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Developing a Rural and Regional Science Challenge to Utilise Community and Industry-Based Partnerships

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Interest and participation in science in schools has been declining for many years and there is a genuine need to rejuvenate interest in science at the high school level. One possible solution is the completion of challenging science projects which fulfil an authentic purpose in the community. This paper discusses the results of ongoing research into the establishment of a rural and regional Science Challenge which makes use of partnerships with local industries and community groups to encourage the development of authentic science projects. In the development of the Science Challenge, many issues are emerging in relation to teachers' work, resources, administration and school cultures. This paper reports on the preliminary findings and indicates directions for the future.

Keywords: Community, Engagement, Learning, Partnerships, Science Education

INTRODUCTION

Interest and participation in school-based science has been declining for many years and there is now an established need to rejuvenate the appeal of science for students at the secondary level (Lyons 2006; Tytler, Osborne et al. 2008). Contributing to the image problem that science has in our schools is a perception commonly held by students that learning science simply involves the transmission of rather abstract scientific knowledge, from the text book or teacher, into the minds of the students. Unfortunately, the scientific knowledge being learned is too frequently considered to be irrelevant by school students (Aikenhead, 2006; Sjøberg & Schreiner, 2005; Thomson & Fleming, 2002).

Yet there exists some shining examples of innovative teaching in science education that encourage students to understand science as a process of meaningful inquiry (Tytler, Symington, Smith & Rodrigues, 2008). Such innovative practices in science education typically involve:

- *Project based or problem based learning;*
- *A strong skills focus involving scientific knowledge and related processes;*
- *More open pedagogies where students are given increased agency;*
- *The creation rather than absorption of knowledge by students;*
- *A wider set of knowledges including knowledge processes, interdisciplinary links, knowledge about the contemporary and local use of Science Technology and Mathematics (STM), and knowledge of people using STM in employment;*
- *School programs providing significant in situ learning experiences for teachers;*
- *A 'real' audience for students' work;*
- *Field trips and projects in the local environment;* and
- *Working with scientists and with local community members, as well as involvement of parents and the wider community (Tytler, Symington, Smith & Ridrigues, 2008 p. 11).*

Fensham (2006) emphasises the need to make stronger links between science education practices and the real world beyond the classroom as a strategy to achieve more meaningful and relevant learning

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experiences for students. This is a theme also represented in place-based education (Sobel, 2004), which highlights the need for teachers to re-connect classrooms with communities and for students to experience 'hands-on' learning in real world contexts. Sobel suggests that:

> *Place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum. Emphasising hands-on, real-world experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens. Community vitality and quality are improved through the active engagement of local citizens, community organisations and environmental resources in the life of the school (Sobel, 2004, P.7).*

In extending the idea of community-embedded and project-based approach to learning science, the researchers have investigated the possibility of students completing extended science projects linked with local industry or community groups, and which fulfil a valuable purpose within the community. It is the researchers' intention to eventually create a network of support and community of practice (Wenger, 2002) around similar pedagogical innovations in rural and regional areas of South West Victoria. Based on this idea, the researchers have developed a Science Challenge that involves students in secondary science working alongside scientists or community groups to solve real problems within the local community.

Students participating in the Science Challenge are expected to work closely with their teacher and a community partner to develop a significant scientific question that has relevance to the local community. They then go about designing an appropriate investigative approach to answering the question through the collection of empirical data. At the end of a project (that may run for six to twelve months) the students present their work at a small conference with fellow students and teachers in the region and members of the local community. This process involves the students producing a research report, giving a presentation to their peers and teachers, and being involved in a brief interview with a panel of judges.

Approach

In developing the Science Challenge the researchers initially investigated the type of science fairs that currently exist in Australia and internationally. We were particularly interested in what was currently available, where fairs were being held and what sort of 'scientific challenge' was being presented to students. It was found that, while there were many examples of challenges that required students to solve a singularly-focused scientific problem formulated by an external organisation such as a university, there were very few science challenges that focused on solving real-life problems originating from the students' local community. Similarly, while we discovered there are many excellent examples of partnerships being formed between schools and their local communities, there is significant potential for the development of a *network of partnerships* approach to research and develop the resources and innovative pedagogical practices that are currently tending to occur in isolated instances.

To research the development of a rural and regional Science Challenge the researchers decided to start by advertising the idea of a challenge to schools and members of the wider community in the region. Participants interested in developing the challenge were then asked to attend a workshop meeting where the idea would be further developed in collaboration with science teachers and potential community/industry partners. Here the researchers presented some examples of international science challenges and then there was discussion loosely based around the following questions:

- *What are current examples of innovation in the local region that provide instances of how science can be taught by solving real-life problems in the community?*
- *What value could be found in the introduction of a regional 'Science Challenge' that emphasises students solving local community problems by using science?*
- *What is the nature of the partnerships that will need to be formed between the schools and their local community to achieve the 'hands-on' approach to teaching science required by the introduction of the Science Challenge?*
- *What challenges are likely to be confronted by teachers and community partners when they undertake 'hands-on' scientific investigations with community partners?*
- *What are the future possibilities for the development of community-embedded science projects in the local region?*

Each of the workshops was video recorded so the researchers could analyse the participants' responses to the questions and the discussions that followed. Four schools and three community partner organisations eventually committed to undertake a trial of a Science Challenge in 2008. An additional two schools had expressed interest in participation in the challenge and attended the first workshop, but were unable to continue because of staffing changes at their schools and a concern that participation would require them to undertake too much additional work. The researchers visited each of the four participant schools to investigate how the process was unfolding in the eyes of the teachers and community partners.

