A Delphi Study: Finding the Best Contributors

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Research over the past decade into the contribution of scientists to school science programs has revealed: the diversity of arrangements, the range of contributors, a lack of agreement on the purpose of these collaborations, and no co-ordinated repository of information.

As a next step in our research program in science community collaborations we plan to explore the opinions of those who have successfully engaged in such collaborations, both scientists and teachers, as well as those with expertise in the field on:

- *what is the best use that can be made of the expertise that scientists bring to school science programs; and*
- *what types of arrangements best facilitate schools making use of this expertise?*

We propose to use the Delphi technique (Dalkey & Helmer, 1963) to gather and analyse the data needed to address these questions. However, there are several critical questions to be answered before we commence:

- *What is the nature of the field we are exploring?*
- *Who are the people who will have the greatest expertise in that field?*
- *How can we identify the experts so defined?*

Background to the study

The scientific community has shown considerable interest in contributing to school science programs in various ways, for example through course and book production, competitions and the participation of individual scientists in school science programs. Such collaborations are seen by many in the science community as important as illustrated in the report of New Zealand's Science Advisory Committee (2011, p. B59) which argues that in order to effectively engage students in learning "teachers need to have access to information on contemporary contexts that students can relate to. To achieve this we need appropriate planned connections between the science education sector and science communities".

- A survey of the relevant studies into the direct participation of scientists in school science programs, such as through the Scientists in Schools program, (for example,Cripps Clark, Tytler & Symington, 2014; Forbes & Skamp, 2013; Husher, 2010: Rennie, 2012; Symington & Tytler, 2011; Tytler & Nakos, 2003; Tytler et al., 2008; Tytler et al., 2011), has shown that:
- There is enormous diversity in the collaborative arrangements for scientists to contribute to school science.
- There is great variation in the motivations and expectations of the non-school participants in these collaborations.
- There is significant variation in the type of contribution that the non-school personnel make to the school program.
- There are identifiable issues, such as communication between the science community and schools and interpretation of the science curriculum, which impact on the establishment and development of effective collaborations.
- There has been little evaluation of the outcomes of such collaborations.
- There is no comprehensive source of information on such collaborations.

The purpose of the proposed study

In the light of what is currently known about such collaborations we wish to research the questions:

- What outcomes should and can flow from the involvement of members of the scientific community in school science?
- What arrangements and conditions maximise the benefits of the involvement of scientists in collaborations in school science?

Our aim is to answer these questions with sufficient authority to be taken up by education, scientific and community leaders and thus maximise the benefits to flow from such collaborations.

The Delphi Technique

The Delphi technique (Dalkey & Helmer, 1963) is an accepted method of achieving convergence of opinion concerning knowledge gathered from, and then shared among, experts within a field. The Delphi technique is used to establish consensus on a complex problem in a systematic and reliable manner, in circumstances where definitive information is dispersed, unreliable or subjective. It harnesses individuals' expertise and critical judgments in a way that coheres and focuses rather than averages and disperses. The process is seen as having specific advantages over other method of achieving convergence by addressing issues such as the domination in group processes by individuals.

This convergence is developed by asking the selected experts to respond to a series of questionnaires, each one incorporating the feedback from earlier forms of the

questionnaire. It has been found that three to four rounds of information sharing are sufficient to achieve the desired outcome. The participants need to be accepted as having significant expertise in the issue under consideration if the agreed statement is to be authoritative.

Who are the experts?

To identify the experts we need first to clarify the nature of the field in which they can be seen to have expertise. We have included all programs which involve community members who have some expertise in science contributing directly in some way to school science programs, whether at primary or secondary level.

The process we are investigating involves people from two communities of practice, the scientific community and the school science education community, working successfully together within the school context. Research (eg. Tytler, Symington & Cripps Clark, under review) has shown that scientists' lack of knowledge of the practices within the school context can lead to difficulties in such collaborative ventures. Further, teachers' greater knowledge of the practices within the scientific community will assist them to identify ways in which the expertise of the scientists can be best used in the educational context.

The experts we seek would need to have demonstrated a deep understanding of the practices of both the science and education communities. We see this research as exploring the considered views of experts operating within a distinct community of practice that sits at the boundary of the science and the school science communities. Such a community by its nature is concerned with exploration of the links between school science curriculum and the authentic practices of the discipline, and is thus well placed to comment on the fundamental purposes of these collaborative processes, that have thus far been ill defined.

Finding the experts

In addition to the demanding criteria suggested above, since there are no comprehensive sources of information about current and earlier collaborations, how to we identify the experts who would be best equipped to contribute to such a Delphi study?

We propose that there are three categories of people who have significant expertise working at the boundary, who could contribute to such a process:

- Teachers who are believed to have been involved in successful collaborations.
- Scientists who are believed to have been involved in successful collaborations.
- Science educators with expert knowledge of such collaborations.

We plan to start with the third group: Science educators with expert knowledge of such collaborations. We see them as the people equipped not only to participate but also to suggest teachers and scientists who have shown an ability to negotiate successfully the boundary issues arising from the distinct practices of the two communities of practice to achieve a sound outcome.

Currently we see the following people as potential members of the third group:

- those employed in the management of major programs such as Scientists in Schools; and
- those who have conducted significant research or evaluation studies in this area.

In conclusion

The purpose of our study is to produce a guide to maximising the contribution that joint activity between teachers and people with scientific expertise can make to school science programs. Critical issues to achieve this are: the definition of the field of activity being studied and the selection of people to participate in the Delphi study who have significant expertise in such collaborative ventures. These present no small challenge to the research team and the purpose of this paper is to raise these questions of method for further exploration.

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