that the scientist learns their way around the school so they can find classes without wasting time.

I guess the great benefit with utilising the same scientist is that we, the teachers and the students, can build up a comfortable relationship with the scientist. Our students are from remote areas and sometimes don't have a lot of contact with 'outsiders' so may be a little uncomfortable or nervous with strangers and take a while to interact and engage in sessions on-air or at a Minischool. As our science units are over five weeks it is great to have the continuity of the same invited guest.

Having the same scientist means that teachers can work with them planning a unit, deciding how they may help and follow through the process. Science is all about enquiry and both teachers and students will ask questions when they feel comfortable and not be embarrassed or feel they may be laughed at. Visits, in person and not just through web conferencing, help everyone get to know each other and familiarise faces, put faces to voices and get hands on together with experiments and procedures.

It goes both ways. If we utilise the same scientist they become familiar with our situation at Distance Education and can prepare accordingly.

Box 2. A teacher's perspective of the benefits of a continuing partnership

The Criteria for a Long Partnership

There was extensive agreement among interviewees about the requirements for a long and successful partnership. One scientist said bluntly, "Communication, communication, communication". That theme was echoed repeatedly and also is evident in the data relating to closed and withdrawn partnerships in Table 4, together with the next requirement: maintaining enthusiasm on both sides. Communication is important for maintaining motivation, because without communication, enthusiasm fades. Communication requires time and effort, so both scientists and teachers need to be "self-starters", as one SiSPO put it, ready to get moving. Another scientist noted the need for "joint driving; for teachers and scientist to agree on some dates in advance, so they don't tend to procrastinate. By making a commitment there is planned follow through". It is also important for each partner to have realistic expectations of what the other is able to do.

Not surprisingly, the absence of these things led to partnerships which faded over time. One scientist documented the demise of his partnership. He found that his teacher expected him to suggest what might be done and to prepare it, and although the teachers were positive and keen about what he did, they were busy and not proactive. Hence when he became busy with his own work, it was "too easy to let the partnership slide". This point highlights the role of the SiSPO when communication breaks down. As one SiSPO noted, there is often a feeling of guilt and embarrassment, so partners do not contact each other, whereas the SiSPO can do so and either assist to re-establish communication or close the partnership and rematch participants if that is the better option.

Box 3 contains augmented field notes from a focus group discussion with four scientists responding to the question about longevity of a partnership, highlighting other points, flexibility of partners, fitting the curriculum, and clear understanding of the purpose of the relationship.

J. Flexibility – no pressure to come or to do, but be available to answer questions (J has a “chatty, informal relationship” with her teacher)

K. Get along well, stay in touch. Our friendship has built even though there is a big age difference. (K’s teacher noted “I really value our relationship as it is ongoing and I never hesitate to call on K for advice or suggestions in addition to regular visits”)

R. Having something to offer directly relevant to their curriculum. It is important to fit the curriculum, otherwise teachers can’t find a place for you. This is most important in senior years.

J. Primary school is easier because they don’t have such a firm curriculum. Teachers can follow students’ interests and themes.

M. My high school success is built on the effort the school puts into the Science Fair. I have a specific purpose (as judge), I know what I am wanted to do, and I like that clarity and focus. In the primary school (M has a second partnership) the teacher also wanted something specific, and I could do something they were not able to do, but fitted into their curriculum.

Box 3. Discussion among scientists about longevity of partnerships

The Effect of Closing the SiS Project

The final question asked of most interviewees was “If funding ceased for SiS/MiS, what would be the effect on schools, students, teachers, scientists, and mathematicians?” There was a consistent response from all participants. Some currently strong partnerships would continue until circumstances changed, shaky ones would soon fade, and very few new partnerships would form. Teachers and scientists are busy people who, unless they are friends outside of their employment, or the scientists have children at the school, rarely communicate with each other. Interviewees argued that other scientists and teachers would not know how to start a partnership.

These views all highlight the centrality of the SiS Project Team, including SiSPOs, to the success of the program. They provide the framework to establish and facilitate partnerships. One small but very important factor is that SiS facilitates the police check which most scientists found very annoying. Without SiS help, some said they would not bother to organise it themselves. Further, some scientists already have trouble getting time during a working day to visit schools because their employer is not supportive of their involvement, and without SiS to provide legitimacy and credibility for the program, it would be even more difficult to participate.

Some interviewees were quite blunt in their assessment. One scientist thought it would be “a crime to cut the SiS budget”. Another described it as “one great lost opportunity”. Yet another summed up a theme that bubbled underneath some of the interviews (and also came through in comments on the online survey): “It would confirm what many believe: that government is not fundamentally interested in the shortage of maths and science graduates, that their oft-touted claims about the importance of science and maths to our future prosperity are hollow.”

Findings from the Online Surveys

The 976 responses to the online surveys were analysed separately for SiS and MiS partnerships. The much smaller number of respondents involved in MiS partnerships reflects the overall national composition of partnerships, as revealed in Tables 2 and 7a and 7b below. Because the surveys were set up to ensure anonymity of respondents, it is not possible to match teachers with their scientist or mathematician, but it is certainly the case that both members of many partnerships responded.

Demographic Information

Table 6 describes the samples responding to the scientist and teacher surveys by state and territory. The final column in the table reports national data obtained from the SiS database on November 28, 2011, the day the online survey closed. It can be seen that the distribution of survey respondents is reasonably similar to the total number of partnerships, except for proportionally fewer teachers in NSW responding, and proportionally more responding in Western Australia. At this date, the SiS database recorded 1456 active and assigned SiS and MiS partnerships involving a total of 1310 teachers and 1190 scientists (see Table 1), so the overall response rate to the survey was 43.2% for scientists and 35.3% for teachers.

Table 6. Respondents Involved in SiS and MiS Partnerships by State/Territory

State/Territory	Scientists/Mathematicians		Teachers		National Partnerships	
	Number	%	Number	%	Number	%
ACT	21	4.1	25	5.4	71	4.9
NSW	133	25.9	88	19.0	382	26.2
NT	6	1.2	8	1.7	35	2.4
Qld	103	20.1	103	22.3	302	20.7
SA	52	10.1	52	11.3	116	8.0
Tas	25	4.9	22	4.8	96	6.6
Vic	119	23.2	97	21.0	299	20.5
WA	54	10.5	67	14.5	155	10.7
Total	513	100.0	462	100.0	1456	100.0

Note. One scientist did not respond.

Tables 7a and 7b, respectively, describe the samples of scientists and teachers involved in SiS partnerships, and mathematicians and teachers involved in MiS partnerships, who responded to the online survey. Again, the final column in the tables report data from the SiS database as at November 28, 2011 (see Table 2). It can be seen that many fewer MiS partnerships are represented, but the response rates are similar to the total number of partnerships. In both tables, the patterns are similar between scientists and teachers, and mathematicians and teachers, except for proportionally fewer teachers in NSW responding.

Table 7a. Respondents Involved in SiS Partnerships by State/Territory

State/Territory	Scientists		Teachers		National SiS Partnerships	
	Number	%	Number	%	Number	%
ACT	17	3.8	21	5.0	52	4.0
NSW	114	25.3	81	19.3	341	26.5
NT	6	1.3	7	1.7	28	2.2
Qld	91	20.2	93	22.1	274	21.3
SA	44	9.8	46	11.0	99	7.7
Tas	21	4.7	19	4.5	85	6.6
Vic	109	24.2	88	21.0	265	20.6
WA	49	10.9	65	15.5	142	11.1
Total	451	100.0	420	100.0	1286	100.0

Note. One scientist did not respond.

Table 7b. Respondents Involved in MiS Partnerships by State/Territory

State/Territory	Mathematicians		Teachers		National MiS Partnerships	
	Number	%	Number	%	Number	%
ACT	4	6.5	4	9.5	19	11.2
NSW	19	30.6	7	16.7	41	24.1
NT	-	-	1	2.4	7	4.1
Qld	12	19.4	10	23.8	28	16.5
SA	8	12.9	6	14.3	17	10.0
Tas	4	6.5	3	7.1	11	6.5
Vic	10	16.1	9	21.4	34	20.0
WA	5	8.1	2	4.8	13	7.6
Total	62	100.0	42	100.0	170	100.0

The types of school represented in the survey data are shown in Tables 8a and 8b, which report for SiS and MiS partnerships, respectively. Around two-thirds of schools are government, about a fifth are Independent schools, and the remainder belong to the Catholic sector. The proportional distribution of SiS and MiS partnerships together in schools involved nationally in these sectors is 69.7% government, 14.9% independent, and 15.4% Catholic and this distribution is very similar to the distributions of respondents.

Table 8a. Participants Involved in SiS Partnerships by Sector

Sector	Scientists		Teachers	
	Number	%	Number	%
Government	311	69.4	294	70.5
Independent	76	17.0	69	16.5
Catholic	61	13.6	54	12.9
Total	448	100.0	417	100.0

Note. 4 scientists and 3 teachers did not respond.

Table 8b. Participants Involved in MiS Partnerships by Sector

Sector	Mathematicians		Teachers	
	Number	%	Number	%
Government	36	60.0	30	71.4
Independent	15	25.0	6	14.3
Catholic	9	15.0	6	14.3
Total	60	100.0	42	100.0

Note. 2 mathematicians did not respond.

The majority of respondents (around 60%) were located in schools in capital cities, about a quarter in regional cities and the remainder in rural and remote areas, as shown in Tables 9a and 9b. Location information from the SiS database is classified according to ARIA code, and so is not easily compared with the distributions of respondents shown here. However, with 62% of partnerships located in major cities (which include some regional cities), 20% in inner regional Australia and 18% in outer, remote and very remote Australia, the proportions seem to indicate that the survey sample is representative.

Table 9a. Participants Involved in SiS Partnerships by Geographic Location

Geographic Location	Scientists		Teachers	
	Number	%	Number	%
Capital city	274	60.6	238	56.7
Regional city	116	25.7	104	24.8
Rural and remote areas	62	13.7	78	18.6
Total	452	100.0	420	100.0

Table 9b. Participants Involved in MiS Partnerships by Geographic Location

Geographic Location	Mathematicians		Teachers	
	Number	%	Number	%
Capital city	42	67.7	28	66.7
Regional city	12	19.4	9	21.4
Rural and remote areas	8	12.9	5	11.9
Total	62	100.0	42	100.0

The above tables demonstrate that the distributions of respondents to the survey compare well with the overall distribution of partnerships for the SiS program, although it can be seen that the numbers involved in MiS partnerships tend to be more variable, probably because of the smaller sample size. This suggests that the voluntary survey sample is proportionally representative of the national distribution of partnerships, in terms of the numbers of partnerships in each state or territory, and the sector and geographic location of schools involved in partnerships.

More detailed information about the location of scientists, mathematicians and teachers is visible in Tables 10a, 10b, 11a and 11b. Here, the respondents are allocated across different types of schools by their geographic regions. The schools of the respondents in SiS partnerships are shown for scientists and teachers in Tables 10a and 10b respectively. The patterns are very similar: a little over half of the schools are primary and nearly 30% are secondary schools. Around 4% of partners were working in senior colleges (Years 10 and/or 11 and 12), and just over 12% of scientists and 15% of teachers were in schools with both primary and secondary students.

Table 10a. Type of School by Location for Scientists

Location	Primary School	Secondary School	Senior College	Combined Primary + Secondary	Total
Capital city	158	80	11	23	272
Regional city	49	41	3	23	116
Rural and remote areas	37	14	2	9	62
Total number	244	135	16	55	450
Percentage	54.2	30.0	3.6	12.2	100.0

Note. Two scientists had missing data.

Table 10b. Type of School by Location for Teachers Partnered with Scientists

Location	Primary School	Secondary School	Senior College	Combined Primary + Secondary	Total
Capital city	133	65	10	30	238
Regional city	56	30	3	15	104
Rural and remote areas	31	20	5	19	78
Total number	223	115	18	64	420
Percentage	53.1	27.4	4.3	15.2	100.0

Tables 11a and 11b report the distribution of mathematicians and teachers, respectively, in MiS partnerships. The two tables show similar distributions. However, compared with SiS partnerships, the pattern is quite different. Less than 30% are primary schools and half were in secondary schools. MiS respondents were twice as likely to be in senior colleges as SiS respondents. These results suggest that mathematicians were more easily placed in upper school classes than lower secondary or primary school classes. This suggestion is confirmed in Tables 17a to 18b describing the topics and year levels that were the focus of SiS and MiS partnerships.

Table 11a. Type of School by Location for Mathematicians

Location	Primary School	Secondary School	Senior College	Combined Primary + Secondary	Total
Capital city	16	17	3	6	42
Regional city	1	7	2	2	12
Rural and remote areas	1	7	-	-	8
Total number	18	31	5	8	62
Percentage	29.0	50.0	8.1	12.9	100.0

The distribution of primary schools to secondary schools in the survey sample is interesting. The data in Tables 10a to 11b can be combined into primary schools, secondary schools including senior colleges, and combined primary and secondary schools and the result is shown in Table 12. Included also are National data[6] for 2009, the latest report currently available, showing 9,529 schools in Australia, of which 67.3% are primary, 15.1% are secondary, and 13.2% are combined primary and secondary. The remainder (4.4%) are classified as special schools.

[6] *National Report on Schooling in Australia 2009*, Table 3.2. See http://www.acara.edu.au/reporting/national_report_on_schooling/national_report_on_schooling.html.

Table 11b. Type of School by Location for Teachers Partnered with Mathematicians

Location	Primary School	Secondary School	Senior College	Combined Primary + Secondary	Total
Capital city	11	12	3	2	28
Regional city	1	7	1	0	9
Rural and remote areas	0	2	0	3	5
Total number	12	21	4	5	42
Percentage	28.6	50.0	9.5	11.9	100.0

The data in Table 12 show that the percentage of combined primary and secondary schools in partnerships, as represented by scientists/mathematicians and teachers who responded to the online survey, is similar to the national data. However, the percentages show that there are almost one and one-half times as many primary schools as secondary schools involved in SiS partnerships. Nationally, however, there are more than four times as many primary schools as secondary schools. It is likely that this reflects that a greater proportion of secondary schools, compared to primary schools, are located in large centres, where most of the scientists and mathematicians are likely to be located.

Table 12. Schools Represented by Survey Respondents and National Data (%)

Level of school	Schools represented by respondents		National data
	Scientists/mathematicians	Teachers	
Primary	51.2	50.9	67.3
Secondary (including senior colleges)	36.5	34.2	15.1
Combined primary and secondary	12.3	14.9	13.2
Total	100.0	100.0	95.6

Note. National data are from Table 3.2, *National Report on Schooling in Australia 2009.* 4.4% of schools nationally are designated special schools.

Reasons for Participation in the SiS and MiS Projects

All respondents to the online survey were asked "why did you decide to participate in the project?" On each survey a list of eight potential reasons were suggested and respondents could choose whether these reasons were "important", "less important", or "not important" to them. The lists were prepared from the reasons given by scientists and teachers in response to the survey used in the 2008-2009 evaluation, in which respondents were asked an open-ended question. The themes identified in those earlier responses were not identical for scientists and teachers, so the lists of reasons here are a bit different and the results are reported separately. Respondents were able to add an additional reason, if they wished. Unfortunately, a fault on the survey resulted in unusable data for one item on the survey completed by scientists and mathematicians: "Practise my communication skills". This left a total of seven reasons for this group of respondents.

Tables 13a and 13b report the responses for scientists and mathematicians involved in partnerships, respectively, and Tables 14a and 14b report results for teachers in SiS and MiS partnerships, respectively. In all tables, the reasons are ordered in decreasing frequency of the response choices for "important". For ease of reading, science/scientists are replaced by mathematics/mathematicians in the wording of the tables.

Reason for Scientists' and Mathematicians' Participation in Partnerships

The results in Tables 13a show that scientists rated three reasons for their participation very highly; inspiring and engaging students, sharing their passion for science and raising the profile of science in school. Three other reasons were still important, but less so, for over 90% of scientists. Over 80% attributed at least some importance to offering school greater access to resources. Table 13b shows more varied responses from mathematicians, but with most importance given to the same items as were rated highly by scientists.

Table 13a. Importance of Reasons Given by Scientists for Participation in SiS (%)

Reason	Important	Less Important	Not Important
Inspire and engage students in science	98.5	1.1	0.4
Share my passion for science	91.4	7.5	1.1
Raise profile of science in schools	83.6	13.9	2.4
Promote contemporary science	59.5	35.6	4.9
Engage in service to the community	57.1	34.7	8.2
Alert students to science-related careers	55.8	38.1	6.2
Offer school access to better resources	41.8	41.6	16.6

Note. Data based on 452 scientists.

Table 13b. Importance of Reasons Given by Mathematicians for Participation in MiS (%)

Reason	Important	Less Important	Not Important
Inspire and engage students in mathematics	90.3	6.5	3.2
Share my passion for mathematics	82.3	12.9	4.8
Raise profile of mathematics in schools	74.2	16.1	9.7
Engage in service to the community	66.1	24.2	9.7
Alert students to mathematics -related careers	54.8	38.7	6.5
Promote contemporary mathematics	48.4	40.3	11.3
Offer school access to better resources	45.2	37.1	17.7

Note. Data based on 62 mathematicians.

Some respondents (66 scientists and 14 mathematicians) took advantage of the invitation to describe another reason for their participation and the themes they mentioned are clustered in Table 13c and ranked according to the number of scientists responding. The most commonly cited additional reasons included promoting their subject to students, giving something back to the community and having a family member at the school where they partnered.

Table 13c. Additional Reasons Given by Scientists and Mathematicians for Participation (%)

Other reason for participation	Scientists	Mathematicians
Increase students' opportunities to do science/mathematics	2.4	4.8
Make links with, or invest in the community	2.2	1.6
Have a family member at the school	2.2	1.6
Increase interest in science/mathematics more broadly	2.0	3.2
To have fun myself	1.8	1.6
Increase my own knowledge about the subject in schools	1.5	6.5
Keep up my teaching skills	1.1	1.6
Consider a career move to teaching	0.4	1.6
Facilitate my own professional development	0.9	-
Total scientists/mathematicians responding (%)	14.6	22.6
No response (%)	85.4	77.4

Note. Percentages based on 452 scientists and 62 mathematicians.

Some example comments from respondents are included below.