FINDINGS

Support for the challenge

The schools who committed to participate in the Science Challenge were all represented by teachers who anticipated using the Science Challenge as a part of their Year 9 and 10 Science programs. The reasons for their interest have been summarised in Table 1 below:

Although the idea of the Science Challenge was offered to high school science teachers generally, it is interesting to note that all of the teachers who responded to the invitation intended to use it as a strategy for engagement for their Year 9 or 10 classes. When this point was discussed at the workshop the teachers' responses emphasised the significant potential they saw for the 'hands-on' dimension of the Science Challenge to engage their Year 9 and 10 students in learning science.

> *They [Year 9] respond much better when they can do something 'hands-on' for our science classes…I think this would be a great opportunity for the students to undertake a real science project that gets them thinking about what they are learning [Year 9 Science Teacher].*

Several of teachers noted that while they would have liked to participate in such a challenge with their senior Biology or Chemistry students, they felt that the "*pressure of the VCE curriculum meant they had too much content to get through and could not afford the time out of the classroom*". On this point the teachers noted that the time constraint of the senior curriculum was one of the most significant factors stopping them from engaging their senior students in more hands-on activities outside the classroom.

As shown in Table 2, each of the community groups represented at the workshops expressed an interest in the challenge that related to their core business in the community as well as providing authentic opportunities for students to learn science within the realm of their area. The Regional Water Authority, for example, understood that there was a need to develop better understanding in community about water conservation and management and thought the "*Science Challenge could provide the potential to develop deep understandings in the next generation by their 'hands-on' involvement in a local issue*" related to water management.

In the course of the discussion there was general agreement between the teachers and the community groups that the Challenge could provide a good strategy to link theory and practice for young people learning about science. They also expressed concern that a lack of *connection to the real world* meant *many students' were turned-off learning science by the time they get to Year 10* and that the challenge would potentially address this issue by *making science more real* for students.

Factors potentially inhibiting participation

The teachers and community partners identified a number of significant factors that could potentially inhibit their sustained participation in the Science Challenge. These have been summarised in Table 3.

During the workshops, two of the three key factors identified to be potential inhibitors to participation in the challenge were able to be overcome by developing new 'partnership arrangements' between schools and community partners. In the case of access to resources it was decided during the workshops that the schools would be able to utilise some resources available in industry to support students undertaking investigations in the challenge. Such resources included instruments that were likely to be useful for undertaking scientific measurements and the discussion eventually lead to a consideration of other potential community/industry partners.

The idea of forming partnerships between schools and community/industry organisations also enabled the issue of teachers' concern for their knowledge of current scientific practices to be addressed. To support the Challenge it was decided that schools would be able to access the knowledge and expertise of industry staff. This would allow teachers the opportunity to up-date their knowledge of science.

The issue of time was more difficult to resolve as it was a factor over which teachers and the community/industry organisations had limited control. The four schools that were able to overcome the concern for accessing suitable amounts of time needed to participate in the Challenge were schools that had already committed to making available blocks of time in the timetable as a strategy to support 'hands-on' learning throughout the middle years curriculum in particular. The Challenge therefore represented an opportunity to support what the schools were already attempting to do. For Schools 5 and 6 the issue of time represented a serious inhibitor to their participation in the Challenge.

The Projects

The projects proposed and developed by the students and their teachers from the four schools were all related to themes that were understood to be relevant to each individual school's community context. All of the projects adopted an environmental focus and involved accessing local contexts, such as creeks and parks. The projects have been summarised in Table 4.

The following case study provides a more detailed account of one school's challenge project in action. The nature of the students' scientific investigations must be understood in the context of their local community to reveal the significance and meaning of their local application of science.

Table 1. School Participants' interest in the Science Challenge

School Participants	Interest expressed in the Science Challenge
Schools 1 to 4 were all represented by Year 9 and 10 Science Teachers.	• Interested in the potential for the challenge to engage Year 9 and 10 students in learning science by using 'hands-on' projects. • Professional learning benefits from the development of a wider network of like-minded science teachers. • Benefits to be gained from purposeful links to community resources that will support 'hands-on' teaching of science. • Excellent strategy to connect theory and practice for students and to make science more meaningful. • An opportunity to encourage and extend students displaying a high aptitude for science. • The idea would work well with each of the four schools' commitment to applied learning in the middle years. This meant the schools each had timetabled extended periods of time for applied learning activities where students would be able to undertake the challenge. • Significant potential for the Science Challenge to achieve several outcomes within the Victorian Essential Learning Standards (VELS) (Victorian Curriculum Assessment Authority, 2008) if an integrated approach across the disciplines was to be adopted by schools.
Schools 5 and 6 were also Year 9 and 10 teachers who were interested in the Challenge but unable to continue involvement past the first workshop.	• Expressed an expectation that there would be benefits for their Year 9 and 10 Science students. • Noted that the challenge did not fit into any allocated time for this type of 'hands-on' learning. • Did not continue because the challenge would require additional time over and above the existing science curriculum which was timetabled as single periods of contact.

