DEVELOPING A SCIENCE CHALLENGE TO SUPPORT PARTNERSHIPS AND PEDAGOGY IN RURAL AND REGIONAL SCIENCE

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ABSTRACT

In 2007 the researchers decided to investigate the development of a “science challenge” as a means of engaging students in science. They wanted to ensure that whatever was developed was sustainable, addressed the needs of students and provided some answers for the dilemma of equitable education in regional and rural areas. A literature search indicated that whilst science competitions were not new, one which was based on school-community partnerships and involved students in the solving of real problems, was quite different. This paper will report on the development of the science challenge with reference to the viewpoints of teachers, community and industry participants.

Keywords: science education, partnerships, engagement

1. BACKGROUND

There is a crisis in the provision of scientists and engineers the world over (Barmby, Kind & Jones, 2008). University enrolments reflect the declining interest in science or engineering as a valid career path. This is similarly reflected in the number of secondary students engaging with school science in post-compulsory education. This has raised huge concern amongst educators, government and industry alike. Recent research (Lyons 2006; George 2006) indicates that school science needs to change and needs to change in ways which are meaningful to students. It is also accepted that a traditional emphasis on teaching science and mathematics as the transmission of abstract content fails to inspire the sort of innovation and creativity outlined in the Federal Government’s paper Backing Australia’s Ability – Building our Future through Science and Innovation. The call for more ‘hands-on’ teaching approaches in secondary school science and mathematics programs is a direct response to diminishing numbers of secondary students willing to pursue science and mathematics as a career.

In the last few years the Australian government (DEST) has supported the establishment of many school-community projects (ASISTM) at both primary and secondary levels which appear to be successful for the duration of the time of the project. A recent national forum “Charting Futures for Science, ICT, Mathematics Education in Rural and Regional Victoria” (Symington, Campbell & Tytler, 2008) called for closer links between schools, pedagogy, and community science resources to enhance opportunities for rural and regional students. Explicitly the Forum proposed the following recommendations:

Recommendations for action by Government

That Government develop a policy framework and funding base which will facilitate support for activity by schools systems, schools and universities to take appropriate action, including the actions proposed below, to ensure that schools are more effectively and appropriately able to develop the potential of students in rural and regional centres.
**Recommendation for action by schools**

That rural and regional schools explore ways of collaborating with community members and organisations and using community resources, human and material, in programs in science, mathematics and ICT.

**Recommendations for action by researchers**

Researchers should undertake research into rural education which takes account of their wider setting and new ways of approaching opportunities.

Researchers should collaborate with schools and school systems to investigate effective ways of identifying and measuring the outcomes of innovative programs.

Yet within the local community of science and mathematics educators there exists some shining examples of teachers and schools that inspire innovative and creative learning by encouraging students to learn science and mathematics as processes that are applied to solve real world problems. In these cases, science and mathematics education have much closer associations with learning as a research activity rather than traditional content transmission. Importantly, the emphasis on applying science and mathematics to solve real world problems links learning to the broader community, where the knowledge is valued for its creativity, innovation and contribution to society. In many of these cases of inspiring learning, the teachers and schools have responded to support offered by partnerships with industry, universities and community organisations. This project supports this view and is currently linking school science students with industry and community partners in the pursuit of authentic science.

As a means of celebrating the science learning, Deakin researchers have instigated a Science Challenge which allows students to report on their project at a science conference. Just like real scientists, students will be required to prepare a written report (which also becomes the teacher’s assessment item), prepare and deliver a 10 minute presentation to conference delegates and to respond to a panel of judges.

This proposed science challenge has a number of purposes which are inter-linked. Firstly, it is anticipated to rejuvenate interest in science at secondary level through the completion of real science projects. Secondly, it is expected that strong links will be forged between school communities and industry partners that will provide ongoing support for the pursuit of science in the area. Thirdly, it will provide a forum for young scientists through which to develop skills of scientific investigation and share scientific discoveries. These aims will be pursued through the development of a science congress which will provide opportunities for students to link with a local scientific enterprise, undertake research and present results to others in a conference-like congress. It is expected that this proposed congress will provide schools and students who are attempting to undertake innovative and creative learning with a means of support and public recognition.