As a student, it would have been a dream opportunity for me to visit such a lab. I want to give like-minded students the chance I never had. (S93)[7]

Wanted to pass on to the next generation some of the knowledge I and people I know have accumulated over my working career. (S208)

To raise the profile of my area of interest – infectious diseases and lung disease. Also, I became a mother around the time that my partnership began, and I feel strongly that children are most open to new ideas and concepts when they are given a positive example (which I hope to be!) (S250)

To promote the idea that women can do science, that there are different ways of working scientifically, alert some of the students to the fact that there are already some opportunities around for them to contribute what they observe and therefore contribute to scientific endeavour. (S268)

Interaction with students. Kids (even teenagers!) are a fun distraction from the office :) (M233)

To do what the current curriculum doesn't do: Teach maths, its beauty and mathematical thinking to students. (M298)

As a lecturer in Mathematics at first second third and fourth year students at the University, I am most interested in keeping up with a good line of communication with the Senior mathematics student group at college level. (M129)

Reasons for Teachers' Participation in Partnerships

Tables 14a and 14b report the importance attributed by teachers to the list of potential reasons for their participation in the SiS or MiS partnerships, respectively. Interestingly, teachers in SiS partnerships tended to assign more importance, overall, to the reasons than did teachers in MiS partnerships. Access to a real scientist/mathematician and increasing student engagement were clearly the most important reasons for participation. Given the emphasis on literacy and numeracy in schools compared to science, particularly in primary schools, it is not surprising that 97.3% of teachers of science rated "raise the profile of science in school" as an important or less important reason for participation. Access to contemporary knowledge in the field was also considered an important reason for participation. Teachers in both SiS and MiS gave strong support to linking with the community, alerting students to careers and to professional learning for themselves. Of less importance, particularly for teachers in MiS, was access to better resources. Interestingly, no comments were recorded on the survey for teachers describing any other reasons for their participation.

[7] Quotations are identified by S = scientist, M = mathematician, TS = teacher in SiS, TM = teacher in MiS followed by an ID number in the survey.

Table 14a. Importance of Reasons Given by Teachers for Participation in SiS (%)

Reason	Important	Less Important	Not Important
Access to a real scientist	96.4	3.3	0.2
Increase student engagement	93.1	5.2	1.7
Raise profile of science in schools	84.2	13.1	2.6
Access to contemporary science knowledge	76.9	21.7	1.4
Make links with the community	71.1	25.8	3.1
Alert students to science-related careers	67.6	28.1	4.3
Access to better resources	59.9	34.4	5.7
Professional learning for me	49.9	40.3	9.8

Note. Data based on 419 teachers in SiS.

Table 14b. Importance of Reasons Given by Teachers for Participation in MiS (%)

Reason	Important	Less Important	Not Important
Increase student engagement	85.7	14.3	0.0
Access to a real mathematician	85.7	9.5	4.8
Alert students to mathematics-related careers	71.4	26.2	2.4
Make links with the community	71.4	21.4	7.1
Raise profile of mathematics in schools	69.0	23.8	7.1
Access to contemporary mathematics knowledge	61.9	26.2	11.9
Professional learning for me	47.6	38.1	14.3
Access to better resources	33.3	42.9	23.8

Note. Data based on 42 teachers in MiS.

Attendance at SiS Events

When scientists and mathematicians are matched with teachers, they receive some support from the SiSPO and also have access to resources on the website. An additional source of information is obtained by voluntary attendance at a workshop or networking event, which the SiS Project Team organises at varied venues. These serve to allow partners to meet and plan, sometimes for the first time. The online survey asked respondents whether they had attended any events, if they found attendance useful, and if so, in what way was it useful to them. Table 15 reports the percentages of respondents who have attended an event and it seems that the majority have not. About a third of teachers have attended, over 40% of scientists, but less than 30% of mathematicians.

Table 15. Attendance of Scientists/Mathematicians and Teachers at SiS Events (%)

Event Attendance	SiS partnerships		MiS partnerships	
	Scientists	Teachers	Mathematicians	Teachers
Responding Yes	43.6	34.0	29.0	35.7
Responding No	54.9	63.8	71.0	64.3
No response	1.5	2.1	-	-

Note. Percentages based on 452 scientists, 62 mathematicians, 420 SiS teachers and 42 MiS teachers.

An open-ended question allowed respondents to comment about the usefulness of the SiS events to them. Not all respondents who attended an event chose to make a comment, but between 80% and 90% did so. The comments were clustered into themes, coded with up to 2 codes per respondent, and reported for the different partners in Table 16.

The patterns of responses shown in Table 16 are similar across types of partnerships, suggesting that the SiS events were equally useful for all kinds of partners. Getting ideas from other partnerships was most important, followed by networking and meeting others. Next in usefulness was learning about the SiS program resources available both from the CSIRO and other sources, such as CREST, and getting to know their partner; for some this was their first meeting. There were a few comments which indicated that the event was not useful; some had attended before and found it repetitive and some mathematicians felt a little isolated being surrounded by scientists. A sample of comments relating to partners' experiences at events follows.

> It was very useful to see and hear the variety of ways other people are working on their partnerships. Also, other resources and opportunities are available to promote them to school. (S296)

> Vaguely useful ...the relevant teacher could not be present, but I met another teacher who was interested in starting a MiS project, and I heard about some ideas being used in other MiS projects. (M261)

> Background showing what others are doing and giving confidence that you are not the only "fool" giving large slabs of time to students. (S323)

> Very useful to catch up with partner, especially to get my partner enthused about the program and about the resources available. (S346)

I have been to two, two years apart. They were almost identical. They were fine as an intro but not useful particularly for someone with a bit of experience already (although I did learn a little bit about the new national curriculum). (S385)

Minimally so. My partnership seems to have evolved rather differently to other partners in SiS. With my minimal amount of time now available to contribute, I find that a few school visits a year, carefully targeted and matched to the curriculum needs of the teachers, seems to be the most efficient mode of interaction. (S481)

Useful to meet face to face with the organiser for the regional area. Equally to find out existing links of other schools. (TS13)

Extremely useful and inspiring - I was enthralled with the outstanding work being done in some areas by involved scientists. (TS73)

A PD followed by a dinner; both were very useful and well organised. (T283)

Table 16. Usefulness of SiS Event Attendance to Scientists/Mathematicians and Teachers (%)

Comment on Usefulness	SiS partnerships		MiS partnerships	
	Scientists	Teachers	Mathematicians	Teachers
Usefulness comments				
Getting ideas from other partnerships	48.7	42.0	33.3	26.7
Meeting people, networking	22.8	24.5	16.7	26.7
Learning about SiS and resources	13.2	9.1	16.7	6.7
Getting to know partner	11.2	18.2	16.7	-
Better understanding of scientists/mathematicians/teachers	5.1	4.9	-	6.7
Be inspired, motivated	5.1	9.8	5.5	6.7
Better understanding of subject curriculum/in school	3.6	2.8	-	6.7
Not useful comments				
Not useful, repetitive	3.0	2.1	5.5	13.3
Low attendance, partner not there	2.5	0.7	5.5	6.7
Event too far away	0.5	1.4		-
Unfocussed response	1.0	6.3	-	-
Total partners responding (%)	88.3	90.2	77.7	80.0
No response (%)	11.7	19.8	22.3	20.0

Note. Percentages based on the 197 scientists, 18 mathematicians, 143 SiS teachers and 15 MiS teachers who attended an event.

The Focus of SiS and MiS Partnerships

In this section, the level of schooling and the content focus of the SiS and MiS partnerships are described. The following four tables indicate the subject areas of interest of the partnerships according to ten topics and five year levels. Most partnerships covered more than one subject area and often involved students at more than one year level, so the total percentages in the tables frequently exceed 100%.

It is noticeable that for SiS, the partnerships reported in Tables 17a and 17b, include every combination of subject and year level. Interestingly, both the Pilot Project evaluation and the 2008-2009 evaluation demonstrated similar coverage, in that the partnerships covered all school year levels, and all seven subject areas listed in those evaluations. The data reported here show that the most common year levels involved were middle and upper primary and the most common content areas were biology and environmental science. This is consistent with the earlier evaluations where the most common topic was Living Things. Science inquiry skills were more likely to be part of the content in primary schools, and a career focus more likely to occur in secondary schools.

Table 17a. Subject Areas and Year Levels for Scientists Involved in Partnerships (%)

Subject Area	Lower Primary	Middle Primary	Upper Primary	Junior Secondary	Senior secondary	Total (%)
Earth and Space	15.0	17.3	15.9	8.8	5.8	62.8
Biology	21.0	24.3	23.9	13.5	18.1	100.8
Physics	9.3	14.6	13.5	8.4	8.8	54.6
Chemistry	12.8	17.0	18.1	9.3	11.7	68.9
Environmental Science	21.7	22.8	22.6	10.4	11.1	88.6
Mathematics	4.0	5.1	5.8	3.1	2.7	20.7
Engineering and Technology	4.6	6.9	9.7	5.5	6.0	32.7
Human & Social Aspects	6.4	6.4	6.6	4.0	3.5	26.9
Science Inquiry	18.8	19.9	20.1	10.2	10.2	79.2
Careers in Science	9.7	11.5	16.8	12.2	15.3	65.5
Total (%)	123.3	145.8	153.0	85.4	93.2	600.7

Note. Percentages based on 452 scientists.

Table 17b. Subject Areas and Year Levels for Teachers Involved in SiS Partnerships (%)

Subject Area	Lower Primary	Middle Primary	Upper Primary	Junior Secondary	Upper secondary	Total (%)
Earth and Space	14.0	15.2	16.9	7.4	5.2	58.7
Biology	16.0	19.0	20.5	14.3	23.1	92.9
Physics	8.6	10.2	12.4	6.9	10.2	48.3
Chemistry	11.9	14.8	20.0	9.5	12.6	68.8
Environmental Science	17.4	20.0	25.7	11.9	10.5	85.5
Mathematics	2.6	3.3	5.7	3.1	3.6	18.3
Engineering and Technology	4.3	4.8	8.3	4.3	5.7	27.4
Human & Social Aspects	7.1	10.5	10.5	6.9	6.4	41.4
Science Inquiry	20.2	22.1	27.6	17.1	14.8	101.8
Careers in Science	7.1	10.2	16.0	14.5	18.3	66.1
Total (%)	109.2	130.1	163.6	95.9	110.4	609.2

Note. Percentage based on 420 teachers.

Perhaps not surprisingly, mathematics was the subject of least focus area in the results for SiS partnerships, but by far the greatest focus in MiS partnerships, as shown in Tables 18a and 18b. Further, as suggested earlier in Tables 11a and 11b, there were more MiS partnerships working in secondary schools, particularly with upper secondary school students, than in primary schools.

It is noted that there are some empty cells in these tables for MiS partnerships, particularly at the lower primary level. This emphasises the focus on mathematics, but more importantly, the sample sizes of mathematicians and teachers with mathematician partners are much smaller than for science.

Table 18a. Subject Areas and Year Levels for Mathematicians Involved in Partnerships (%)

Content Area	Lower Primary	Middle Primary	Upper Primary	Junior Secondary	Senior secondary	Total (%)
Earth and Space	1.6	-	1.6	1.6	1.6	6.4
Biology	1.6	-	-	1.6	1.6	4.8
Physics	-	3.2	3.2	8.1	8.1	22.6
Chemistry	1.6	-	-	1.6	1.6	4.8
Environmental Science	1.6	-	-	3.2	3.2	8.0
Mathematics	6.5	14.5	30.6	51.6	59.7	162.9
Engineering and Technology	-	4.8	4.8	9.7	11.3	30.6
Human & Social Aspects	3.2	3.2	6.5	3.2	1.6	17.7
Science Inquiry	1.6	1.6	3.2	4.8	4.8	16.0
Careers in Science	1.6	1.6	4.8	4.8	12.9	25.7
Total (%)	19.3	28.9	54.7	90.2	106.4	299.5

Note. Percentage based on 62 mathematicians.

Table 18b. Subject Areas and Year Levels for Teachers Involved in MiS Partnerships (%)

Content Area	Lower Primary	Middle Primary	Upper Primary	Junior Secondary	Upper secondary	Total (%)
Earth and Space	-	-	2.4	2.4	2.4	7.2
Biology	-	2.4	7.1	2.4	2.4	14.3
Physics	-	4.8	7.1	2.4	7.1	21.4
Chemistry	-	4.8	4.8	2.4	7.1	19.1
Environmental Science	-	4.8	4.8	2.4	2.4	14.4
Mathematics	7.1	14.3	28.6	35.7	54.8	140.5
Engineering and Technology	-	4.8	7.1	2.4	2.4	16.7
Human & Social Aspects	-	2.4	4.8	2.4	2.4	12.0
Science Inquiry	-	4.8	7.1	4.8	-	16.7
Careers in Science	-	-	7.1	9.5	4.8	21.4
Total (%)	7.1	43.1	80.9	66.8	85.8	283.7

Note. Percentage based on 42 teachers.

Status of Current Partnerships

Respondents were asked three questions about the status of their current partnership: whether it was their first, how long it had been running, and whether or not they had started running activities with their partner.

Most respondents replied that the current partnership was their first; 78.5% of scientists and 75.7% of teachers in SiS partnerships, 87.1% of mathematicians and 85.7% teachers in MiS partnerships. As MiS is a recent sub-program of the SiS Project, it is not surprising that its percentages are much higher. A range of comments were made by respondents for whom this was not their first partnership; nearly all of these comments listed previous partnerships or locations, or described some of the activities.

Length of Current Partnerships

The SiS program began in the second half of 2007, so towards the end of 2011 partnerships could be over four years old. However, as described in an earlier section, over this period of time, many partners had experienced changes in their circumstances, so partnerships were closed, but very frequently, new ones were formed. It might be expected that not many partnerships would last as long as four years, even though a particular teacher or scientist may have been in the SiS Project for this length of time. Tables 19a and 19b provide information about the lengths of survey respondents' current SiS and MiS partnerships, respectively.

As expected due to the newness of MiS, a greater proportion of SiS partnerships have tenure longer than one year than do MiS partnerships. Nearly half of scientists (48.5%) and teachers in SiS partnerships (43.9%) have partnerships longer than a year, compared to a quarter of mathematicians (25.8%) and 40% of teachers in MiS partnerships. Assigned partners were expected to select "up to 2 months", or perhaps "2 to 6 months", and the relatively high omission rate for SiS partnerships could be that some of the assigned partnerships had not yet begun activities and were not considered as having a "length".

Table 19a. Length of Current SiS Partnerships

Length	Scientists		Teachers	
	Number	%	Number	%
Up to 2 months	40	9.3	48	11.8
2 – 6 months	94	21.8	71	17.5
6 – 12 months	88	20.4	109	26.8
1 – 2 years	109	25.3	101	24.9
Two years or longer	100	23.2	77	19.0
Total	431	100.0	406	100.0

Note. 21 scientists and 14 teachers did not respond.

Table 19b. Length of Current MiS Partnerships

Length	Mathematicians		Teachers	
	Number	%	Number	%
Up to 2 months	7	11.3	6	15.0
2 – 6 months	17	27.4	7	17.5
6 – 12 months	22	35.5	11	27.5
1 – 2 years	14	22.6	14	35.0
Two years or longer	2	3.2	2	5.0
Total	62	100.0	40	100.0

Note. 2 teachers did not respond.

Active Partnerships

Once a partnership has begun its activities, it is described as active, and much of the content of the online survey was designed to elicit partners' experiences in, and perceptions about, the SiS Project. It was important to know whether or not partnerships were active, so respondents were asked if they had begun activities. The results are in Table 20a and 20b for SiS and MiS partnerships, respectively.

It can be seen that well over 80% of partnerships were active. The remaining partnerships would be considered as assigned, and only a small number (presumably very recently assigned) had not yet made contact with their partner to begin planning. Most had, however, and comments in other sections of the survey indicated that partnership activities would start as early as "next week".

Table 20a. Number of Scientists and SiS Teachers That Had Started Running Activities

Started Activities?	Scientists		Teachers	
	Number	%	Number	%
Yes	385	85.4	342	81.4
No – not made contact	9	2.0	17	4.0
No – still planning	57	12.6	61	14.5
Total	451	100.0	420	100.0

Note. One scientist did not respond.

Table 20b. Number of Mathematicians and MiS Teachers That Had Started Running Activities

Started Activities?	Mathematicians		Teachers	
	Number	%	Number	%
Yes	53	85.5	37	88.1
No – not made contact	1	1.6	1	2.4
No – still planning	8	12.9	4	9.5
Total	62	100.0	42	100.0

Partners who answered “yes” to having started their partnership activities continued to respond to the following survey questions designed to learn more about the activities and outcomes of the SiS and MiS partnerships. Respondents who were still planning or were recently assigned and had not yet contacted their partner were asked to skip the remaining survey items and go to the “additional comments” section at the end of the survey. Thus, the following sections report results only for those scientists/mathematicians and teachers who were in active partnerships and responded “yes” in Tables 20a and 20b.

Contributions of the Scientist/Mathematician to the Partnership

The contributions made by the partners to the program in schools were determined by listing nine potential contributions and leaving a space for respondents to describe any "other activity" that may have occurred. As noted above, only the data for those respondents who indicated that they had started running activities were analysed.

The list of potential contributions was derived from those used in the 2008-2009 evaluation, with minor edits and an expanded response format. Respondents were asked to indicate whether the contribution was used "often", "occasionally" or "not used". Tables 21a and 21b report percentages for scientists and teachers in SiS partnerships, and for mathematicians and teachers in MiS partnerships, respectively. To use space effectively, percentages are reported only for the "often" and "occasionally" response categories and do not total to 100%. Contributions are ranked according to the frequency with which scientists/mathematicians responded "often", so the contributions perceived to be the most important are listed first.

It is important to recall that some of the scientist/mathematician respondents will be partnered with some of the teachers who responded to the survey, but as responses are anonymous it is not possible to know how many or to match them. Consequently, we cannot expect the patterns of responses for scientists and mathematicians to correspond exactly to those of teachers, but there should be some similarity if the data are valid.

