The role of economic analysis in educational evaluation

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The Scientists and Mathematicians in Schools Program

The key features of the program, relevant to the evaluation, are:

- The broad objectives proposing possible gains for students, teachers, and STEM professionals
- Its scope, being open to primary and secondary schools in all systems
- Its breadth, operating across Science, Maths and ICT curricula
- A partnership between a teacher and a STEM professional who determine the program in the school
- There is no specification of evaluation procedures.

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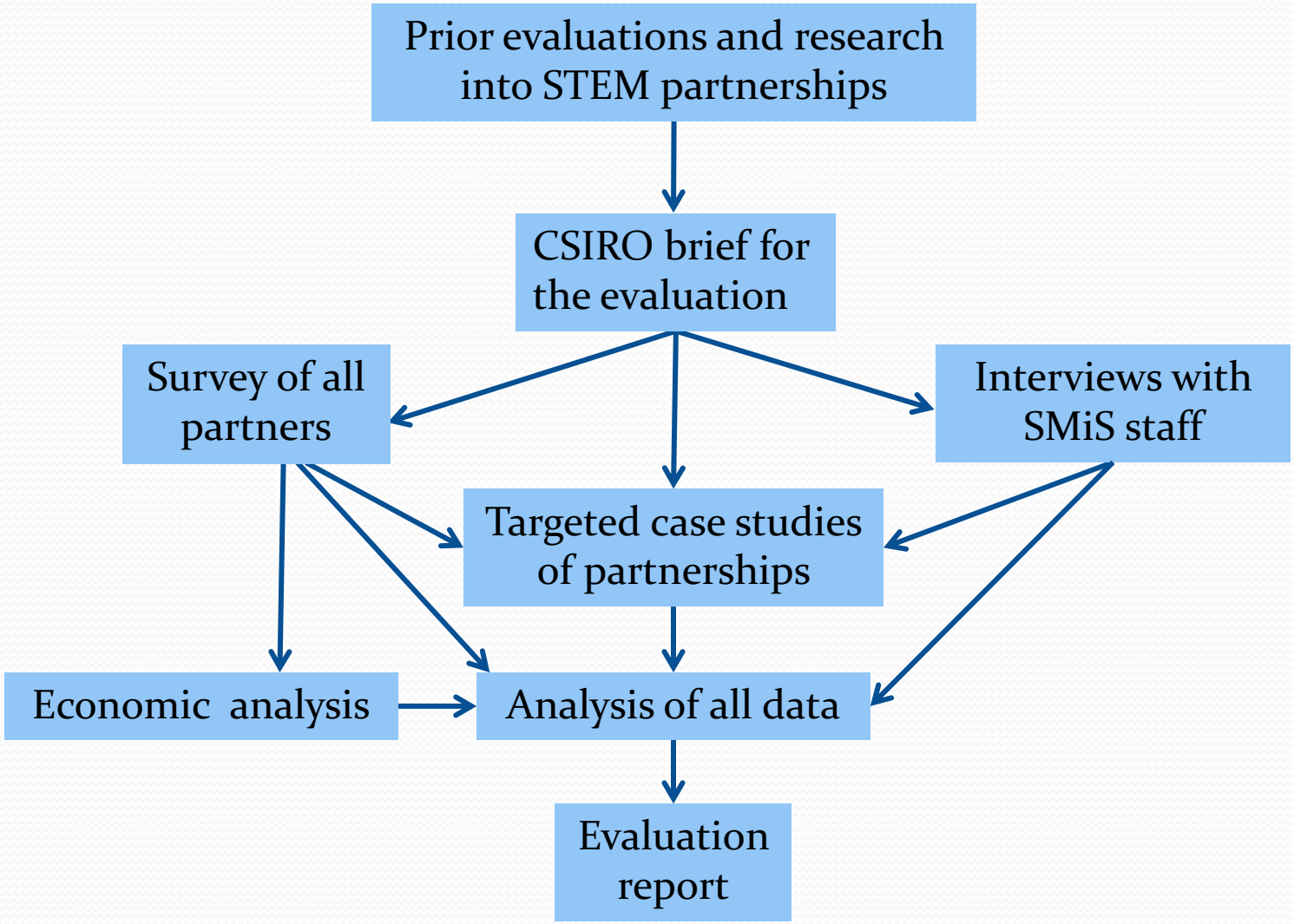
Evaluating the SMiS program