This research is driven by key questions:

- What work is being undertaken nationally & internationally to engage students in learning science through the use of challenges?
- What evidence exists to support the use of this approach as a strategy for teaching and learning science?
- What are the key features contributing to the success of such challenges?
2. LITERATURE REVIEW

An Australian national survey conducted in 2005 of 2940 teachers, 928 parents and students found significant disadvantage for rural schools and students in a number of different areas. The principal findings of this extensive research indicated that there was a high turnover of teaching staff (>20%) as well as huge difficulty (up to four times more difficult) in finding staff to fill positions, particularly in mathematics, science and ICT. Teachers in remote and regional areas were twice as likely to teach in an area for which they were not qualified. Teachers in regional and rural schools indicated a high unmet demand for professional development in all areas. Aspects such as mentoring, release time and collaboration with colleagues were not as available for rural and regional teachers. In addition, teachers, parents and students reported inequities in terms of the availability and quality of on-line access, access to technical assistance and support services, and resource provision (Lyons, Cooksey, Panizzon, Parnell & Pegg, 2006). The teachers believed that their students had a significantly higher unmet need for a broad range of learning experiences which included things like visits to educational sites, and alternative activities for gifted, talented and special needs students. Parents of children in rural and regional areas also believed that their children had fewer resources and learning experiences than their metropolitan counterparts (Lyons et al., 2006). There is clear data from TIMSS and PISA that rural and regional students are significantly disadvantaged in terms of learning outcomes (Pegg, 2005). There is clearly evidence of a “divide” with rural students disadvantaged when it comes to educational opportunities afforded their metropolitan counterparts. However, the disadvantage is not wholly one-way as community support in country areas can often alleviate other disadvantages (Pegg, 2008).

The idea of community support as a means of redressing disadvantage has been developing over a number of years. Many projects involving community-school partnerships in rural and regional areas around Australia have been successful and have provided new insight into the ways in which partnerships can be beneficial as a pedagogical tool. In particular, a report to the Australian Government (Tytler, Symington, Smith & Rogrigues, 2008) discussing the Australian School Innovation in Science, Technology and Mathematics (ASISTM) Project highlighted many benefits of community based learning. For example, the report highlighted that students found the science learning more meaningful and relevant. By linking science to students’ lived experiences, students were more motivated and could understand the need for the science in the community. “The use of real world contexts and stories involving science and technology has been a key to engaging both boys and girls” (Fensham, 2006). In the ASISTM projects which linked students with Science or Community partnerships, students were often involved in cutting-edge science using material and resources which were unavailable in a school setting. The science knowledge that students gained was specific, purposeful and authentic to the needs of the project. In addition, teachers reported that for themselves, there was a level of professional growth through interacting with the project and community/science partners. Some even indicated a professional renewal in their area of science. Community-school partnerships can provide an endogenous transformation from old traditions into new practices.

In determining if the Science Challenge would be a meaningful and valid end-point to the students’ research project, the literature on science competitions was surveyed. Searching through the literature proved to be a daunting and challenging task. Skimming through several hundred web entries for science fairs, challenges and competitions revealed several similar patterns. All science competitions were conducted within the school, often around a tightly prescribed set of competition guidelines. Students would use their teacher, school time and
some home time to complete a project which may include some research and construction. This would be submitted for a larger national competition. Often the student (or school) had to pay an entry fee. Another form of challenge consisted of a student or student team presenting to a venue for a series of on-the-spot problem-solving challenges. There was a limited time for solving the problem(s). Students who were successful at the local level, went on to compete in the national or international level. Often the science challenges were supported by local communities and industry, but the support was usually in the form of a dollar amount contribution. There does not appear to be any concerted effort to map the components which have led to a successful result, nor to provide a model for the establishment of successful partnerships.

The idea of a Science Challenge, based on students reporting on an authentic community-school science project, was quite unusual. Only one other example existed, in SE Asia, where developing nations were successful in changing the face of science education using authentic problem-based projects set in local environments and linked with local organisations.

3. METHODOLOGY AND METHODS

Our research methods are mainly qualitative, using interviews and surveys to develop case studies of the community-school projects. Through the case studies, we anticipate being able to illuminate the appropriate approach (or approaches) for successful engagement of students in community-school projects. The case studies will allow a critical appraisal of problem-based science education which is occurring in local situations.

Phase One of the project was established and completed in 2007. Funded by SIMERR (Science, ICT, Mathematics Education in Rural and Regional Areas-DOTARS), the project undertook a feasibility study by interacting with industry groups, local community groups and school staff to establish some simple working principles. Our approach was qualitative in nature, drawing on focus groups and interview discussions to collect the data. Initially invitations were sent out to twenty-eight industry and community groups around the Geelong region, asking for their involvement in a number of focus groups. The focus groups discussions occurred with Community participants from: Barwon Water; Water Watch; Parks Victoria; Weed Spotters; Lorne Landcare, County Fire Authority, Weed Warriors, Weed Busters & the Biotechnology industry. Two interviews of approximately 90 minutes each were conducted. At the conclusion of the Focus group discussion, an invitation was sent to all the secondary schools in the Geelong region, (approximately 20) requesting their attendance at a regional forum into the possibility of a Science Challenge. The regional forum was conducted to provide local teachers and industry partners with the outcomes of the literature search, community discussions and to gauge their interest in the proposed Science Challenge. Key questions addressed the perceived benefits and problems arising from the introduction of a science challenge.