Table 21a. Nature of Contribution Made by Scientists in the SiS Partnerships

Nature of Contribution	Scientists		Teachers	
	Often (%)	Occasionally (%)	Often (%)	Occasionally (%)
Visit classroom to interact with students	43.4	44.9	34.7	54.9
Assist teacher with science content	21.8	36.4	23.4	35.6
Supervise student(s) in a project	14.8	19.7	13.6	20.2
Make presentation to students in classroom about careers in science	9.9	40.5	10.7	46.0
Participate in excursion with students	8.3	16.6	11.3	20.5
Answer students' email questions	4.7	16.6	7.4	18.1
Presentation to parents or teachers about science	4.2	21.6	3.0	21.4
Judge a science competition	3.9	6.2	1.8	9.8
Support a science club	3.6	6.8	4.2	6.8

Note. Analysis based on responses from 385 scientists and 337 teachers.

Table 21a shows general agreement between scientists and teachers about the nature of the contributions. Most commonly, scientists visited classrooms and interacted with students, or they assisted teachers with science content. About a third of scientists assisted students with projects, and about half made presentations about science careers. A variety of responses were given in the "other activity" category. Scientists often presented prizes at ceremonies, participated in science fairs, and made presentations to classes other than those of their partner. Some responses simply gave more details about the activities already listed.

Table 21b. Nature of Contribution Made by Mathematicians in MiS Partnerships

Nature of Contribution	Mathematicians		Teachers	
	Often (%)	Occasionally (%)	Often (%)	Occasionally (%)
Visit classroom to interact with students	41.5	37.7	29.7	51.4
Assist teacher with mathematics content	11.3	35.8	5.4	24.3
Make presentation to students in classroom about careers in mathematics	9.4	28.3	10.8	35.1
Supervise student(s) in a project	7.5	15.1	5.4	10.8
Presentation to parents or teachers about mathematics	1.9	17.0	-	10.8
Answer students' email questions	1.9	9.4	8.1	8.1
Participate in excursion with students	1.9	3.8	2.7	8.1
Support a mathematics club	-	-	5.4	2.7
Judge a mathematics competition	-	1.9	-	-

Note. Analysis based on responses from 53 mathematicians and 37 teachers.

Table 21b reports the contributions made by mathematicians and teachers in the MiS partnerships. Generally, the pattern is similar to the SiS partnerships. Indeed, a comparison of each item revealed that only two contributions were perceived differently: Scientists were more likely than mathematicians to participate in excursions and to support a club.[8]

Frequency and Nature of Contact in SiS and MiS Partnerships during 2011

Similar questions were asked of teachers and their partners to obtain a picture of the frequency and nature of interaction with students in the SiS and MiS partnerships. The first question asked how often the scientist interacted with students during the last year, the second asked about the size of the group of students, and the third the number of students interacted with on each occasion. The following tables report these results for SiS and MiS partnerships, respectively. Together with the distributions of topics and year levels covered in Tables 17a to 18b, and geographic and sector location of respondents shown in Tables 10a to 11b, these data show that the nature of partnerships under the SiS program varies enormously.

[8] A Chi-square test indicated statistical significance at the .05 level ($\chi^2 = 9.89$, $p = .007$ for excursions and $\chi^2 = 6.06$, $p = .048$ for clubs), with small effect sizes (Cramer's V = 0.15 and 0.12, respectively). For Cramer's V, 0.10 is considered to be a small, and 0.30 a medium, effect size. It is interpreted as the proportion of variance accounted for in the relationship between the two variables.

Table 22a. Interactions between Scientists and Students in SiS Partnerships During the Last Year

How many interactions	Scientists		Teachers	
	Number	%	Number	%
Once	107	28.3	102	30.5
Twice	99	26.2	73	21.9
3 to 5 times	88	23.3	90	26.9
More than 5 times	84	22.2	69	20.7
Total	378	100.0	334	100.0

Note. 7 scientists and 8 teachers did not respond.

Table 22b. Interactions between Mathematicians and Students in MiS Partnerships During the Last Year

How many interactions	Mathematicians		Teachers	
	Number	%	Number	%
Once	12	24.5	10	30.3
Twice	12	24.5	7	21.2
3 to 5 times	9	18.4	4	12.1
More than 5 times	16	32.7	12	36.4
Total	49	100.0	33	100.0

Note. 4 mathematicians and 4 teachers did not respond.

Table 23a. Nature of the Group in SiS Partnerships During the Last Year

Nature of group	Scientists		Teachers	
	Number	%	Number	%
1 or 2 students	6	1.6	2	0.6
Small group	38	10.0	42	12.5
Whole class	198	52.0	163	48.4
Several classes	109	28.6	101	30.0
Varies according to activity	30	7.8	29	8.6
Total	381	100.0	337	100.0

Note. 4 scientists and 5 teachers did not respond.

Table 23b. Nature of the Group in MiS Partnerships During the Last Year

Nature of group	Mathematicians		Teachers	
	Number	%	Number	%
1 or 2 students	1	2.0	1	2.9
Small group	15	30.0	12	34.3
Whole class	23	46.0	15	42.9
Several classes	8	16.0	4	11.4
Varies according to activity	3	6.0	3	8.6
Total	50	100.0	35	100.0

Note. 3 mathematicians and 2 teachers did not respond.

Tables 22a and 22b show that there is no "typical" number of interactions between scientists or mathematicians and students, with the number of interactions spread over all four choices of group size. The next pair of tables, Tables 23a and 23b, describing the nature of the group, shows that scientists and mathematicians most commonly work with a whole class. Tables 24a and 24b report the number of students worked with on each occasion, and the mode of 16 to 30 students, or about one class, is consistent with these results. Scientists are next most likely to interact with several classes, while mathematicians are more likely to interact with small groups. This is also consistent with the results in both sets of tables. Information obtained from comments on the surveys and the case studies suggest that mathematicians, who are more likely than scientists to work with secondary school students (see Tables 10a and 10b), are also more likely to visit often and work with small groups.

Table 24a. Number of Students Interacted with on Each Occasion in SiS Partnerships

Number of students interacting with scientists	Scientists		Teachers	
	Number	%	Number	%
1 or 2	11	2.9	6	1.8
3 to 8	20	5.2	14	4.3
9 to 15	51	13.5	41	12.5
16 to 30	204	54.0	176	53.7
31 to 60	59	15.6	54	16.5
61 to 100	19	5.0	25	7.6
100 plus	14	3.7	12	3.7
Total	378	100.0	328	100.0

Note. 7 scientists and 14 teachers did not respond.

Table 24b. Number of Students Interacted with on Each Occasion in MiS Partnerships

Number of students interacting with mathematicians	Mathematicians		Teachers	
	Number	%	Number	%
1 or 2	2	4.0	1	2.9
3 to 8	9	18.0	7	20.0
9 to 15	14	28.0	6	17.1
16 to 30	18	36.0	16	45.7
31 to 60	6	12.0	4	11.4
61 to 100	1	2.0	1	2.9
100 plus	-	-	-	-
Total	50	100.0	35	100.0

Note. 3 mathematicians and 2 teachers did not respond.

How Many Students Have Been Involved in SiS and MiS Partnerships?

This is a very difficult question to answer, as the diversity of interactions in the above six tables reveal. It was unreasonable in a survey to request busy partners to remember sufficient details to calculate accurately the total number of students involved in their partnership and the number of student-scientist/mathematician interactions, and even if they had done so, the survey dealt with only a subset of the population, so the results would still be an approximation. In the interests of time and encouraging a response to the survey questions, partners were asked to respond on a simplified scale with bands of numbers of students and numbers of visits. The resulting data can be used to make estimates of both the number of students who were involved in SiS and MiS, and the total number of student-scientist/mathematician interactions, by calculating the minimum and maximum numbers reported by partners and interpolating a reasonable estimate, albeit with a considerable margin of error. The following tables report cross tabulations of the responses by scientists/mathematicians, and by teachers, respectively, of the number of school visits and the number of students interacted with on each occasion.

Table 25a. Scientist/Mathematician Reports of Interactions in SiS and MiS Partnerships

Times interacted	Number of students interacted with on each occasion							Total
	1 or 2	3 to 8	9 to 15	16 to 30	31 to 60	61 to 100	100+	
Once	5	11	21	47	18	10	6	118
Twice	3	7	16	51	22	5	5	109
3 to 5 times	1	3	9	64	15	3	2	97
5+ times	4	7	18	58	9	2	1	99
Total	13	28	64	220	64	20	14	423

Note. 15 scientists/mathematicians did not respond to both questions.

Table 25b. Teacher Reports of Interactions in SiS and MiS Partnerships

Times interacted	Number of students interacted with on each occasion							Total
	1 or 2	3 to 8	9 to 15	16 to 30	31 to 60	61 to 100	100+	
Once	2	8	9	54	21	7	6	107
Twice	0	1	9	46	16	5	2	79
3 to 5 times	3	2	14	51	11	10	2	93
5+ times	2	10	14	38	9	4	2	79
Total	7	21	46	189	57	26	12	358

Note. 21 teachers did not respond to both questions.

Using the data in Tables 25a and 25b, it is possible to calculate estimates of the minimum and maximum values for the total student-with-scientist/mathematician interactions, and also the minimum and maximum values for the total numbers of students involved in SiS and MiS partnerships in the samples of respondents. One set of results was obtained from scientist/mathematician data, and another set of results from teacher data.

Assuming that these samples are generally representative, and using 1456 (the number of partnerships at the close of the survey, see Table 1) to approximate the number of partnerships over the year, it is possible to estimate the maximum and minimum numbers of interactions and students nationally, as reported by scientists/mathematicians and by teachers. These estimates are reported in Table 26 to the nearest 1000. As the scientists/mathematicians and teachers are not matched in their partnerships, it is not expected that the estimates would be the same, however, they are reasonably close.

Table 26. Estimates of Number of Interactions in SiS and MiS Partnerships during 2011

Number of	Scientists/Mathematicians		Teachers	
	Minimum	Maximum	Minimum	Maximum
Interactions of student with scientist/mathematician	95,000	256,000	88,000	238,000
Students interacted with	31,000	58,000	34,000	62,000

The differences between minima and maxima are large, and the best estimate is somewhere between these. One way to make this estimate is to redo the calculations based on the midpoints of each of the bands of numbers or frequencies of interactions in the tables above. Another, less conservative, method is to average the estimates. Results for both of these methods are reported in Table 27. Again, in recognition that they are estimates, results are given to the nearest 1000.

Table 27. Midpoint and Average Estimates of Number of Interactions in SiS and MiS Partnerships during 2011

Number of	Scientists/Mathematicians		Teachers	
	Midpoint	Average	Midpoint	Average
Interactions of student with scientist/mathematician	164,000	175,000	152,000	163,000
Students interacted with	44,000	44,000	47,000	48,000

The results in Table 27 show a range of student- with-scientist/mathematician interactions for the last year between 152,000 and 175,000, a difference of 23,000. A reasonable estimate could be to allow for an error band of about twice this value, or 50,000, and suggest that the total number of interactions between students and scientists/mathematicians is in the range 140,000 to 190,000.

Table 27 shows that the range of estimated numbers of students involved in interactions with a scientist or mathematician is 44,000 to 48,000, a difference of 4,000. Using a similar approach as above, and suggesting an error band of 8,000, then the total number of students involved in the SiS Project may lie between 42,000 and 50,000.

A rough cost-benefit analysis can be carried out knowing that the funding for SiS in 2011 was $1,100,000. If it is considered that all benefits accrue to students, and using a conservative estimate based on Tables 22a and 22b that students are interacting 3 times a year with a real scientist or mathematician, then on average, students have interaction with a scientist or mathematician for about $8. If it is considered that all benefits accrue to scientists/ mathematicians and teachers, of whom about 2,500 are involved, then each partner is receiving professional development worth around $440. Further, there are benefits to school communities. The parent population of over 1100 schools involved in MiS or SiS partnerships have access, via their children, to insights about scientific practice and mathematical applications, a valuable means of increasing awareness of science and mathematics throughout the community. If it is assumed that all benefits go to school communities, then considering an average of only 500 parents per school, this represents an educational opportunity for about $2 each parent. Of course students, partners and school communities all benefit from the SiS Project, so these calculations, which are based on only one of these three groups, overstate the cost. In total, SiS provides an impressive level of benefits for the cost involved for all participants.

Benefits of the SiS and MiS Partnerships to Students

Benefiting students underpins the purpose of the SiS Project, both by direct interaction with scientists/mathematicians, and also enhancement of the pedagogical practice of teachers through their contact with scientists/mathematicians. Respondents to the survey were asked what benefits they perceived for students from the partnership with which they were involved. As before, a list of potential benefits was derived by minor editing of the list provided in the previous evaluation, taking account of responses to it. As in that evaluation, scientists and mathematicians were also offered the choice of “unsure of benefit to students”. The results for the SiS and MiS partners are reported in Tables 28a and 28b, respectively, by recording the percentage choosing the “yes” response to each item. Perceived benefits are ranked according to the frequency with which scientists and mathematicians rated the perceived benefit.

Table 28a. Perceived Benefits of SiS Partnership to Students

Perceived Benefit	Scientists’ View		Teachers’ View	
	Number	%	Number	%
Opportunity to see scientists as real people	375	98.2	334	99.1
Having fun	360	94.2	295	87.5
Opportunity to experience science with practicing scientists	353	92.4	311	92.3
Increased knowledge of contemporary science	346	90.6	315	93.5
Increased awareness of the nature of scientific investigation	341	89.3	293	86.9
Increased ability to recognise and ask questions about the world around them	338	88.5	294	87.2
Increased awareness of science-related careers	308	80.6	290	86.1
Increased understanding about using scientific evidence to make decision about health and the environment	289	75.7	259	76.9
Willingness to look to science to make decisions about their own lives	240	62.8	237	70.3
Access to science equipment and/or facilities	206	53.9	223	66.2
Unsure of benefit to students	23	6.0	NA	

Note. Analysis based on responses from 382 scientists and 337 teachers; 3 scientists and 5 teachers did not respond.

The results in Table 28a show that both scientists and teachers in SiS partnerships perceived great benefits for students. The opportunity to see scientists as real people and to work with them on real science to improve knowledge and awareness were very strongly supported. One teacher commented about benefits in an open-ended response: “An appreciation of the importance and value of science in our world and affirming their status as science learners worthy of attention from a practicing scientist” (TS73). These results are educationally significant in the context of the strand of Science as a Human Endeavour in the new Australian Curriculum: Science, and this point was remarked upon by some teachers and scientists in open-ended responses in other parts of the survey.

Having fun was also ranked highly, particularly by scientists, many of whom commented elsewhere about the fun they themselves were having. A scientist noted a "change in perception of science from 'boring' and only for old men, to 'exciting and fun'" (S368). In contrast, one teacher remarked: "Our students are all doing the IB curriculum which is very heavy with content. We don't have time to have 'fun'" (TS47).

Increasing awareness of science-related careers was regarded as a benefit by over 80% of respondents. One scientist put it rather poetically: "Planting the seeds of interest for the next crop of scientists" (S136). A teacher wrote that the "scientist was a great female role model. Amazing knowledge, energy and passion for her subject" (TS365). Another noted that "several students look likely to want to pursue a career in astronomy and this was well reinforced" (TS323).

Table 28b. Perceived Benefits of MiS Partnership to Students

Perceived Benefit	Mathematicians' View		Teachers' View	
	Number	%	Number	%
Opportunity to see mathematicians as real people	48	92.3	34	97.1
Having fun	41	78.8	26	74.3
Increased awareness of mathematics-related careers	37	71.2	28	80.0
Increased knowledge of contemporary mathematics	36	69.2	29	82.9
Opportunity to experience mathematics with practicing mathematicians	35	67.3	30	85.7
Increased awareness of the nature of mathematical investigation	34	65.4	23	65.7
Increased ability to recognise and ask questions about the world around them	33	63.5	26	74.3
Willingness to look to mathematics to make decisions about their own lives	20	38.5	19	54.3
Increased understanding about using mathematical evidence to make decision about health and the environment	17	32.7	18	51.4
Access to mathematics equipment and/or facilities	9	17.3	14	40.0
Unsure of benefit to students	6	11.5	NA	

Note. Analysis based on responses from 52 mathematicians and 35 teachers; 1 mathematician and 2 teachers did not respond.

There were similar patterns of benefits for students perceived by mathematicians and teachers in MiS partnerships, particularly the importance of seeing mathematicians as real people, and the importance of mathematics. For example, a teacher pointed out as benefits "seeing various aspects of mathematics used in the work place. Hearing about the different pathways possible after tertiary study" (TM253). A mathematician noted: "Increased enthusiasm for the fun that can be found in the mathematical patterns that exist all around us" (M277).

As in previous tables, support for the potential benefits listed in Table 26b was a little muted compared to the enthusiasm for the SiS partnerships. Perhaps this has some relationship with the fact that MiS partnerships were found mostly in secondary schools and SiS partnerships in primary schools, where a greater difference in emphasis is given to science in comparison with mathematics. Open-ended comments elsewhere in the survey suggested that some MiS partnerships focused on gifted or senior students.

Before leaving this section, it should be noted that the wording of the response choices on questions about benefits on the survey is generic, and a "yes" response indicates agreement, but does not reveal any of the subtleties that may underpin the response. This is why there are always opportunities to add in comments about "other benefits" in an open-ended response. In the case of benefits for students, 70 scientists, 20 mathematicians and 52 teachers made a comment. Several respondents gave considerable thought to their open-ended additional responses about the benefits to students, and three are reported below.