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Logic Model Development Guide (2004): W.K. Kellogg Foundation, Michigan

Planned work

	Elements	Data Categories
INPUTS	•Australian Government funding •CSIRO funding •Volunteered services of STEM professionals	•Funding expenditure •Funding expenditure •Hours contributed by STEM professionals
ACTIVITIES	•Establishing and maintaining partnerships of teachers and STEM professionals. •Management and coordination of national program.	•Number of partnerships (plus length and nature of partnerships)

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Intended results

	Elements	Data categories
OUTPUTS	•Experience of the students - exposure to STEM professionals in presentations, class exercises and small groups. Experience of the teacher and the STEM professional	•Number of students in class activities with STEM professional •Number of students in 1:1 or group activities with STEM professional •Number of interactions of teacher with STEM professional
OUTCOMES	Perceived changes in: •students (e.g. attitude towards STEM); •teachers (e.g. increased understanding of STEM knowledge and practices); •STEM professionals (e.g. increased u/s of community perceptions of science); •participating schools (e.g. sharing of ideas and practices within the school)	•Data available from surveys recording observed changes in the behaviour of students, and observed and self reported changes in teachers and STEM professionals
IMPACTS	•Longer term, indirect changes in student study, career and community choices etc. attributable to the program •Longer term changes to curriculum and national education performance	•Program specific data not available.

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Data relevant to economic analysis

- Estimate by teachers of science (n= 135) of the total annual hours spent by their partner scientist in various activities, representing the outputs of the program.

Activity	Annual hours per partnership as estimated by science teachers
Whole class presentation/discussion	5.9
Working with individual students	4.5
Working with a small group of students independent of a class	4.5
Working with small groups within a whole class	4.5
Working with several classes or whole school	3.7
Planning with me	3.7
Planning with groups of teachers	1.8
Other:	0.3
Total hours per year spent in school by scientist	29.0

Proxy estimates of the value of selected SMiS program outcomes

Objective	Time per year	Proxy measure	Equivalent value per year
Increased enthusiasm for STEM learning (students)	5 days of 6 hours (30 hours per school)	Cost of one day visit to school by a STEM presenter- $1000	5 x 1263 x $1,000 = $ 6.3M
Increased STEM knowledge (students)	23, 000 hours individual and group tuition	Hourly STEM tutor fee - $80	23,000 x $80 = $1.84M
Strengthened STEM knowledge and practice (teachers)	5 days (29 hours) per teacher	Cost of one day professional development training per teacher - $800	5 x 1700* x $800 = $ 6.8M

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Aspects of the economic argument

- A focus on 'cost efficiency' rather than 'return on investment'—the leveraging effect in drawing valuable volunteered services
- 'Efficiency' is conditional on the complex nature of the model
- The effectiveness was conditional on the worthwhileness of the patterns of outcomes – alignment with research literature on student engagement, and with curriculum outcomes – e.g. Inquiry Skills and Science as a Human Endeavour
- Impact is more difficult and must be argued indirectly

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Inferential nature of impact argument

- The chain of causation is argued to be:
  - increased engagement of STEM professionals in contributing to public understandings of STEM, and
  - increased knowledge and capability of teachers in STEM subjects, leading to
  - increased engagement of students with quality learning in STEM subjects, and
  - support for the Australian Curriculum in representing and promoting new practices, leading to
  - increased numbers of students choosing STEM pathways, leading to
  - creation of a STEM literate population, and an increase in the STEM capable workforce, leading to
  - increased national productivity through improved invention and creativity.

Causal links are evidenced through the STEM Education literature

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Limitations of the economic analysis

- The contribution of the economic analysis was limited when considering issues such:
  - Lack of knowledge concerning the causal linkages between the type of practices developed within SMiS partnerships and longer term outcomes such as student involvement in science at more senior levels of education and the workforce
  - Uncertainties concerning the impact of the SMiS program on ongoing teacher and school practices;
  - The wider role of the SMiS as a lighthouse partnership model;
  - The value judgments involved in articulating how the program addresses key purposes of science education;
  - Social justice issues associated with the targeting of programs such as SMiS.

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Benefits of the economic analysis

The requirements of the economic analysis forced a discipline on the evaluation, leading to:

- a closer look at the variety of partnership arrangements
- a more explicit analysis of the program's efficiency and effectiveness in delivering outcomes
- a more explicit analysis of the alignment of outcomes with education and policy literature
- added sharpness to the wider consideration of impacts

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