Currently underway, Phase Two (January 2008 – December 2008) involves four schools in partnerships with local industry groups. The school students are undertaking research for the industry and have documented success in regional newspapers. This phase, funded by the Educational Futures & Innovation group within the Faculty of Arts and Education, will culminate with a regional presentation by students of their research at a Science Challenge Conference at Deakin in November, 2008. Schools, industry partners and the wider community will be invited to celebrate in the students’ success.
4. DATA

National and International Science Fairs/competitions

The search for instances of academic papers referring to science fairs and their effectiveness, located only one recent paper. The authors, Yaşar and Baker (2003) state “… researchers generally agree that most of the articles written about the effectiveness of science fairs are based on opinion rather than research”. Other papers were written in the 1980s and early 1990s, which partly explains the paucity of thorough research. Examples of overseas and national fairs and competitions indicate that many exist and follow a fairly rigid set of guidelines. None allows a truly interactive role for the student with the research problem, to be solved over a sustained period of time. Many science fairs are integrated with Maths, Technology or Engineering or any mixture of these tags.

Community/Government participants’ responses

Barwon Water; Water Watch

- These groups had already experienced success with primary schools, but wanted to extend into secondary schools. They saw the Science Challenge as a way to do this.
- Their educational focus provided them with the understanding that the Science Challenge could help students focus on water conservation issues.
- They realised that the students could be a valuable resource in assisting with scientific data collection on the local waterways.
- They believed that the issues of water conservation provided valid challenges for the students

Parks Victoria; Weed Spotters; Weed Warriors & Weed Busters; Lorne Landcare

- Some of these groups already had some access to primary students and wanted to extend into secondary schools
- They noted that conservation and land issues are authentic problems which could be suited to student involvement.
- They felt that there was a real benefit for students to experience first hand some of the issues facing the local area

County Fire Authority

- The representatives from CFA commented on the opportunity for students to bridge the gap between science and local knowledge.
- They immediately identified a number of potential science-based research projects which would be within the students abilities and opportunity.
- They commented that the research would have an objective and real purpose.
- In addition, the CFA recognised that using secondary students could extend their current opportunities. They identified the students as resources.

Biotechnology representative

- Increasing students’ awareness of science in the real world was valuable for the future
• Saw an opportunity for industry to have some influence with local schools and students
• Potential for students to relate to the growing biotech industry and see it as a possible career
• Student opportunities for involvement in an industry which is becoming more important locally

**School teachers' responses**

**Group One – Year 9-10 teachers who participated**
• Interested in the hands-on experience for engagement of students
• Potential for the development of professional learning for the teachers
• Linking with community had ‘other’ benefits
• Science becomes more meaningful when linking theory with practice.
• Students can work at their own level – opportunity to extend some students
• Teachers believed in applied learning as a middle years’ strategy
• Science challenge could relate well with state curriculum documents

**Group Two – Year 9-10 teachers who were unable to continue their involvement**
• Their school did not have any way of timetabling such a prolonged activity
• Did not wish to commit additional time above the existing time given to science
• Could see the benefits for their students

It was clear from the discussion with each of the Community Focus Groups that there was significant support for the idea of a community-school science project which addressed the needs of the community groups but which added value to the science program. Each of the community groups represented could see benefits for their core community business whilst supporting educational needs of young people. Focus group participants identified a number of research possibilities, but also highlighted the importance of local knowledge, local networks and intergenerational understandings.

Interestingly, although the Science Challenge was initially offered to all middle years teachers, it was only Year 9-10 teachers who responded to the invitation. All commented on its value as an engagement strategy where the Science Challenge was a vehicle, rather than the main component, ‘...they respond much better if they can do something ‘hands-on’. Initially, there was scepticism to the idea of secondary students having the capability to undertake real scientific problem-solving tasks. However, using the one example that existed in SE Asia, the scepticism was replaced by a realisation that there was a possibility that students could also undertake something a little more challenging. Teachers discussed their senior classes as they felt that they would benefit most from a closer link with real science projects. However, the pressure of the VCE curriculum left little opportunity for innovative practice. Further discussion noted that in fact, the content of the curriculum and related time constraints were significant in determining how many hands-on activities were undertaken. (Researcher’s Notes, 12 December 2007)

Overall, there was general agreement between the community, industry and teacher participants about the benefits of the Science Challenge as a strategy to link theory with practice and
improving science learning. All expressed concern at the world-wide growing trend of the lack of interest in science and the connection that young people had with real world science. They felt that the Science Challenge would assist in addressing these issues.