> In the case of the local school, an opportunity to see that a mum can be involved in science. For some individual students they found other opportunities to find out more or to make a contribution, for example an 8-year-old boy contacting me in the playground to get the web details again for the NSW wildlife atlas and the Birds Australia website. An understanding also that there are different ways of working scientifically, associated with careers for example, but in my own case I am an applied scientist so in recent years I have not been doing experiments or surveys in the fields but drawing knowledge together and trying to make sure the science gets into national park plans. An extension of this is that kids who may have been interested in a career with people may think now that science can be a career that offers people contact and can require people skills – i.e. the more straightjacketed thinking about – If I want to work with people I will be a teacher or a nurse – does not have to apply (S268)

> Some teachers have told me (and I have observed) that students will respond to me, and my more informal "lessons", when that same student is not necessarily very responsive in a formal lesson. Also, some children can show knowledge that they have, but which they don't get the opportunity to show in a formal lesson (even some autistic and educationally disadvantaged kids). Also there is the above mentioned comment about my being able to pick up misconceptions and discuss them – with teachers and all the class. (S451)

> It has been pleasant to see the indoctrination of mathematics as a cold, stale, hard, boring subject being ever so slightly undone. Obviously, having the true beauty of mathematics slowly revealed to them, the students themselves are benefiting, too. As an aside, the benefits to society of its children learning to think critically and logically cannot be exaggerated. It is this process which should be emphasised in maths classes (and which I emphasise with the kids), not memorisation of magical formulae. (M298)

Benefits of SiS and MiS Partnerships to Partners Themselves

Some of the important outcomes of SiS and MiS partnerships are associated with the benefits to the partners themselves. These benefits were explored using a slightly edited version of the list of possible benefits used in the 2008-2009 evaluation of SiS. The lists were a little different for scientists/mathematicians and teachers, so the results are reported for scientists and mathematicians in Table 29 and for teachers in SiS and MiS partnerships in Table 30. In these tables, the perceived benefits are ranked according to the frequency with which scientists and teachers in SiS partnerships responded "yes".

Table 29. Scientists' and Mathematicians' Perceptions of the Benefits of SiS Partnership to Themselves

	Scientists		Mathematicians	
Perceived Benefit to Scientist/Mathematician	Number	%	Number	%
Enjoyment in working with students	366	95.8	47	90.4
Opportunity to communicate with students	364	95.3	44	84.6
Opportunity to promote public awareness of science/mathematics	351	91.9	36	69.2
Enjoyment in working with teachers	327	85.6	40	76.9
Opportunity to communicate with teachers	326	85.3	41	78.8
Improved skills in communicating with students	316	82.7	32	61.5
Increased understanding of the community's awareness of science/mathematics	305	79.8	36	69.2
Opportunity to promote science/mathematics-related careers	284	74.3	34	65.4
Renewed satisfaction in my own career	272	71.2	27	51.9
Improved skills in communicating with teachers	249	65.2	29	55.8

Note. Analysis based on responses from 382 scientists and 52 mathematicians; 3 scientists and 1 mathematician did not respond.

Table 29 shows that enjoyment in working with students was ranked very highly by both scientists and mathematicians. Nearly as important a benefit for scientists, and well supported by mathematicians, was opportunity to communicate with students.[9] One mathematician remarked:

> Silly as it sounds, [a benefit for me is] time out of office. It's not that I don't like my office, it's just great to have a change of scenery for an hour now and then. This would be equally true of labs or field work if I was that sort of scientist, but I'm not, I just have an office – so getting out is good – and the fact that the change of scenery is to something as intense and dynamic as a school classroom is awesome, definitely keeps you alert!! (M233)

[9] A Chi-square test indicated a statistically significant difference favouring scientists at the .05 level (χ^2 = 9.26, p = .007), with a small effect size (Cramer's V = 0.15).

The largest difference is in terms of promoting public awareness of their subject; something perceived as important by over 90% of scientists, but not quite 70% of mathematicians.[10] Possibly this relates to the higher profile mathematics already has in schools. Around 80% of scientists and mathematicians enjoyed working and communicating with teachers. Interestingly, about 83% of scientists compared to 64% of mathematics believed that they benefited from improved skills in communicating with students and more scientists than mathematicians also found renewed satisfaction in their career.[11] Having opportunities to promote careers in science or mathematics were considered benefits by around 70% of respondents.

Table 30 reports teachers' perceptions of the benefits to themselves of participating in SiS or MiS. Three benefits are rated highly by both groups of teachers: opportunities to communicate, and enjoyment in working, with scientists/mathematicians, and the opportunity to increase students' engagement with science/mathematics. One teacher summed it up this way: "Learning new content, having fun, excitement, enjoyment. Working with a bright, enthusiastic, lovely scientist!" (TS16).

Table 30. SiS and MiS Teachers' Perceptions of the Benefits of Partnership to Themselves

	SiS teachers		MiS teachers	
Perceived Benefit to Teacher	Number	%	Number	%
Opportunity to communicate with scientists/mathematicians	328	97.0	31	88.6
Opportunity to increase engagement of students in science/mathematics	325	96.2	32	91.4
Enjoyment in working with scientist or mathematician	316	93.5	29	82.9
Enhance profile of science/mathematics in my school	303	89.6	27	77.1
Ability to update current scientific/mathematical knowledge	286	84.6	22	62.9
Ability to update knowledge of scientific/mathematical practices/methods	273	80.8	20	57.1
Increased motivation to teach science/mathematics	264	78.1	21	60.0
Increased awareness of science/mathematics-related careers	231	68.3	24	68.6
Opportunities to communicate with other teachers about the project	230	68.0	19	54.3

Note. Analysis based on responses from 338 SiS teachers and 35 MiS teachers; 4 teachers of science and 2 teachers of mathematics did not respond.

[10] A Chi-square test indicated statistical significance at the .05 level ($\chi^2 = 24.32$, $p = .000$), with a small effect size (Cramer's V = 0.24).

[11] Chi-square tests indicated statistically significant differences ($\chi^2 = 12.93$, $p = .001$ for communication skills and $\chi^2 = 7.94$, $p = .006$ for career satisfaction), with small effect sizes (Cramer's V = 0.17 and 0.14, respectively).

As for scientists and mathematicians, enhancing the profile of the subject was perceived as more important by SiS teachers, as was the ability to update their own knowledge of the subject and its practice.[12] Very likely this difference can be attributed to more MiS partnerships in secondary schools, where most of the teachers would be trained in their subject, whereas primary teachers are more likely to have limited training in science. One primary school teacher confessed "I realised a few 'furfies' that I had been teaching the children over the years (were not quite right!)." (TS298)

Another important benefit, particularly in SiS partnerships (and again probably because of the predominance of primary level partnerships), was increased motivation to teach the subject. This was clearly expressed by a primary teacher who wrote: "It made me dedicate a specific time each week for science. It took it out of the too hard basket. Science time is now a sacred site and happens every week" (TS450).

Scientists'/Mathematicians' Confidence in Communicating Science/Mathematics to Others

A potential benefit of participation in a SiS or MiS partnership was the opportunity to communicate science to others. Table 29 above revealed that both scientists and mathematicians gave very high ratings to the benefit of communicating with students and high ratings to the benefit of communicating with teachers. To try to measure this benefit, scientists and mathematicians were asked to rate their confidence about communicating science/mathematics before their involvement in the SiS or MiS program and to rate how confident they were at the time of responding to the survey. A four-point scale was used for ratings. The results for scientists are shown in Tables 31a and 31b, and for mathematicians in Table 31c.

Table 31a. Scientists' Ratings (%) of Their Confidence in Communicating Science to Others Before and After Involvement in the SiS Program

Time	Negative end point	1	2	3	4	Positive end point
Before SiS	Not very confident	0.8	14.2	38.1	47.0	Very confident
After SiS	Not very confident	-	1.6	36.1	62.3	Very confident

Note. Percentages calculated on 381 scientists, 4 did not answer both questions.

Table 31a shows that, overall, scientists' confidence in communicating science has improved through their involvement with SiS. It is interesting to examine these data separately for scientists whose partnership is in a primary school and those whose partnerships are at the secondary school level. These results are in Table 31b. The sample size is reduced overall by the omission of scientists in K-12 schools because it was not clear whether they worked with students at primary or secondary level.

Table 31b indicates similar levels of confidence for scientists whose partnerships are at primary and secondary levels when they began SiS, and also that the involvement in the SiS Project has resulted in a perceived increase in confidence for both groups of scientists. The percentage of scientists responding in the most confident category (rating 4) has increased by about 16% in each case. Dependent *t*-tests determined that these differences were statistically

[12] Chi-square tests indicated statistically significant differences (χ^2 = 4.86, p = .046 for subject profile, χ^2 = 10.44, p = .003 for updating knowledge, and χ^2 = 10.51, p = .002 for knowledge of current practices), with small effect sizes (Cramer's V = 0.11, 0.17 and 0.17, respectively).

significant, with $t = 8.81$ ($p < .0005$, $ES = 0.44$) for primary teachers and $t = 6.48$ ($p < .0005$, $ES = 0.46$) for secondary teachers. These changes have effect sizes (*ES*) that are described as moderate, and represent an increase of about 0.45 of a standard deviation.[13]

Table 31b. Scientists in Primary and Secondary schools Ratings of Confidence in Teaching of Science Before and After Involvement in the SiS Program (%)

Level of SiS	Time	Confidence in communicating science rating				Mean Rating	SD
		1	2	3	4		
Primary	Before	0.5	16.1	39.6	43.8	3.27	0.74
	After	-	2.8	37.3	59.9	3.57	0.55
Secondary	Before	0.8	14.0	38.8	46.3	3.31	0.74
	After	-	-	37.7	62.3	3.62	0.49

Note. Analysis based on 217 scientists at primary level and 121 scientists at secondary level.

The results in Table 31c suggest some increase in confidence in communicating mathematics among those with a middle level of confidence, but overall there was no statistically significant difference. Examination separately by mathematicians working in primary and secondary schools also showed little difference. Most (31) of the mathematicians were working with secondary school students, and most of the movement was among the 14 mathematicians working in primary schools.

Table 31c. Mathematicians Ratings (%) of Their Confidence in Communicating Mathematics to Others Before and After Involvement in the MiS Program

Time	Negative end point	1	2	3	4	Positive end point
Before MiS	Not very confident	2.0	15.7	31.4	51.0	Very confident
After MiS	Not very confident	2.0	2.0	45.1	51.0	Very confident

Note. Percentages calculated on 51 mathematicians, 2 did not respond to both questions.

Respondents were invited to indicate the main reason for any change in their confidence, and 87 of the 106 scientists and 5 of the 9 mathematicians who did perceive a change wrote a descriptive comment. The comments were clustered into themes and coded according to the theme. A summary of the responses is reported in Table 31d and example comments are given following the table. Some other respondents who perceived no change merely wrote “no change”, or commented that it was too soon to tell whether there was change. Most often, scientists and mathematicians attributed change to practice and experience and getting feedback from the students.

[13] The effect size (*ES*) is the standardised difference between mean scores, calculated using the mean difference and the pooled original standard deviations, as recommended by Dunlop et al. (1996) for dependent designs to avoid overestimation. Based on Cohen (1988), it is usually accepted that an effect size of 0.2 is small, 0.5 is moderate and 0.8 is large.

Table 31d. Reasons Given by Scientists and Mathematicians for Any Change in Confidence (%)

Reason for change	Scientists	Mathematicians
Practice/experience	44.8	60.0
Seeing student engagement and feedback from them	27.6	-
Better understanding of what public thinks about science	14.9	-
Help from teacher	6.9	40.0
Better understanding of students	1.1	-
SiS legitimates my activity	1.1	-
Already good communicator	2.3	-
Had education training previously	1.1	-

Note. Percentages based on 87 scientists and 5 mathematicians.

> I am still working on it! I have a better idea of how much I can expect to get across and how to go about it. The kids never respond as you expect them to. (S11)
>
> Having education training early in my career was beneficial to breaking sometimes difficult concepts into smaller parcels. (S33)
>
> I think that if you stick to what you know and feel comfortable with talking about, then that's a good place to start for communicating science. Don't go in with the expectation of being Dr Karl! It's OK not to know the answer to a question but take time/ask for help from others to get an appropriate answer back if warranted. (S59)
>
> Some trivial answers are very obvious to students that scientists miss sometimes due to other scientific considerations!! (M92)
>
> Taking feedback from the class and their enthusiasm aids development of the need to communicate science. (S138)
>
> Experience. I have now presented to (including all schools I am associated with) over 1200 students both in big groups as well as class sized groups. (S381)
>
> I realised it is not as hard as I expected and that the students are interested in the things I least expected, often simple little things they can relate to themselves. I was worried that my area of science might be a bit boring, but there were lots of aspects that they found really interesting, so it's a case of being flexible and going with what interests them. (S255)
>
> The positive feedback from the students makes me wanting to do better in my reply and increase my confidence in my communication with them in the process. (S174)
>
> Children are a great reality check. (S359)
>
> Need more practice with the grade 1s! They ask tricky, random questions! (S379)
>
> It provides valuable experience in translating the practice of science from the position of being an inward looking nerd to someone who can present to outsiders so that it is of interest to all. (S60)

Teachers' Confidence in Teaching Science/Mathematics

A notable outcome of SiS uncovered in the earlier evaluation of the SiS Project was that many teachers, particularly primary teachers, stated that they had increased in confidence to teach science because of their participation in SiS. In the current evaluation, this was measured by teachers' self-reports of their confidence in teaching science/mathematics before their involvement in the SiS or MiS program and after it, that is, at the time they completed the survey. The results are shown in Table 32a and 32b for teachers in SiS partnerships and in Table 32c for teachers in MiS partnerships.

Table 32a. Teachers' Ratings (%) of Their Confidence in Teaching Science Before and After Involvement in the SiS Program

Time	Negative end point	1	2	3	4	Positive end point
Before SiS	Not very confident	4.2	10.7	32.1	53.0	Very confident
After SiS	Not very confident	1.8	1.2	30.4	66.7	Very confident

Note. Percentages calculated on 336 SiS teachers, 6 did not respond to both questions.

The data in Table 32a suggest an increase in confidence in teaching science, but this can be examined more closely by making separate comparisons of the responses of teachers in primary and secondary schools. As primary school teachers usually have a limited science background, their confidence might be expected to improve more than for teachers in secondary schools and senior colleges. These data are reported in Table 32b. The sample size has reduced from 336 in Table 32a to a total of 281 by omitting those teachers in K-12 schools because it was not clear whether they taught science at the primary or secondary level.

Table 32b. Primary and Secondary Teachers' Ratings of Confidence in Teaching of Science Before and After Involvement in the SiS Program (%)

Level Taught	Time	Confidence in teaching science rating				Mean Rating	SD
		1	2	3	4		
Primary	Before	5.9	16.7	44.6	32.8	3.04	0.86
	After	1.1	2.2	42.5	54.3	3.50	0.60
Secondary	Before	1.1	3.2	15.8	80.0	3.75	0.56
	After	1.1	-	16.8	82.1	3.80	0.48

Note. Analysis based on 186 primary teachers and 95 secondary teachers.

Table 32b shows clearly that primary teachers do report lower levels of confidence in teaching science than do secondary teachers, and that the involvement in the SiS Project has resulted in teachers perceiving that their confidence has increased. The percentage of primary teachers responding in the most confident category (rating 4) has increased from 32.8% to 54.3%. As would be expected for the usually science-trained secondary teachers, the increase in confidence is rather small. Dependent *t*-tests determined that these differences were statistically significant, with $t = 9.35$ ($p < .0001$, $ES = 0.59$) for primary teachers and $t = 2.29$ ($p = .025$, $ES = 0.09$) for secondary teachers. The change for primary teachers is especially notable as it exceeds one half of a standard deviation, a substantial increase and one which was strongly supported by interview and other contact with primary teachers.

Any changes in teachers' ratings of their confidence in teaching mathematics were examined by preparing parallel tables for teachers in MiS partnerships. The overall results are shown in Table 32c. Because there is a stronger focus on numeracy and teaching mathematics in primary school than teaching science, it might be expected that there would be less scope for change because all primary teachers have a solid grounding in teaching for numeracy. Indeed the results in Table 32c show that teachers were more confident in teaching mathematics before MiS participation than were teachers of science before participation in SiS (see Table 32a), and there is very little change. Inspection of the data indicate that one primary school teacher moved from a rating of 2 to 3, and one secondary teacher moved from a rating of 3 to 4. No further analyses were undertaken.

Table 32c. Teachers' Ratings (%) of Their Confidence in Teaching Mathematics Before and After Involvement in the MiS Program

Time	Negative end point	1	2	3	4	Positive end point
Before MiS	Not very confident	-	3.1	31.3	65.6	Very confident
After MiS	Not very confident	-	-	31.3	68.8	Very confident

Note. Percentages calculated on 32 MiS teachers.

To assist understanding of the changes in confidence in teaching science, teachers were requested to comment on the main reason for any change. A total of 81 teachers in SiS partnerships and 2 in MiS partnerships perceived a change in confidence and on 66 of the SiS teachers made a comment. The two teachers of mathematics both commented that the presence of the mathematician was reassuring to them. Because of the difference in responses for primary and secondary SiS teachers, their responses were examined separately; however, only 56 primary and 4 secondary teachers provided a written response, with the other 6 teachers in K-12 schools omitted because it was not clear whether they taught at primary or secondary level. Teachers' comments are summarised in Table 32d, and most refer to support from the scientist. Some example comments are given below.

Table 32d. Reasons Given by SiS Teachers for Change in Confidence in Teaching Science (%)

Reason for any change in confidence in teaching science	Primary SiS	Secondary SiS
Scientist helps me understand/explains	37.5	-
Reassurance from presence of scientist	33.9	75.0
Seeing different ways of explaining/broadening view	14.3	25.0
High level of student engagement and feedback from them	8.9	-
I like science	3.6	-
Practice/experience	1.8	-

Note. Percentages based on 56 SiS teachers in primary schools and 4 teachers in secondary schools.

Reassurance of my knowledge and the carefree attitude of Dr S instilling confidence. (TS1)

Watching the high level of student engagement and enthusiasm, helps to understand the necessity of providing rich scientific lessons. (TS79)

I think any increase in confidence came about through just becoming more experienced. I run a pretty focussed but relaxed show. Kids look forward to their class all week. (TS102)

Our scientist is keen, flexible, interesting and very normal. (TS147)

The scientist I worked with explained everything so simply that even I could understand! By working and planning together he has given me greater insight on how to plan lessons more effectively for the children to investigate the area we were working on whilst having fun and learning! (TS265)

Practice! Being able to "pick the brain" of my scientist without feeling stupid. (TS285)

Just having a reason to have a go and get support from a visiting scientist and being able to observe science being enjoyed by the kids. Primary Connections is a great resource and this as well as a scientist has helped a great deal. (TS450)

Teachers' Confidence in Their Knowledge of Contemporary Science/Mathematics

A second question on the Teacher Survey asked teachers to rate their confidence in their knowledge of contemporary science/mathematics before and after their experience in the SiS or MiS program. A fault in the survey resulted in a shortfall of responses to these questions, with about a third of teachers responding before it was corrected, so the sample size is smaller than for the previous question.

Table 33a reports the results for teachers in SiS partnerships. The results reveal a positive change in teachers' ratings of their knowledge before and after their involvement in SiS. Again, further information about where those changes are found is gained by breaking the sample into teachers who teach in primary schools and those who teach in secondary schools, and the results are shown in Table 33b.

Table 33a. Teachers' Ratings (%) of Their Confidence in Their Knowledge of Contemporary Science Before and After Involvement in the SiS Program

Time	Negative end point	1	2	3	4	Positive end point
Before SiS	Not very confident	7.6	21.1	52.0	19.3	Very confident
After SiS	Not very confident	2.2	9.4	49.8	38.6	Very confident

Note. Percentages calculated on 223 SiS teachers.

Table 33b demonstrates lower levels of confidence in their science knowledge for primary teachers than secondary teachers. This is not surprising because primary teachers of science are generally not science-trained. Importantly, involvement in the SiS Project has resulted in teachers at both primary and secondary level reporting that their confidence has increased. The percentage of primary teachers responding in the most confident category (rating 4) has more than doubled, from 12.9% to 31.5%, and it has almost doubled for secondary teachers, from 25.4% to 49.2%. Dependent *t*-tests determined that these differences were statistically significant, with $t = 9.70$ ($p < .0001$, $ES = 0.66$) for primary teachers and $t = 4.85$ ($p = < .0001$, $ES = 0.45$) for secondary teachers.

Table 33b. Primary and Secondary Teachers' Ratings of Confidence in Their Knowledge of Contemporary Science Before and After Involvement in the SiS Program (%)

Level Taught	Time	Confidence in knowledge rating				Mean Rating	SD
		1	2	3	4		
Primary	Before	12.9	30.6	43.5	12.9	2.56	0.88
	After	3.2	13.7	51.6	31.5	3.11	0.76
Secondary	Before	1.7	8.5	64.4	25.4	3.14	0.63
	After	1.7	3.4	45.8	49.2	3.42	0.65

Note. Analysis based on 124 primary teachers and 59 secondary teachers.

Changes in teachers' ratings of confidence in their knowledge of contemporary mathematics following their involvement in the MiS program are explored in Table 33c. The numbers are small, but there were positive changes among the 5 primary and 13 secondary teachers involved. Despite the small sample size, these changes were statistically significant at the 0.05 level ($t = 2.36$, $p = .030$) with a moderate effect size of 0.70. Further, comparison with Table 32c indicates that teachers, including secondary teachers, seem to be more confident in their ability to teach mathematics than in their knowledge of contemporary mathematics, and it is here where MiS may be able to make a difference. No further analyses were pursued because of the small sample size.

Table 33c. Teachers' Ratings (%) of Their Confidence in Their Knowledge of Contemporary Mathematics Before and After Involvement in the MiS Program

Time	Negative end point	1	2	3	4	Positive end point
Before MiS	Not very confident	-	16.7	66.7	16.7	Very confident
After MiS	Not very confident	-	-	61.1	38.9	Very confident

* Percentages calculated on 18 MiS teachers.

Teachers were asked to comment on the main reason for any change they felt in confidence in their knowledge of contemporary science. Of the 88 SiS teachers who perceived change, only 58 made a comment, and all 5 mathematics teachers who perceived change commented. Three referred to the reassurance they felt from the presence of the mathematician in their class, and the others considered their mathematician helped their understanding or broadened their view.

The comments of 38 primary and 15 secondary SiS teachers are summarised in Table 33d. The shortfall of 5 teachers is caused by omitting teachers in K-12 schools. A third of both the primary and secondary teachers wrote about having their views broadened and another quarter referred to their scientist helping their understanding and gaining reassurance having them in the classroom. Some example comments are given below the table.

Table 33d. Reasons Given by SiS Teachers for Change in Confidence in Their Knowledge of Contemporary Science (%)

Change in confidence in knowledge of contemporary science	Primary SiS	Secondary SiS
Seeing different ways of explaining/broadening view	34.2	33.3
Scientist helps me understand/explains	28.9	26.7
Reassurance from presence of scientist	21.1	26.7
Use of resources, own research or meeting others	13.2	6.7
Practice/experience	2.6	-
High level of student engagement and feedback from them	-	6.7

Note. Percentages based on 38 SiS teachers in primary schools and 15 teachers in secondary schools.

> I know I can obtain advice and knowledge about topics which I have limited experience in. It gives me a wider range of areas to work with the students. (TS2)
>
> I can ask questions easily – email access is easy. Increased knowledge of how we can use the partnership opportunity. (TS29)
>
> I don't feel it affects my confidence in my knowledge, but it has given me more ideas about excursions and accessing local resources. (TS67)
>
> Working each week with a scientist to plan lessons. Keeping in touch with emails, working together in the classroom to deliver the program. (TS79)
>
> Our scientist has encouraged staff PD - reading and staffroom discussions. (TS147)
>
> Have gained some updates on current study and career paths that did not exist when I went through University. A good thing. (TS314)

Factors Determining the Success of Partnerships

Respondents were asked what, in their view, was the most important factor determining a successful partnership in the SiS program. This question was open-ended and a great variety of written responses were received. Some were one word ("communication"), and other responses were long, sometimes exceeding the space provided. The responses were coded for up to 3 themes represented in the comment. Over 70% of respondents referred to the perceived success or otherwise of their partnership, with proportionally more comments from those in SiS partnerships, compared to MiS. Table 34a summarises the reasons given for the success of partnerships as described by scientists and mathematicians, and Table 34b reports the reasons given by teachers.

Table 34a. Scientists' and Mathematicians' Views of Factors Determining the Success of Partnerships (%)

Factor determining success	Scientists	Mathematicians
Enthusiasm, motivation, desire to succeed	24.2	17.0
Good communication	20.3	18.9
Partners knowing how to plan together	18.7	9.4
Having reasonable expectations of each other	17.4	26.4
Being able to give time to meet and plan	14.8	15.1
Flexibility, able to fit requirements of skills/school	14.5	9.4
Seeing excitement of, or benefit to, students	11.2	11.3
Support from employer	7.0	5.7
Having fun	2.6	-
Scientist/mathematician can relate to students	1.6	3.8
Resources that can foster relationship	0.8	-
Support from government	0.5	-
Distance	0.3	1.9
Legitimacy for partnership provided by SiS program	0.3	-
Total scientists/mathematicians responding (%)	79.5	71.7
No response (%)	20.5	28.3

Note. Percentages based on 385 scientists and 53 mathematicians.

Remembering that respondents were asked to give only the most important factor (although many gave more than one, so the total % of responses exceeds 100%), there is strong support for several factors. Both tables show that all partners gave high value to similar factors, good communication, knowing how to plan together, having reasonable expectations of each other, giving time to meet and plan, being flexible, enthusiastic and motivated. Seeing the benefit to students was also important. These are the same factors that were revealed in interviews and in previous evaluations of SiS.

To give some idea of the kinds of comments made, some of the responses made by scientists, mathematicians and teachers are reported following Table 34b. The comments are copied verbatim, except that any identification of partners or schools has been removed.

Table 34b. Teachers' Views of Factors Determining the Success of Partnerships (%).

Factor determining success	SiS teachers	MiS teachers
Good communication	27.5	27.0
Partners knowing how to plan together	19.0	16.2
Flexibility able to fit requirements of skills/school	18.7	8.1
Scientist/mathematician can relate to students	16.4	13.5
Being able to give time to meet and plan	14.9	21.6
Enthusiasm, motivation, desire to succeed	14.9	8.1
Having reasonable expectations of each other	14.6	8.1
Having expertise from real scientist/mathematician	11.7	10.8
Seeing excitement of, or benefit to students	8.3	8.1
Having fun	2.6	5.4
Distance	2.3	-
Support from employer	2.0	2.7
Scientist has link with school	0.9	-
Learning from partner	0.6	-
Getting a positive start	0.3	1.7
Total teachers responding (%)	85.4	75.7
No response (%)	14.6	24.3

Note. Percentages based on 342 SiS teachers and 37 MiS teachers.

Example comments made by scientists and mathematicians

> Both parties need to make some time mutually available and make a decision to "get started". The experience needs to be enjoyable, not a chore. (S140)

> The enthusiasm of the teacher is great, throughout my work with Waterwatch it is also better if there are more than a one off session, repeat of the same session over time also helpful for students to develop skill in water testing, bug assessment etc. Hands on is best. (S143)

> Communication! Availability to answer upcoming questions. Strengthen the confidence of the teacher to teach science and perform experiments. (S152)

I think this is specific to the type of partnership in question. In my partnership I believe the most important factor in determining the success of this program is the knowledge gained by students on what is involved in a career as a 'scientist' (i.e. in the field of medical research). The work experience they undertake should give them a clear snapshot of what it feels like to work in a laboratory and what career opportunities are available in this field. (S183)

Enthusiasm from both teacher(s) and scientist. In my case I am working in a small local community school, with few teachers who will freely admit that they have little scientific training or background and thus are very happy indeed to utilise my scientific knowledge and expertise, whilst I am very happy to contribute to the community. (S211)

Flexibility of both the scientist and teacher in planning, and willingness to listen to and understand each other's viewpoints and goals. (S314)

Changing students' attitudes towards mathematics, help them see it is interesting, relevant and fun. (M460)

Meeting in the middle. In my experience the teacher expected me to come with pre-loaded lessons and we floundered a bit to start with. She thought I knew how to teach! (S391)

Good communication between the teacher and scientist. I have found it very important to understand the aims of curriculum - I try to assist teachers by designing activities that extend the curriculum, i.e. set up a range of experiments to demonstrate a topic. It is also very important to "level" the programs and use concepts that the children can understand. (S55)

Really enthusiastic teacher and students. Also to be part of the community - I see students out in the community not at school and it always makes me feel part of their school community. My son will join the school in a few years, so there is a real connection. (S71)

I found that full involvement and "ownership" of the activities by the teaching staff at the school was critical to the overall success. (S123) The two sides of the partnership need to share common or complementary expectations and goals. Distance has proved the biggest obstacle in expanding the nature and extent of the engagement in my partnership. So, I would have to include this as another major factor in determining the success of a partnership. (S21)

Example comments made by teachers

Communication between Scientist and teacher about what has to be taught and for the Scientist to be able to relate to the children. (TS298)

A scientist and a teacher who are both interested in the education of students, who are both interested in science and who both are committed to fostering a deeper interest and enjoyment of science to the students they interact with. (TS63)

Having a relevant scientist to whatever programs you're running. Someone who is enthusiastic to get partnership happening and flexible enough to enable it to happen within constraints of secondary school procedures/structures. (TS314)

I have been lucky to have two SiS [partnerships] and they have both provided a wealth of support and materials to advantage the learning of my students. As well, this has led to major professional development for me and the greater teaching community in my directorate. (TS323)

Communication and flexibility on both sides. To successfully work together we need to be comfortable emailing each other and planning ahead and handling it when things change, i.e. kids end up having a meeting so no class, or scientist ends up having to do experiments so can't come last minute. It is the nature of the beast but can work so well when each party understands that nature. (TS364)

The willingness of the mathematician to visit our class and then invite us to their work site for a tour. He shared some data which we used in a statistical investigation - making it “real” for the students. (TM253)

Having the great good fortune to link up with a bio-statistician! In one session, our students' ideas regarding mathematics as a career were enhanced well beyond any expectation of mine prior to our contact with a young, vibrant, enthusiastic medical statistician. (TM248)

I believe the most important factor is having the time and flexibility to communicate and plan possible activities and events. Also being open for continual feedback between the partnership to improve science in the school. (TS128)

Having a scientist able to put in so many valuable hours of contact time with my students. Having a scientist with good communication skills and a sense of humour that students warm to. (TS60)

Communication and sharing information- the initial meeting we arranged to discuss the class, what the unit was about, the demographics/learning needs & abilities of my students was an important starting point from which we could then brainstorm lesson/content ideas. (TS67)

Being flexible on both ends – scientist and school/class teacher. Student-driven content coverage. (TS24)

Communication and flexibility – sorry that is two! Communication is important to stretch the divide between scientist and school - being able to get a picture of what is going on in school for the scientist and being able to hear what the scientist is able to offer for the teacher. Flexibility is important for taking action after the communication – when is the scientist available, if he is travelling how can that be incorporated in class work, adapting what planned for unit to incorporate strengths of scientist and also new learnings teacher is getting from scientist. (TS360)

The positive interaction that comes from working in a successful partnership.....both of us have learned a great deal: I have deepened my scientific understandings and my scientist has learnt how to communicate effectively to this age group of students. (TS404)

The most important factor is communication and the time to plan. I don't think my involvement would have been so successful if it had been left to individual teachers to plan and organise as they have little time to forge the relationship and do the planning. I was trying to get individual teachers to make the connection and while they all thought it was a great idea, nothing happened for quite some time until I decided to take matters into my own hands. I am so very happy with the result, and it is getting better and better. The teachers are very happy as are the students. Thank you for such a great opportunity to bring current mathematics into our students' lives. (TM213)

Partners' Perceptions of the Impact of the SiS Program

The SiS program has been running for more than four years, although the large majority of partners had been involved for much less time. Those respondents who had begun activities with their partners, and thus had some idea of what SiS might be expected to achieve were asked "what is the main impact of your Scientists in Schools partnership?" This open-ended question evoked a considerable variety of responses and these were coded with up to three separate themes in each response. Table 35a summarises the results for scientists and mathematicians, and Table 35b shows the results for teachers. Examples of comments made by respondents are shown after Table 35b.

Table 35a. Scientists' and Mathematicians' Views of the Impact of Partnerships (%).

Perceived impact	Scientists	Mathematicians
Showing science/mathematics is relevant, awareness	19.7	17.0
Motivating students in science/mathematics	13.8	17.0
Enjoyment and enthusiasm of students	11.9	7.5
Alert students to careers in science	11.7	13.2
Support for teacher/help knowledge	8.3	3.8
Seeing scientists/mathematicians are real people	7.5	1.9
Early days, can't tell	7.0	3.8
Increased student understanding of a particular topic	6.5	18.9
Making a contribution to community	4.2	1.9
Opportunity to deal with students	4.2	1.9
Increase science/mathematics profile in school	3.4	-
Not sure	1.6	11.3
Seeing that females can do science	1.6	1.9
Increasing awareness of what happens in school	1.3	3.8
Developing communication skills for scientists/mathematicians	0.8	-
Would like to be a teacher	0.8	
Takes up a lot of time	0.5	1.9
Positive parent feedback	0.5	-
Students gain advanced credit	0.3	-
Total scientists/mathematicians responding (%)	72.7	77.4
No response (%)	27.3	22.6

Note. Percentages based on 385 scientists and 53 mathematicians.

Table 35b. Teachers' Views of the Impact of Partnerships (%).

Perceived impact	SiS teachers	MiS teachers
Seeing scientists/mathematicians are real people	20.5	13.5
Enjoyment and enthusiasm of students	19.3	10.8
Showing science/mathematics is relevant, awareness	13.2	27.0
Support for teacher/help knowledge	12.9	2.7
Increase science/mathematics profile in school	9.9	5.4
Alert students to careers in science/mathematics	9.6	16.2
Improve student learning of science/doing projects	7.6	8.1
Motivating students in science/mathematics	7.0	
Access to facilities and activities	7.0	-
Increased student understanding of a particular topic	5.8	5.4
School participates in community activities	4.4	5.4
Early days, can't tell	2.9	-
Not sure	1.8	5.1
Positive parent feedback	1.5	-
Takes up a lot of time	0.5	-
Seeing that females can do science	0.3	2.7
Developing communication skills for scientists/mathematicians	0.3	-
Students participate in real science/mathematics	0.3	-
Total teachers responding (%)	81.6	73.0
No response (%)	18.4	27.0

Note. Percentages based on 342 SiS teachers and 37 MiS teachers.

Similar comments topped the list of impacts in Tables 35a and 35b. Demonstrating the relevance of the subject, the positive responses from students, motivating them and alerting them to potential careers, were perceived as impacts of the SiS and MiS partnerships. Also very important was the opportunity to show that scientists and mathematicians were real people and being able to give teachers support in the subject area. These reasons are consistent with other information, particularly about the benefits of partnerships, collected in other parts of the survey, as well as interviews and email exchanges with participants. Some of the comments made by respondents are reproduced below.

Example comments made by scientists and mathematicians

> An increased understanding of the relevance of science, particularly how science can be used to assist decision making in society. (S12)

The teacher has learned a few new things about science. This is probably the most important part as she would continue to teach without the knowledge to pass on. So the kids in this class AND following classes benefit. (S31)

Previous partnerships have raised awareness of the marine environment amongst students and staff, also of career opportunities in marine science, and of women in science (S41)

From the few times I have met “my class” I see my main impact as demonstrating to young students that there is more to science than a vast (and mundane) amount of knowledge that rarely applies to daily living. Instead, the students understand what the basics of science are and how applicable these basics are in almost everything we do. (S58)

Introducing programming to young students. It organizes their thinking, enhances their problem solving techniques, and shifts their attention from playing video games to making them. (M92)

The teachers are aware of any unknown theory or results in Mathematics the area they teach. A brief history of Mathematicians helps the students to acquire encouragement to learn mathematics. Altogether they realised that learning Maths is actually fun. (M175)

Better understanding of science to students, helping the teacher and being proud of myself more as a scientist (S269)

Example comments made by teachers

It enables me to run extended investigations by Year 12 students over a semester whereby students can do thorough investigations with sufficient scientific support. (T60)

The scientists in school partnership has helped to raise the profile of science in our school. With a predominantly working class demographic the school's main emphasis has traditionally been based on Literacy and numeracy. The scientists in schools partnership has helped to promote a greater interest in science from students, teachers and the wider community. (TS63)

EVERYONE at the school has Science at the top of their agenda!!!! Parents and students have given massive support to the science programs. (TS323)

Students see scientists as real, normal people who are PASSIONATE about what they do, and are good communicators who are enthusiastic. (TS4)

Immediate impact: Ability of the whole School to participate in a world-wide scientific event – the international year of astronomy. Continuing impact: greater emphasis on science literacy and contemporary science through the CSIRO magazines (TS11)

One big impact has been my professional growth in science and developing confidence in delivering a scientific lesson. My scientist has applied to University and has been accepted to commence training as a primary school teacher. The scientist has enjoyed working with the students and wants to train as a primary teacher. (TS79)

Opened up horizons of mathematics and its application for students and teachers. Raised awareness of big mathematical ideas and the principles of problem solving. (TM213)

A chance for students to see a female involved in maths. A chance for them to see the opportunities for careers in maths. To see how maths in the classroom links with maths in the outside world. (TM166)

Additional Comments about the SiS Project

The final open-ended question was asked to all respondents on the survey: “Please make any additional comments you would like”. A total of 163 scientists/mathematicians and 200 teachers made comments over a wide range of issues. Table 36 summarises their ideas and in both cases, more than half of all comments were positive about various aspects of the SiS Project. Most were general, positive comments, such as “A very valuable partnership”, a comment made by a SiS teacher (TS446) and used in the title of this report. Small numbers of other comments alluded to poor experiences, such as poor communication, time and curriculum pressures, and limited contact. Some scientists (13) wanted more support from their employer to be involved in SiS, a theme that had surfaced in other parts of the survey and the interviews. A selection of these comments, some of which are quite long, appears in Appendix 3 and illustrates their diversity, particularly for scientists/mathematicians.