**Factors which influenced teachers’ participation**

**Time**

- All teachers commented on the restrictions of the school timetable which contributed to their lack of access to programs such as the Science Challenge. However four schools were able to participate in the challenge by approaching the school timetabler and giving sufficient notice for a change in timetable.

- Interestingly, the issue of time was also raised by the community organisations in terms of the availability of time of their volunteer staff to assist the students.

**Resources**

- Some teachers commented on the possible lack of resources required for participation in a valid science challenge. At this point, both the community participants and the biotechnology participant indicated that resources would be part of the partnership arrangement.

- Additional comments were made about the opportunities for accessing quite sophisticated equipment through the local group of biotech industries who would be willing to assist.

**Teachers’ knowledge**

- Some teachers expressed concern at their own lack of recent, relevant scientific knowledge. They felt that it may not be sufficient to support the students adequately.

- The teachers recognised that it would be a wonderful opportunity for them to update their own knowledge and saw the Science Challenge in terms of their own professional development.

During the Forum, the issues were raised and two of them were immediately solved by the development of ‘partnerships’ between schools and community groups. The access to resources was solved through the generous assistance presented to schools by industry and community groups. Some of the resources offered included things like Atomic Spectrophotometers, Dissolved Oxygen meters and other such analytic equipment. The teachers’ concerns over the currency of their knowledge were also addressed by the industry/community group suggesting that their expertise would be available to the teacher as well. The partnership would extend beyond the students’ Science Challenge. This would ensure that teachers would not only be able to assist their students, but their own knowledge would grow.

The final issue raised by both the teachers and community partners, time, was much more difficult to resolve. Much of a teacher’s time is outside of his/her control. The school structure takes precedence. However, four schools (moving into Phase 2 of the study) were able to influence their school’s timetable to enable extended lengths of time for field and project work. For the remaining two schools (and teachers), ‘time’ and their inability to manipulate it for their own needs meant that they were unable to participate in the challenge.
5. DISCUSSION

All participants interviewed and surveyed as part of a focus groups or forum provided very positive commentary to the concept of a Science Challenge. For all participants, the perceived benefits outweighed any possible problems. Whilst some issues were raised, some solutions were also found through the development of partnerships. Four schools, through these partnerships, have been undertaking extended science projects as a result of these arrangements. It is quite clear that partnerships between the science teachers and the community/industry partners are essential for supporting the Science Challenge with specific knowledge and resources that would otherwise be unavailable to schools. Teachers report increased engagement in school, increased interest in science and a better understanding of the industry concerned.

At the point of writing, the Science Congress hasn’t occurred and full data collection from that point of the research hasn’t been undertaken. By the time of reporting to the ISFIRE Conference, preliminary analysis of the final data would have been completed.

6. CONCLUSION

We consider the original research questions:

- What work is being undertaken nationally & internationally to engage students in learning science through the use of challenges?
- What evidence exists to support the use of this approach as a strategy for teaching and learning science?
- What are the key features contributing to the success of such challenges?

There are a huge number of science competitions and fairs both nationally and internationally, however only one in SE Asia attempts to link students with community/industry partners in a mutually beneficial partnership. There is little research to indicate whether science fairs/competitions actually engage students, provide an alternative pedagogy to “school science” or in fact what elements may contribute to a broader science learning agenda. This is a strong indication that the further development of this research must address the question of the benefits of this approach.

The project has found that partnership arrangements between school and industry partners are appealing to both school and industry. However, neither group is skilled in setting up the arrangements, and special support, for instance by a university or community based body, is valuable as a catalyst for such activities. Through the continuation of this research project and the development of case studies we hope to highlight particular features of partnership arrangements to improve the sustainability of the relationships.

The results from data collection at the end of 2008 and the development of the case studies will attempt to address the final two research questions in detail.

We anticipate that the Science Challenge with its culmination in a science conference will:

- provide effective quality learning experiences for students (particularly in isolated areas)
- identify strategies by which teachers can learn professionally, in rural and regional situations, by sharing ideas or receiving support through their partnership arrangements.
- Identify ways in which students can experience success in science
• Identifying ways of overcoming resource disadvantages,
• Identifying strategies by which schools can gain advantage from regional and rural settings through community-based initiatives.

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