Table 36. SiS and MiS Partners’ Other Comments (%).

Comments	Scientists/mathematicians	Teachers
general positive	20.0	27.5
didn't start, poor communication	3.5	2.2
need support from employer	2.5	-
pressures of time and curriculum	2.7	3.2
partnership not satisfactory, poor match, would like a move	1.8	-
good support from SiS	1.2	0.2
limited contact various reasons	1.2	3.5
planning	1.4	4.1
need more training, communication about SiS	0.8	-
trying to do better	0.6	5.0
Total responses (%)	31.7	43.3
No response (%)	68.3	56.7

Note. Percentages based on 514 scientists and mathematicians, and 462 teachers.

Evidence for the Impact of SiS

One CSIRO building where the SiS office was located displayed a banner with a quotation from a SiS teacher proclaiming *You cannot measure the impact this program has had on my class. They have become curious, enthusiastic and engaged.*

Very likely this teacher meant that the change in her students was so large that it could not be measured, but the teacher is literally correct: measuring change that is indisputably attributable to SiS is simply not possible because when dealing with human interactions, there are too many confounding variables. In 1963, Campbell and Stanley wrote a seminal (and still relevant) analysis of threats to validity in even the best research designs attempting to identify cause-effect relationships in quantitative social research. Major threats to programs such as SiS include the almost total lack of control over how individual partnerships are implemented, and the myriad intervening variables over the length of time required to allow lasting change to occur. The findings of this evaluation, particularly from the survey, demonstrate that the large majority of participants are very happy with their partnership and its benefits for students, but there are a few who are unhappy and dissatisfied with their lack of progress, often due to variables such as pressures of time, inflexibility in a crowded curriculum, and lack of support from employers, over which SiS has no control. General, sweeping statements about the impact of SiS must be made very carefully.

Seeking Hard Evidence

In planning and implementing this evaluation, the researcher sought clear indications of the success – or otherwise – of the SiS Project. While the overwhelming amount of data is clearly supportive of SiS, the search for hard evidence enjoyed little success. There are impressive effect sizes for increases in scientists' perceptions of their confidence in communicating science to others, and in teachers' confidence in teaching science (particularly at the primary level) and their knowledge of contemporary science, but these results are based on averaged responses. Some teachers were already confident and more concerned with impact on students than on themselves; for example, in response to the question about whether SiS had improved confidence in teaching science, one secondary teacher (TS153) wrote "I am sorry, but this is a silly question, an interaction with a Scientist is hardly going to increase or decrease my confidence in teaching! I am a professional educator, trained for this role." Although this was the only comment made long these lines (and a very many expressed quite the opposite view), it is a reminder that the impact of SiS varies with the background experiences and circumstances of the participants. Nevertheless, the large support for a range of benefits to students and partners themselves is very persuasive.

One of the avenues in which the impact of SiS should eventually be felt is an increasing number of enrolments in science subjects in senior secondary schools and on into tertiary level science-related courses. The online survey for scientists asked "if you are at a training institution, have you noticed any change in enrolment patterns or interest in science-related careers that are attributable to SiS?" Only 5 of the 92 respondents indicating that the question was applicable to themselves had a response. The full set of these responses is reported in Box 4.

Secondary teachers in SiS and MiS were asked in the survey whether they had any evidence that changed enrolment patterns at their school could be attributed to participation in SiS. Thirteen of the 131 teachers who considered the question applicable to themselves made a response, and these are all listed in Box 5.

Yes the practical application of the learning has made some previously disengaged students engage in active learning.

Not sure though. [This response followed the previous comment in which the scientist had written, “we have increased the number of maths, physics, chem and biol classes in Year 11 at this school”.]

Secondary students gain a better understanding of the possibilities of careers in software engineering and interactive media, and so tertiary institutions see a higher enrolment rate.

At least one enrolment by a student who is now keen and committed to community service.

Improved recruitment from schools I interact with.

Box 4. Scientists’ and mathematicians’ responses relating to possible changes in enrolment patterns attributable to participation in SiS

Our first Research project by a student at Year 12 was undertaken in the field of Astronomy. The student achieved an A+. Several students in Year 12 are pursuing University courses in the field of Astrophysics.

Science is well represented amongst our students’ selections with subjects like Chemistry now running.

Our numbers in science and biology especially have risen over the last 5 years whereas neighbouring colleges have stayed static or have fallen.

Our school has measurable, high uptake levels in the Sciences.

Increased number of [science] classes in the senior school

More discussion about careers after [presumably after SiS activities]

Students who are interested in Health have chosen more science subjects

We have improved the profile of Science at Year 9 extending choices for Senior School options.

The aquaculture course and native fish recovery program has seen increased student numbers over the 3 years. The numbers of girls has increased over the length of the program.

Students identifying science pathways and choosing sciences as a result

Well...there are many factors, but this is one of them. We have a very strong Science focus and level of students doing Science subjects to Year 12 level. Also a lot of students indicate at Year 12 exiting level that their first and or other preferences for tertiary studies are science based subjects.

There has been a significant swing back towards Science in our enrolments. We now have two classes each of stage 2 Biology and stage 2 Physics. We have not had two of these for several years.

Many students participate in agriculture at school and go on to med science, ag. science and vet. science and related fields in tertiary studies. This has increased since we formed such a great relationship with a willing partner at [the local university].

Increased enrolment in VET course (58)

Box 5. Secondary teachers’ responses relating to possible changes in enrolment patterns attributable to participation in SiS

The information in Boxes 4 and 5 is simple but generally persuasive. It is noteworthy that many other scientists and teachers commented that it is too early to see such effects because the students involved in SiS are still too young.

The Success of SiS Is in the Stories

One comment made to the researcher in response to her question about "hard evidence" was "It is successful but its success is in the stories". There are many, many stories. A great strength of SiS is its flexibility in implementation, so there are almost as many stories as partnerships. Many comments in interview, via email and on the survey told stories of success in SiS. Some of them are gathered in Box 6.

> It cannot be measured yet, but at least I get on well with the teachers and with one student who emailed me that my help with her project was "awesome". (S134)
>
> [I have] 20 or so kids that think physics is awesome (S196)
>
> Students are more receptive to science. Students wish that I would visit more often. (S246)
>
> Having students in smaller regional/country areas actually meet and interact with a practicing engineer/scientist – they rarely have this opportunity to the same extent as students in city schools. (S123)
>
> Large numbers of kids at my school clamour for more science related activities. (S28)
>
> Kids are coming to me with stories of what they have observed in the natural environment. (S75)
>
> Students who are usually only very minimally exposed to science have now been part of a programme where science is a part of their normal school routine. (S236)
>
> I have more than a hundred students who know me by my first name, who tell me they want to be scientists when they grow up. The world would be a better place if everyone had a bit more scientific knowledge but what we really need is another Einstein, Darwin, Dirac, Tesla, Newton. The outside, remote possibility that I might have slightly improved the odds of another of those is outcome enough. (S373)

Box 6. Some stories of scientists' outcomes from SiS

An email from one SiSPO summarised the benefits noticed so nicely that the comments are included verbatim in Box 7.

> For me perhaps the most striking benefit is to **primary school teachers**, and in turn to their current – and future – students. Primary school teachers rarely have a background in Science and Maths, and they tend to be unconfident about teaching science in particular. When they do teach it, they emphasise learning of content, with little in the way of experiments. Having a scientist invariably changes this. They become much more comfortable running hands-on investigations, the kids are enthusiastic, and the teachers get all this positive feedback about the different approach and they WANT to do science. And this seems to be a permanent change in their approach to teaching science and to allocating more time to it.
>
> Here's a couple of quotes from some primary school teachers that encapsulate what I so often hear:
>
> *"I only used to do dribs and drabs for science, because of the crowded timetable and the emphasis on literacy. But since being involved in the SiS program, I set aside a "sacred spot" for science every* week. It's a special time that I will never forgo… And, I will continue to do this for the rest of my teaching career now – even if I don't have a scientist!" (Grade 4 teacher, metro)
>
> "I never felt confident about teaching science – in fact I'd avoid it if I could. Now I absolutely love it – *I just can't get enough of it. And it never would have happened without the Scientists in Schools program. It's so good knowing that there's someone there with the knowledge and background that I can call on for advice." (*Grade 6 teacher, rural)

Secondary teachers benefit enormously too of course, and their comments tend to be along the lines of these teachers:

"The SIS program enables me to access outside expertise for my students and to help them to understand that science has importance beyond the classroom." (High school teacher, regional)

"[My scientist] has helped me to improve my preparation and teaching generally in the environmental science/ecology area … I wanted my students too to have the opportunity to describe their own 'research' to a 'real' scientist. Our scientist proved to be perfect for this role." (High school teacher, metro)

Students of course benefit – from the opportunity to see, and to work with, real scientists. And to see how diverse research jobs can be, and how interesting. They also get a sense that "anyone can do science" which is a really powerful message for many of them. And they get the benefit of a more confident/reinvigorated teacher.

Scientists get to have fun and bask in the warm glow of being an inspiring role model. It can also provide increased motivation for their own work – the enthusiasm of the students and teachers rubs off. As one of my scientists said this week: *"The enthusiasm and energy of the students is invigorating. It makes you realize that being a scientist is quite cool."*

SiS also increases the scientist's understanding of the community's perceptions of scientists and their work, and what actually happens in schools.

Scientists improve their skills in communicating with students and teachers. Having to pitch their science at a different audience, and place it in context, can assist scientists' own understanding, and give them a fresh perspective on their own research. As one of my scientists (who lectures uni undergraduates, but was partnered with a primary teacher) described it, *"I really hadn't expected that teaching at such an early level would prove to have such an effect on my teaching. Even without other benefits to me it was worthwhile as Professional Development as a science teacher at University."*

It looks good on their CV – ticking the community outreach/corporate citizenship boxes, particularly as they're part of a national program which is supported by the nation's premier research organisations and prominent scientists.

So all in all, in successful partnerships the benefits are enormous! (My evidence is all anecdotal though – has anyone got hard figures?)

Box 7. One SiSPO's summary of the benefits of SiS partnerships

As positive as the comments are in Box 7, three points need to be made. First, not every partnership is successful, as we have seen in earlier sections, and so the benefits mentioned will not always occur. Second, the evidence is that the majority of partnerships are successful, and the points made by the SiSPO were echoed by many of the scientists and teachers contacted in this evaluation, including in the online survey results. Thirdly, the last sentence, in parentheses, returns us to the difficulty of finding hard evidence. One scientist seemingly echoed the thoughts of many by writing "Unfortunately I don't have any way of measuring this. I would hope that the students I have interacted with and who have heard me speak are more excited about science – but I have no way of knowing or measuring this" (S68).

Summary, Conclusions and Recommendations

This evaluation, undertaken in the fifth year of the Scientists in Schools Project, has confirmed that, within the limits of its current resources, the project is achieving its objectives to

- bring the practice of real world science and mathematics to students and teachers,
- inspire and motivate teachers and students in the teaching and learning of science and mathematics,
- provide teachers with the opportunity to strengthen their knowledge of current scientific practice and mathematical applications,
- enable scientists and mathematicians to act as mentors or role models for students,
- broaden awareness of the types and variety of careers available within the mathematics and science fields,
- enable teachers, scientists and mathematicians to share ideas and practices with other teachers, scientists and mathematicians, and
- increase scientists' and mathematicians' engagement with the broader community, thus raising public awareness of their work and its social and economic importance.

This affirmation of SiS aims is based on consistent and mutually supporting evidence from all of the data sources used in this evaluation. These data were collected from four focus groups comprising 4 SiSPOs, 2 assistants and 11 scientists/mathematicians, and various interviews conducted by email or telephone with the other 5 SiSPOs, 9 scientists and 14 teachers. Case studies of 13 SiS and MiS partnerships from five states and territories were constructed from data obtained. Online surveys placed on the SiS website gathered data from 514 scientists/mathematicians and 462 teachers, who came from every Australian state and territory, every school type, and from schools located in capital and regional cities, rural and remote areas. The online survey achieved a proportionally representative sample of SiS and MiS partnerships nationally. In addition, considerable information relating to progress in partnerships was provided by the SiS Project Team from the SiS database and other documentation collected routinely, such as SiSPO reports.

This section of the report synthesises the findings presented earlier, drawing conclusions about the progress of SiS in response to the recommendations from the 2008-2009 evaluation,[14] the patterns of SiS partnerships; the contribution of the SiS Project Team, including the SiSPOs; the benefits of SiS to participants; factors affecting the success and longevity of partnerships; the impact of SiS; and recommendations made for the future of the SiS Project.

Conclusions

Progress of SiS Following the 2008-2009 Evaluation

Eight recommendations were made in the 2008-2009 evaluation of the SiS Project (see Rennie & Howitt, 2009, p. 91-93) and the response of the SiS Project Team is summarised below.

2008-2009 Recommendation 1
SiS should be continued and the following recommendations should be considered to ensure that it remains effective and efficient.

[14] See Rennie & Howitt (2009).

This recommendation was accepted and funding for SiS was continued. In addition, a sub-program, Mathematicians in Schools (MiS), was introduced and is experiencing considerable success, currently comprising about 12% of active and assigned partnerships. There will always be more occupations described as “scientist” than there are “mathematician”, so MiS can be expected to remain a smaller program. Although there was a suggestion from comments in the online survey that some mathematicians feel a little marginalised because they are in the minority, there is no evidence that is the case.

2008-2009 Recommendation 2
SiS targets need to be examined carefully to ensure that they are realistic, in terms of being both achievable and sustainable.

In 2008, SiS had a notional partnership target of 15% of the schools in each region. This was probably not attainable due to the uneven distribution of available scientists. Currently, penetration ranges from 30% in the ACT to 10% in NSW (see Table 1). This is considered satisfactory under current staffing levels and considering the individual characteristics of each state and territory.

In terms of numbers of partnerships, the 2008-2009 evaluation noted that “with the current staff resources a realistic total number of partnerships is unlikely to exceed 1500”. At the time, there were just over 1100 partnerships and since then the number of active partnerships has grown to hover between 1400 and 1500. It seems that 1500, including MiS partnerships, remains an appropriate target for effective operation of SiS.

2008-2009 Recommendation 3
The website should be updated as required, but not greatly expanded.

The SiS website is currently being refurbished, streamlined and made easier to use. For example, the researcher was advised that there would be three sections relating to starting the partnership, resources and support notes to help “keeping going”, and links to complementary programs. This will enable the provision of relevant, focused and up-to-date information.

2008-2009 Recommendation 4
The database must be kept up-to-date in terms of its monitoring role and also to reflect technical advancements.

The database continues to provide rapid and current information relating to registration and monitoring of partnerships. Maintaining a very high level of accuracy in the database continues to be important.

2008-2009 Recommendation 5
The regionalisation of the SiS Project should continue, and the SiSPOs be continually supported in their roles.

The introduction of the SiSPOs was essential to expand the SiS program, and continue to make and monitor partnerships. The current SiS Project Team is hard-working and professional, and the annual SiSPO face-to-face workshop is much appreciated. SiSPOs are currently working to capacity.

2008-2009 Recommendation 6
The symposia and networking sessions should be continued but their structure refined to ensure they address networking, partnerships, and maintain a focus on education.

The symposia achieved positive outcomes but were not very cost effective. Better value has been achieved by continuing locally-based networking sessions.

2008-2009 Recommendation 7
Every opportunity should be sought to obtain positive publicity for the SiS Project and its outcomes.

The production of *EmphaSiS*, the SiS and MiS newsletter, helps promotion in a localised way. Publicity has been achieved through various media outlets. Recently SiS completed a *Stakeholder Engagement Strategy 2011-2013,* partly in response to the independent assessment of SiS's management strategy, and this sets out clearly a stakeholder engagement, communication and media plan. Its implementation will enhance future publicity for SiS.

2008-2009 Recommendation 8
Should SiS continue into the future, it is recommended that there be a further evaluation in the third year to ensure that the management and outcomes of SiS remain current and appropriate in the contemporary Australian educational context.

The present evaluation fulfils this recommendation, assisted by an earlier evaluation of the SiS management model. It is clear that the new national science and mathematics curricula are causing some consternation among teachers and their SiS and MiS partners. The SiS Project is becoming an important source of information for partners, as "roll-out" tends to focus on schools rather than other institutions.

Patterns of SiS and MiS Partnerships

At 28 November, 2011, there were 1456 SiS and MiS partnerships involving 1310 teachers and 1190 scientists/mathematicians in 1118 of Australia's 9581 schools (see Table 1). This represents at least one partnership in 12% of Australian schools. The scientists and mathematicians came from 334 organisations across Australia, covering a very large range of careers relating to science and/or mathematics. A partnership is defined as a relationship between one teacher and one scientist/mathematician, and because one teacher or scientist/mathematician can be involved in more than one partnership simultaneously or consecutively, the average life of a partnership will under-estimate the average length of time a partner has been involved in SiS.

Over the life of SiS, a total of 3267 partnerships have been made, of which 1712 have been closed or withdrawn (see Table 2). The median length of closed partnerships is 19 to 24 months, or over one and a half years (see Figure 2), and for currently active partnerships, it was 13 to 18 months at the end of November (see Figure 3). Nearly half of the scientists and nearly half of the teachers in SiS partnerships who responded to the online survey had been in their partnership for more than 12 months (see Table 19a). MiS is a more recent initiative, but 40% of teachers and more than 25% of mathematicians had partnerships of a year or more.

An analysis of the reasons for partnerships being closed or withdrawn was undertaken on 1467 records for which descriptive notes were available. More than half of closed partnerships and a third of withdrawn partnerships resulted from a change in circumstances preventing the continuation in SiS of one of the partners (see Table 4). Lack of communication between partners accounted for about a fifth of terminations, and lack of time, motivation, or incompatibility (often a lack of flexibility) between partners accounted for nearly 30%.

These patterns were not surprising to SiSPOs, whose task it was to close or withdraw partnerships (as well as to make them), and are also not surprising in the context of findings from the 2008-2009 evaluation of SiS. Of course, the converse factors are those that support the maintenance of partnerships: stable circumstances, effective communication, and sufficient time, flexibility and commitment underpin successful partnerships, as evidenced in earlier as well as the current evaluations.

The Contribution of the SiS Project Team, Including the SiSPOs

SiS is managed by a Project Team of four in CSIRO Education Headquarters and a total of 5.5 fulltime equivalent SiSPOs located in every state and territory. The SiSPOs are the people who make SiS work in the field. Most of their time is spent dealing with partnerships; recruitment, including "cold calling" of organisations for potential partners, information meetings and generally publicising SiS; matching partners; checking that they make contact and begin to plan activities; monitoring progress; repairing or rematching partners when partnerships are failing. The "personal touch" from a local SiSPO who obtains the trust of partners and has in place a procedure that flags follow-ups is the best way to make and monitor partnerships. Workshops, particularly where some new information is offered and much time spent in sharing ideas and networking, is an effective way to build a community wherein there can be mutual support.

All SiSPOs are fully occupied with their role and seem to be working to capacity. Helping human beings who are trying to work together is a challenging and time-consuming role, and it can be very frustrating trying to find a balance between making partnerships, tending and mending them, and meeting targets. In order to undertake the role effectively, SiSPOs need the coordination and support of the other members of the SiS Project Team located in Canberra.

The SiSPOs have diverse backgrounds and length of experience with SiS so helping them to keep in touch with each other, as well as managing the database overall, is an important role of the central office. Nevertheless, SiSPOs believe that their job is worthwhile, and find it rewarding. As one SiSPO reflected, "I have the funnest job ever".

The Benefits of SiS to Participants

The first three purposes of this evaluation were to assess the perceived benefits to students, benefits to teachers, and benefits to scientists/mathematicians. Very clearly benefits accrue. Qualitative anecdotal evidence from interviewees, including the broadly experienced SiSPOs, strongly supports these benefits and the quantitative data from nearly 1000 respondents to the online survey endorse the anecdotal information.

For students, more than 90% of SiS partners perceive benefits to include the opportunity to see practicing scientists as real people, to experience science with them, and to increase their knowledge of contemporary science. More than 80% see benefits in students' having fun, increasing their awareness of the nature of scientific investigation, of science-related careers, and their ability to recognise and ask questions about science-related issues in the world around them (see Table 28a). Benefits for students perceived by MiS partners were similar but more muted (see Table 28b). Further, these benefits are available to many students. Even the most conservative estimates indicate that during 2011 SiS involved more than 30,000 students in around 90,000 interactions with scientists each year (see Table 26). A more realistic figure is likely to be around 45,000 students and 160,000 interactions (see Table 27). These benefits are currently free to students and their teachers. The immediacy and excitement of personal interaction with scientists/mathematicians sets the SiS program apart from other curriculum support or professional learning packages.

For more than 90% of scientists/mathematicians, the most important benefit for themselves was the opportunity to work and communicate with students (see Table 29). More than 85% of scientists, and around 77% of mathematicians, also enjoyed working and communicating with teachers. They also had opportunity to promote their subject in schools and more broadly to the public, and interest students in science/mathematics-related careers. More than 71% of scientists and 52% of mathematicians also found renewed satisfaction in their career. Scientists' response to a question asking them to rate their confidence in communicating science before and after SiS, revealed changes of around 0.45 of a standard deviation for scientists working in both primary and secondary schools (see Table 31b). This is a substantial, positive effect.

Teachers perceived significant benefits for themselves. Table 30 shows that opportunities to communicate with scientists/mathematicians and to increase engagement of students in science/mathematics are the most important benefits supported by more than 96% of SiS teachers and around 90% of MiS teachers. Enjoyment in working with a scientist/mathematician was a close third. For teachers of science, especially in primary schools, enhancing the profile of the subject in their school and the ability to update their knowledge and practice were supported by more than 80% of teachers.

Teachers were asked to rate their levels of confidence in teaching science and their confidence in their knowledge of contemporary science before and after their SiS experience. For primary teachers, there was an increase of 0.59 of a standard deviation in their confidence in teaching science, and for primary and secondary teachers, respectively, increases of 0.66 and 0.45 of a standard deviation in their confidence in their knowledge of contemporary science. Teachers of mathematics also demonstrated an increase in their knowledge of contemporary mathematics. These are impressive increases and, in the context of new Australian curricula, SiS/MiS partnerships clearly provide an avenue to keeping teachers up-to-date with contemporary knowledge in their field.

Factors Affecting the Success and Longevity of Partnerships

One factor that promotes success in the SiS Project is its ability to support enormous variability in the nature of partnerships. They vary by location, by the nature of the interactions with students, by the year level of student and the content focus. SiS can have something for everyone. However, beginning a partnership does not ensure that success will follow. Like any other successful venture, time and effort are required.

The 2008-2009 evaluation identified effective communication; flexibility in finding time to meet and plan, and flexibility to fit the scientist's contribution into the curriculum; and support from both partners' work places as essential for partnerships to progress and flourish. Effective communication and flexibility require enthusiasm and motivation from each partner. These factors re-emerged in the current evaluation from interviews and from the online survey, which asked respondents what they considered to be the most important factor determining a successful partnership in the SiS program. Tables 34a and 34b show the support for these same factors.

Another important factor that comes through strongly, both in the tables and in respondents' comments, is the need for partners to have reasonable expectations of each other.

This emphasises the importance of good matching, mutual respect, help from the SiS website and networking for ideas, and effective mediation from a SiSPO when required. Like most human relationships, getting started to do something jointly with another person you have only just met and whose work and background are quite different from your own, requires considerable social skill. As one SiSPO noted, “all people want to do their best, their intentions are genuine, but everyone has different priorities and needs professionally”.

Assessing the Impact of SiS

If weight of evidence counts, then SiS is a very successful program with worthwhile benefits for most of its participants. Finding “hard” data to demonstrate this is difficult, as previously discussed. There are measurable increases in perceived confidence for scientists in communicating science, and in teachers’ confidence in teaching science and being confident of their science knowledge, but although these differences are statistically significant and around half of a standard deviation, not all scientists or all teachers perceived change. Nevertheless, three-quarters of the survey respondents in active partnerships pointed to positive impacts of the program, particularly impacts relating to bringing the practice of real world science to students and teachers, enabling scientists to act as mentors and role models for students, and inspiring and motivating teachers and students in the teaching and learning of science and mathematics, all stated objectives of the SiS program.

Perhaps the most telling support for the impact of the SiS program are the responses of interviewees who were asked what would happen if funding for SiS were to cease. There was clear agreement on three things: only a few strong partnerships, particularly where there were family connections with a school, would likely continue, and then only until circumstances changed; the majority of partnerships would dissipate without support; but most importantly, very few new partnerships would be created. Most teachers and scientists/mathematicians would not know how, nor would many have the time, to make fruitful contacts with potential partners. A source of extensive benefits currently enjoyed by tens of thousands of students and no-cost professional development for thousands of teachers and scientists/mathematicians would be lost.

At the conclusion of the 2008-2009 evaluation,[15] the following comment was made:

> *Overall, it seems that there are three kinds of scientist-teacher partnerships. The first kind includes the strong, stable partnerships that move along with notable benefits for their participants because the teacher and scientist (who often has children at the school) work respectfully and flexibly together. These partnerships require little attention from SiS and most would exist with or without SiS (in fact some of them pre-date SiS). The second group of partnerships, and this is probably the largest group, generally work well. However, they are not spontaneous. Some needed SiS to effect the initial matching, and were able to grow from there. Others may have needed SiS intervention to get them onto a steady track and the occasional contact to keep them moving along. The third group includes the partnerships that don’t work. This may be because of unfortunate matching, changes in circumstances of one or both partners, or lack of support from schools or employers. These partnerships need SiS intervention to dissolve them without embarrassment, rematch where possible, or allow participants to withdraw gracefully. It is the latter two groups where SiS has the most input, and it is the area where most of the effort of the SiS Project Team should be directed.*

This evaluation has demonstrated the continuing benefits of the SiS Project, and the above comment highlights why every effort should be made for it to continue. Even the first kind of partnership needs the legitimisation of SiS to assist with workplace support, to facilitate the

[15] Rennie & Howitt (2009), p. 94.

obtaining of police clearances so that scientists/mathematicians can enter schools. Without SiSPO support, the second kind of partnership would dissipate, and the third group would not have the opportunity to begin.

Recommendations

The SiS Project has been operating for nearly five years and three evaluations, including this one, have demonstrated achievement of its objectives to an increasingly high level. It is now an established program with considerable momentum. Its key strength (and uniqueness internationally) is that it enables students and, importantly, their teachers to experience face-to-face contact with scientists and mathematicians, usually for an extended period of time, and thus experience first-hand the wonder and excitement of science and mathematics as they are practised outside of school. It is a program which has developed efficient and effective management procedures, implemented by dedicated, personable staff.

In addition, the program offers opportunities for scientists and mathematicians to participate constructively in the education of the future generation of people, some of whom will step into science-related careers, and others who will simply become more scientifically and mathematically literate. Instead of making one-off visits to a school as an outside expert, SiS fosters longer term relationships, allowing scientists and mathematicians and teachers to plan together. Thus SiS provides a means for scientists and mathematicians to reflect upon the nature and practice of their discipline and how its significance can be communicated effectively to a public that would benefit from a higher level of scientific awareness. Further, increasing science awareness in schools is an indirect but effective means of increasing the public awareness of science in the broader community.

At the present time, with new, national curricula in science and mathematics being phased into schools, an established and proven program such as SiS can offer students and teachers in schools opportunities to augment the new curricula with experiences that bring relevance and meaning to science and mathematics in schools. For example, the Australian Curriculum: Science has three strands named *Science Understanding, Science as a Human Endeavour* and *Science Inquiry Skills.* In a description of these strands on its website, the Australian Curriculum, Assessment and Reporting Authority (ACARA) states the following: “In the practice of science, the three strands … are closely integrated; the work of scientists reflects the nature and development of science, is built around scientific inquiry and seeks to respond to and influence society’s needs. Students’ experiences of school science should mirror and connect to this multifaceted view of science.”[16] The SiS Project provides a low-cost, recognised means of integrating the *Science as a Human Endeavour* and *Science Inquiry Skills* strands in the context of contemporary science, from the pre-school to senior levels of secondary schooling. The following recommendations are made with these points in mind.

Continue the SiS Project

This evaluation, like those before it, found that the SiS Project achieves demonstrable benefits for scientists and mathematicians, teachers, and students. Further, the efficiency of management has been streamlined and the benefits are cost-effective. The current SiS Project Team, including the SiSPOs, is fully occupied. Increasing targets would require increased levels of staffing if the quality, efficiency and effectiveness are to be sustained.

[16] Australian Curriculum, Assessment and Reporting Authority (ACARA), see http://www.australiancurriculum.edu.au/Science/Content-structure

Recommendation 1
Funding for SiS should be continued at least at its present level. At the current funding level, supporting 1500 partnerships is realistic and sustainable.

Maintain the Management Structure of SiS

The introduction of the SiSPOs as the regional face of SiS continues to be successful, and their work is essential to the progress of SiS. The SiSPOs have local knowledge that facilitates their work in their region, but they must be supported by leadership from a coordinating central team. This evaluation has analysed an historical body of data relating to closed and withdrawn partnerships, and although the results contained few surprises for the SiS team, they did highlight that increasing the effectiveness of SiS, particularly in terms of converting assigned to active partnerships, likely depends on enhancing the process of matching partners, ensuring they get started and following more closely those who seem a bit shaky. Making sure partners have a good understanding of their own role, realise that time and effort is required for success, and hold reasonable expectations of their partner are factors likely to enhance the success rate and longevity of partnerships. Some SiSPOs indicated that they had become more aware of these matters and were giving them attention. Careful analysis of the lists of comments collected by the survey will provide useful information to assist the SiS Project Team in their monitoring and assessment of the progress of partnerships.

Recommendation 2
The SiSPOs should maintain their regional focus and give close attention to ensuring that partnerships get off to a strong start. It is important to ensure that SiSPOs are coordinated and supported centrally, both personally and with technology. Face-to-face meetings between SiSPOs should continue both for information exchange and support.

Support SiS and MiS partnerships

Establishing and maintaining partnerships requires a variety of support measures that are appropriate for the stage of the partnership. Networking events and workshop sessions are important for partnerships and for those unable to attend, the website and news letters are alternative means of keeping up-to-date on current issues, and obtaining ideas to enhance partnership activities.

Recommendation 3
Continue to provide flexible, responsive support for partnerships, including using face-to-face events and online technology.

Support the Implementation of the Australian Curriculum

As would be the case for the implementation of any new curriculum, there is some concern among teachers about the effects on them and their classes and naturally this has become a topic for many SiS and MiS partnerships to consider. SiS has already delivered a series of workshops relating to the new curriculum in science and based on these workshops, is currently preparing relevant curriculum support materials on both science and mathematics for the website. It is important that the SiS Project Team continues to monitor implementation so that relevant information continues to be provided to partnerships. SiS and MiS partnerships also provide a means of keeping teachers abreast of new knowledge in the disciplines of science and mathematics.

Recommendation 4
Continue and expand the focus on supporting partnerships to implement the Australian Curriculum in Science and Mathematics.

Continue to Publicise SiS

The outcomes of SiS are positive and deserve attention by a wider audience. Continuation of efforts to achieve publicity will aid recruiting as well as give support to those scientists, mathematicians, teachers and schools so that SiS can continue to make a difference.

Recommendation 5
Continue to increase awareness and recognition of SiS and its outcomes through the implementation of the Stakeholder Engagement Strategy and associated media plan.

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Appendix 1. Online Survey for Scientists

HOME GET INVOLVED CURRENT PARTNERSHIPS RESOURCES FOR PARTNERS CONTACT US

Online survey for scientists – 2011

Please use this form to complete our online survey. If you are involved in more than one partnership, please fill in the survey for the longest running partnership. For more details about Scientists in Schools, read the information for scientists. For more information about Mathematicians in Schools, read the information for mathematicians.

Note: If you are a **teacher**, please use the teacher survey.
Your responses will be anonymous.

A. Description of school involved in partnership

State/Territory	select...
Location	select...
Type of school	select...
Which best describes the year levels at school?	select level...

B. Describing partnership

What type of partnership are you in?	select...

Why did you decide to participate in this project?

	Important	Less Important	Not Important
Share my passion for science			
Promote contemporary science			
Inspire and engage students in science			
Practise my communication skills			
Alert students to science-related careers			
Raise profile of science in schools			
Engage in service to the community			
Offer school access to better resources			

Other reason, please describe:

Please indicate **all** the subject area(s) and level(s) that are involved in the partnership:

	Year level(s) of interest				
Subject area(s) of interest	Lower Primary	Middle Primary	Upper Primary	Junior Secondary	Senior Secondary
Earth & Space					
Biology					
Physics					
Chemistry					
Environmental Science					
Mathematics					
Engineering & Technology					

Human & Social Aspects	☐	☐	☐	☐	☐
Science Inquiry	☐	☐	☐	☐	☐
Careers in Science	☐	☐	☐	☐	☐

Is this your first Scientists in Schools partnership?
- Yes
- No — If no, please comment:

How long has this partnership been operating?
select...

Have you attended a networking event or workshop for the Scientists in Schools Project?
- No
- Yes — If yes, was it useful for you?
In what way was it useful?

Have you started running activities with your partner teacher yet?
- Yes
- No — Have not made contact.
- No — Still planning.

If no, please skip ahead to Section F.

Which of the following activities have been used during the partnership?

Contribution of scientist	Often	Occasionally	Not used
(1) Presentation to parents or teachers about science	○	○	○
(2) Make presentation to students about careers in science	○	○	○
(3) Visit classroom to interact with students	○	○	○
(4) Participate in excursion with students	○	○	○
(5) Answer students' email questions	○	○	○
(6) Supervise student(s) in a project	○	○	○
(7) Assist teacher(s) with science content	○	○	○
(8) Support a science club	○	○	○
(9) Judge a science competition	○	○	○
(10) Other activity - please describe:			

How many times have you interacted with students during the last year?	select...
What best describes the nature of the group of students that your scientist interacts with?	select...
About how many students would you interact with on each occasion?	select...
Please describe details of partnership interactions (nature and numbers) not represented in the items above	

C. Benefits of the partnership for students

Based on your observations of the students, what do you think are the benefits for the students?

Benefit to students		
(1) Increased knowledge of contemporary science	Yes	No
(2) Opportunity to see scientists as real people	Yes	No
(3) Opportunity to experience science with practising scientists	Yes	No
(4) Increased awareness of science-related careers	Yes	No
(5) Increased ability to recognize and ask questions about science-related issues in the world around them	Yes	No
(6) Increased understanding about using scientific evidence to make decisions about health and the environment	Yes	No
(7) Willingness to look to science to make decisions about their own lives	Yes	No
(8) Increased awareness of the nature of scientific investigation	Yes	No
(9) Access to science equipment and/or facilities	Yes	No
(10) Having fun	Yes	No
(11) Unsure of benefit to students	Yes	No
(12) Other benefit - please describe:		

D. Benefits to you as a scientist in the Scientists in Schools program

Are any of the following of benefit to you?

Possible benefit to you		
(1) Opportunity to communicate with teachers	Yes	No
(2) Improved skills in communicating with teachers	Yes	No
(3) Opportunity to communicate with students	Yes	No
(4) Improved skills in communicating with students	Yes	No
(5) Increased understanding of the community's awareness of science	Yes	No
(6) Renewed satisfaction in my own career	Yes	No
(7) Opportunity to promote science-related careers	Yes	No
(8) Opportunity to promote public awareness of science	Yes	No
(9) Enjoyment in working with teachers	Yes	No
(10) Enjoyment in working with students	Yes	No
(11) Were there any other benefits to you? Please describe:		

In your view, what is the most important factor determining a successful partnership in the Scientists in Schools program?

How confident were you about **communicating science to others before** involvement in the Scientists in Schools program?

Not very confident 1 2 3 4 Very confident

How confident are you **NOW** about **communicating science to others**?

Not very confident 1 2 3 4 Very confident

What is the main reason for any change?

E. Outcomes from Scientists in Schools

What is the main impact of your Scientists in Schools partnership?

If you are at a training institution, have you noticed any change in enrolment patterns or interest in science-related careers that are attributable to Scientists in Schools?

- Not applicable
- No
- Yes — If yes, please describe this evidence (use numbers if possible)

F. Additional comments

Please make any additional comments you would like

Submit Form   Reset

Appendix 2. Online Survey for Teachers

HOME GET INVOLVED CURRENT PARTNERSHIPS RESOURCES FOR PARTNERS CONTACT US

Online survey for teachers – 2011

Please use this form to complete our online survey. If you are involved in more than one partnership please fill in the survey for the longest running partnership. For more details about Scientists in Schools, read the information for teachers.

Note: If you are a **scientist or mathematician**, please use the scientist survey.
Your responses will be anonymous.

A. Description of school involved in partnership

State/Territory	select...
Location	select...
Type of school	select...
Which best describes the year levels at school?	select level...

B. Describing partnership

What type of partnership are you in?	select...

Why did you decide to participate in this project?

	Important	Less Important	Not Important
Access to a real scientist	○	○	○
Access to contemporary science knowledge	○	○	○
Increase student engagement	○	○	○
Professional learning for me	○	○	○
Alert students to science-related careers	○	○	○
Raise profile of science in school	○	○	○
Make links with the community	○	○	○
Access to better resources	○	○	○

Other reason, please describe:

Please indicate **all** the subject area(s) and level(s) that are involved in the partnership:

Subject area(s) of interest	**Year level(s) of interest**				
	Lower Primary	Middle Primary	Upper Primary	Junior Secondary	Senior Secondary
Earth & Space	☐	☐	☐	☐	☐
Biology	☐	☐	☐	☐	☐
Physics	☐	☐	☐	☐	☐
Chemistry	☐	☐	☐	☐	☐
Environmental Science	☐	☐	☐	☐	☐
Mathematics	☐	☐	☐	☐	☐
Engineering & Technology	☐	☐	☐	☐	☐
Human & Social Aspects	☐	☐	☐	☐	☐
Science Inquiry	☐	☐	☐	☐	☐
Careers in Science	☐	☐	☐	☐	☐

Is this your first Scientists in Schools partnership?
- ○ Yes
- ○ No — If no, please comment:

How long has this partnership been operating? select...

Have you attended a networking event or workshop for the Scientists in Schools Project?
- ○ No
- ○ Yes — If yes, which, was it useful for you? In what way was it useful?

Have you started running activities with your partner scientist yet?
- ○ Yes
- ○ No — Have not made contact.
- ○ No — Still planning.

If no, please skip ahead to **Section F**.

Which of the following activities have been used during the partnership?

Contribution of scientist	Often	Occasionally	Not used
(1) Presentation to parents or teachers about science	○	○	○
(2) Make presentation to students about careers in science	○	○	○
(3) Visit classroom to interact with students	○	○	○
(4) Participate in excursion with students	○	○	○
(5) Answer students' email questions	○	○	○
(6) Supervise student(s) in a project	○	○	○
(7) Assist teacher(s) with science content	○	○	○
(8) Support a science club	○	○	○
(9) Judge a science competition	○	○	○
(10) Other activity - please describe:			

How many times has your scientist interacted with students during the last year? select...

What best describes the nature of the group of students that your scientist interacts with? select...

About how many students would your scientist interact with on each occasion? select...

Please describe details of partnership interactions (nature and numbers) not represented in the items above

C. Benefits of the partnership for students

Based on your observations of the students, what do you think are the benefits for the students?

Benefit to students		
(1) Increased knowledge of contemporary science	○ Yes	○ No
(2) Opportunity to see scientists as real people	○ Yes	○ No
(3) Opportunity to experience science with practising scientists	○ Yes	○ No
(4) Increased awareness of science-related careers	○ Yes	○ No

(5) Increased ability to recognize and ask questions about science-related issues in the world around them	Yes	No
(6) Increased understanding about using scientific evidence to make decisions about health and the environment	Yes	No
(7) Willingness to look to science to make decisions about their own lives	Yes	No
(8) Increased awareness of the nature of scientific investigation	Yes	No
(9) Access to science equipment and/or facilities	Yes	No
(10) Having fun	Yes	No
(11) Other benefit - please describe:		

D. Benefits to you as a teacher in the Scientists in Schools program

Are any of the following of benefit to you?

Possible benefit to you		
(1) Opportunity to communicate with scientists	Yes	No
(2) Ability to update current scientific knowledge	Yes	No
(3) Ability to update knowledge of scientific practices/methods	Yes	No
(4) Opportunities to communicate with other teachers about the project	Yes	No
(5) Increased awareness of science-related careers	Yes	No
(6) Opportunity to increase engagement of students in science	Yes	No
(7) Increased motivation to teach science	Yes	No
(8) Enjoyment in working with the scientist	Yes	No
(9) Enhance profile of science in my school	Yes	No
(10) Were there any other benefits to you? Please describe:		

In your view, what is the most important factor determining a successful partnership in the Scientists in Schools program?

How confident were you about **teaching science before** involvement in the Scientists in Schools program?

Not very confident ◯ 1 ◯ 2 ◯ 3 ◯ 4 Very confident

How confident are you **NOW** about **teaching science**?

Not very confident ◯ 1 ◯ 2 ◯ 3 ◯ 4 Very confident

What is the main reason for any change?

How confident were you about your **knowledge of contemporary science before** involvement in the Scientists in Schools program?

Not very confident ◯ 1 ◯ 2 ◯ 3 ◯ 4 Very confident

How confident are you **NOW** about your **knowledge of contemporary science?**

Not very confident ◯ 1 ◯ 2 ◯ 3 ◯ 4 Very confident

What is the main reason for any change?

E. Outcomes from Scientists in Schools

What is the main impact of your Scientists in Schools partnership?

If you teach secondary students, are you aware of any evidence that indicates changed enrolment patterns in science in your school that could be attributed to participation in Scientists in Schools?

◯ Not applicable

◯ No

◯ Yes — If yes, please describe this evidence (use numbers if possible)

F. Additional comments

Please make any additional comments you would like

Submit Survey Reset Form

Appendix 3. Selection of Comments Made in Response to Section F on the Online Survey

Additional Comments from Scientists/Mathematicians

I think this concept is brilliant as ALL children get to participate in these programs. Many science-targeted programs only target obviously "bright" or "gifted" students. I think this approach has failed us - and them. In my experience, there are quite a few students out there with a strong scientific ability that only need the encouragement - and to be engaged! It also provides students, teachers and parents to see scientists as they are - normal people! (S55)

One of the problems with the SiS program is that it does not differentiate between "real scientists" and those who practice technology. For example the label of "scientist" actually refers to someone who is generating hypotheses, testing those, generating theories and has skills in design and analysis and is usually highly trained. In other words, there are scientists and there are scientists. Engineers, science teachers, pharmacists, chemists, veterinarians, dentists and medical Drs. are not scientists but they do work in a science-based discipline. They are not involved in the same work that a "scientist" performs on a day to day basis. Usually a scientist has, as a minimum, a Ph.D. as it is the highest academic degree that western culture offers and the holders of a doctorate have to practice science on a daily basis to earn the title. SiS advocates a less strict use of the term and this is understood from a technical perspective. (S60)

I like the idea of this program. But it really only seems to be set up for scientists and not mathematicians. I have found the networking and support to be virtually non-existent and useless for mathematicians. In fact I was disgusted how marginalised I felt as a mathematician. I don't think I will continue with the program unless things improve greatly. (M73)

I am glad that I had the opportunity to be a part of the "Mathematicians at Schools" program. I was able to experience the activities in a (non- randomly selected!) senior mathematics class room, which includes teacher's organisation of the "session for the day", students' general input (the way they learn the concepts and their communication through their written work). My contribution to their program was in two folds: (1) Introduction of new concepts which involved a brief look into abstract mathematical reasoning, (2) Adding a few more technical details to their actual "tools kit" (i.e., providing them with additional (more difficult) problems based on the standard curriculum and giving help to solve some of them). This is a valuable experience for any educator at tertiary level who would appreciate the insight into students' experience at pre-tertiary level. (M129)

A great program. I understand that SiS is at capacity though and requires more resources to continue running smoothly. It should be clear that there are tangible benefits to the program, and I hope that more resources can be committed to meet the demand. (S187)

I hope that the powers that be continue to support this project, it is wonderful. Also I hope that this project extends into underprivileged areas. I love the school I visit, but it is clearly well resourced and many of the children have parents on high incomes. I came from a family with one migrant parent and in which no close relatives had ever been to university; projects such as SiS are vital in inspiring children from all backgrounds to learn about science in their everyday lives, and to consider it as a career. Please, could you also circulate the responses from this survey to participants? Thanks! (S250)

Math departments are understaffed and undertrained (and probably underpaid) and even the good maths teachers' hands are tied by an outrageously stupid curriculum. Without programs like SiS, the endless cycle of violence against mathematics will only continue unabated. On the other hand, as G.H Hardy so eloquently noted, "The function of a mathematician is to do something, to prove new theorems, to add to mathematics, and not to talk about what he or other mathematicians have done. Statesmen despise publicists, painters despise art-critics, and physiologists, physicists, or mathematicians have usually similar feelings: there is no scorn more profound, or on the whole more justifiable, than that of the men who make for the men who explain. Exposition, criticism, appreciation, is work for second-rate minds". That is to say: With mindsets like this, we really need to try hard to encourage mathematicians/scientists/artists to share their passion with the next generation! I believe the SiS program is a nice attempt towards bridging the gap between research and education. (M298)

I feel that the program is perceived as being a promotion for science with one objective being to encourage more scientists down the track ("clever country", etc.). However it is obvious to the students that science is a very uncertain career path, for example with the cuts to various parts of CSIRO and the cuts by the NSW government to forestry and fishery research. I am also aware of the number of post-docs who are well established in their research careers but still surviving on short-term contracts, etc. Thus the scientists of the future are getting a real mixed message, hopefully some inspiration from me but no matter how enthusiastic I am about the science they may not choose it as a career. A minor comment is that the program can get too bogged down in paperwork (such as the regular background checks for working with children). They need to remember that participants are usually full-time workers and may not have time. (S300)

Partnership 1: Principal wanted to promote science within the school program and saw me as a great opportunity to do so, but this has not happened at all, even though I am available and have offered suggestions and programs. I am completed frustrated with their lack of communication and willingness to utilise me within their program. They are relying on relaying the information through a 3rd party (Partnership 2), which is on a temporary contract through the school system, finishing at the end of this year, so that will end. I am certain after then P1 will not contact me and that partnership will also cease. The interaction I have done with the students I have enjoyed though and I will endeavour to find another partnership in 2012. (S316)

Being involved in scientists in schools is an absolute joy. (S353)

When joining the SiS scheme late last year, I was offered a Kindergarten Class. Having taught science in one form or another to students from University level, through TAFE levels, down to 5th class Primary School, I was keen but unsure if I could teach science to a group of students who would be largely responding to visual and verbal stimuli, rather than written. Nevertheless, I accepted. The experience has made me completely review my former teaching methods; I use more abstract concepts and encourage lateral thinking. So many of the parents of the students have commented on how much the young students love their science classes and really look forward to them; they observe science in nature wherever they go. This has really confirmed to me that it is easily possible to promote science to quite young students, if you choose the correct way to go about it. (S375)

It is too early to say whether my time as a Scientist in School is achieving a significant improvement in the appreciation of the significance or importance of a good scientific knowledge by students at the school. I am only involved with one out of nine year nine classes and the teachers appear to be unable to give priority time to club activities (in this case the Environment Club).Nevertheless, there are encouraging signs and I believe that the SiS scheme can contribute to an improved appreciation of science (and mathematics) by students, and therefore the community at large. I have been told by many staff of the school that most students and their parents think that science has no relevance to them and their world. The area is rural and described by school staff as low socio-economic and these are seen as possible reasons for this lack of interest in science. Changing this situation is an essential precursor to increasing the number of students from the school who go on to further studies in the scientific area. I would like the opportunity to develop the SIS scheme in this school as well as the primary school I am involved with. (S394)

Thank you very much for enabling this program, and taking care of the nitty gritty of police check and other such things, and making it possible to find a new partnership when one breaks down through no fault of the school or the scientist. Other stray comments appended to those in the blank boxes above. Oh, and although I ticked “city”, I am not really in the city – but not rural or regional either. It is a formerly rural, extremely outer suburban area 70 km from Sydney. I live on a hobby farm, as do many of the kids at the school, but others live a very middle-class suburban lifestyle. So please note that none of those choices about where we live applied to me or “my” school. Also note that all three of my own kids did science degrees, and two did PhDs in science and the other did science/law. That is a testament to my ongoing enthusiasm for my own science career and my communication skills with young people. (S451)

The program is very cost effective, since schools gain the resource of a scientist at no cost to the school. SiS staff are efficient and friendly, and this valuable program should continue to be funded by the government. (S452)

This is my 4th year of the programme. In 2011 we have approximately 175 students in year 9 participating in block mode activity for 5 weeks. This SiS programme involves lectures, demonstrations, setting up experiments, interpretation of results and a result presentation session by each group within the 7 classes. It has been extremely rewarding and interesting to all those involved. Hope funding is retained for SiS programme for the future. (S456)

Additional Comments from Teachers

Our scientist has been amazing. She has taken it upon herself to plan exciting and engaging lessons. She is great with the kids and is extremely personable. I have highly enjoyed getting to know her and she has taught the kids a lot. More than anything she has encouraged their interest in science. I would love to continue to work with her and we will certainly use your program in the future. Thanks! (TS16)

Parents have been coming into class telling me how excited their children are about having a scientist in the room once a week. The students are going home and talking about what they have learnt and enthusiasm has picked up. We thoroughly enjoy our visits from our scientist! (TS24)

This program is a very good idea. My students love talking to and interacting with working scientists. Some of my young girls are already thinking of jobs in science. (TS40)

A fantastic program and I am very happy with my partnership. I have used local media to promote Scientist in Schools program to the community. Parental feedback has been excellent. (TS79)

I think the program is great. Next year if I am there and even if I'm not, I'll suggest the program to the staff. I'll leave some well researched and tested stuff in the system too. My school has been better than most. But science isn't well taught or regularly taught in many schools. Teachers just don't know how I think. (TS102)

Both partnerships with our two scientists have been fantastic. Both scientists have been willing to travel up to 50km out to school to meet students and both have had meetings with me in the holidays to enrich my course design for the following year. I am very grateful to both scientists for giving us so much of their time and expertise. (TS185)

It is an extremely worthwhile project however it is often difficult to tailor activities to make the most appropriate use of the scientists' knowledge and skills. It is also difficult to schedule activities as they are busy and the curriculum is already quite crowded. (TS195)

SiS is an extremely worthwhile program, but mathematicians in schools needs to be greatly expanded. To excite students about maths is a very valuable asset for any nation and there must be many other mathematicians from various fields who are willing. (TM248)

It's a great program and it slots so well into the Australian Science Curriculum. (TS276)

Thank you so much for the opportunity of being partnered with our scientist. I can't sing his praises enough! He is easy to communicate with, designs great investigations, has a great rapport with the children, has taught me a lot and helps out with every class!! (And) he wants to come back for more, next year!! (TS296)

The interaction has been minimal due to time constraints for both of us. The area of specialisation of the scientist was not particularly useful for my program. I wanted to take my year 10 to a lab, chem, physics or biological, or be involved in an environmental project where the students could collect meaningful data. (TS339)

The main issue is finding the time which is mutually convenient to both of us. We have lots of ideas but only get to enact some of them for time constraints. Red tape (at school level) involved in organising excursions to university laboratories is off-putting (transport, risk assessments etc.) (TS352)

This program has excellent potential that I don't think has been reached yet. Schools and teachers are slow to take on change but as experiences are shared more people want to be involved. With the introduction of the Australian curriculum it is important that programs like this are available to help incorporate the Science as a Human Endeavour strand. (TS360)

I have not made the most of my partnership. The mathematician was city based and could not make regular visits. He was very theoretical with the kids. Over their heads. We should have worked through these issues together but I was a bit intimidated to do so. We ended up drifting away from the partnership after one meeting. I would have preferred someone a bit more local and rather than a university mathematician, perhaps just someone who uses mathematics in their job. A more practical person like an engineer. (TM412)

Although Scientists in Schools Scientists is a formal organisation – we found that Scientists visiting the museum and Scientists from various corporations including Water Corp and the Astronomy and Space CSIRO were more frequent visitors to our school – some scientists from SiS were relatively inaccessible for visits and talks. Maybe some recognition should be give via your organisation to people who generously give their time and skills from run of the mill science departments such as the Department of Water, Museum etc. (TS444)

SiS is an extremely worthwhile program, but mathematicians in schools needs to be greatly expanded. To excite students about maths is a very valuable asset for any nation and there must be many other mathematicians from various fields who are willing. (TM248)

I waited 3 years to get a SiS [scientist] and the wait was worth it! This year has seen the elevation of Science at my school to the point where the community engagement is almost overwhelming! Two major science projects have led to great community input, outside sponsorships and a flood of support from the scientific community. A nomination for Prime Ministers Award was given from the parents as well as nomination for 2UEs Favourite Teacher Award. The students are "buzzing" with all aspects of science and I am constantly challenged to improve/expand my teaching practice. (TS323)

What a fabulous program! Our scientist has impacted many students over the last 3 years and we have been privileged to welcome her into our school community. A mathematician from MiS has JUST started (today) and we are hoping for an equally long and successful partnership. (TS418)