Table 2. Community Participants' interest in the Science Challenge

Community Participants	Interest expressed in the Science Challenge
Regional Water Authority, including Water Watch	• Understood there was significant potential for the challenge to assist with students learning about contemporary issues of water conservation and management. • Had experienced success with accessing Primary schools with the Water Watch program but had very limited success with high schools. The challenge provided an opportunity to connect to science education in high schools. • Understood there was an opportunity to extend their scientific data on the local water ways with the help of high school students. • The theme of water conservation and management provided an excellent source of authentic challenges for the students.
Parks Victoria, Weed Warriors and Weed Busters	• Noted there were several authentic problems related to conservation and management of land in the region suited to the challenge. • An opportunity for students to experience first-hand some the issues that are affecting the local area.
Biotechnology Industry	• Identified the significance of increasing students' awareness of science in the real world. • An opportunity for students to become involved in a science-based industry that is increasingly important in terms of the region's economy. • Potential for students to see the region's growing Biotechnology Industry as a career path at a time when interest in science-related careers is waning.

Table 3. Factors potentially inhibiting participation in the challenge

Factors expected to inhibit participation	Comment
Time	✓ All of the teachers involved noted the school's timetable ultimately controlled their access to time to participate in the challenge. However, four of the schools were able to synchronise their participation in the challenge with periods of extended time allocated in the timetable for applied learning activities. The remaining two schools did not have access to these larger periods of time in the timetable and concluded they were likely to struggle to sustain their involvement in the challenge. ✓ The issue of time was also raised by the community/industry organisations who were concerned that because their core business was not education, their involvement in the challenge could potentially be expensive if too much time was required of their staff.
Accessing resources	✓ Two of the teachers were concerned that they may not have access to the appropriate scientific equipment required for the students to participate in the challenge. Examples of the equipment that might be required for participation in a water-related investigation included pH meters, Dissolved Oxygen (DO) meters and other similar instruments. On this point the participants from the Water Authority noted they were willing to assist with access to such equipment. ✓ Further discussion revealed many opportunities for schools to access scientific equipment they normally had limited access to, including Atomic Absorption Spectrophotometers (AAS) and other very sensitive analytic instruments that would be helpful.
Teachers' Knowledge	✓ In the course of the discussion about potential investigations several teachers expressed concern that their own scientific knowledge might not be sufficient to support their students undertaking an investigation. Teachers who were specialists in Biology, for example, expressed concern about their need for detailed knowledge of physics if an open-ended investigation was predominately in this area. ✓ Both the teachers and community organisations noted the challenge would provide a good opportunity for teachers to up-date their knowledge of science in different areas as they could be exposed to current industry practice.

Case Study: Year 9 Science Challenge Students Investigating Water Quality in their Local Creek

The Context: *The school is located in a large rural township in Victoria which is currently experiencing the full effects of sustained drought in the region. The town has a large, centrally located lake that forms a prominent feature of the town and which is in close proximity to the school. The dwindling water levels in the lake and its connecting water ways and creeks have been a source of major concern in the community, particularly because of the apparent impact on water quality and the local fauna and flora. The poor condition of the lake is commonly discussed in the local newspaper and on the radio, although there has been very limited reference to scientific investigations describing the changing water quality.*

The Challenge for Students and their Teacher: *The science teacher and students in Year 9 decided to investigate precisely how water quality in the local creek was changing as a result of the diminishing levels of water in the town's lake. The students and their teacher decided to approach the local council and the regional Water Catchment Authority to discuss how they could design and carry out their investigation. The Water Authority was able to assist with the provision of suitable equipment for testing water quality and provided training for both the students and their teacher to assist with their use of scientific instruments. The Council and Water Authority decided they would publish the students' results on their website as they did not currently have access to that level of data about changing water in the region's creeks.*

The Students and Teacher in Action: *As the school bell rings to signify the end of lunch, Ms Smith moves swiftly through the staffroom to meet her Year 9 Science students at the front of school where she has arranged their transport to the nearby creek. The fifteen students are already gathered at the entrance of the school with their water analysis equipment stacked neatly for their imminent departure in the mini-bus. The equipment is loaded into the bus carefully, followed by the students eager to begin collecting data at the creek. They know they have a limited time and the routine has been well-rehearsed for the past few weeks.*

The students arrive at the creek and, without being prompted by Ms Smith, they unpack the testing equipment and prepare to collect data about the quality of the creek water passing through their town. Each of the students has a particular role in the process which they carry out with confidence and without delay.

The first pair of students to alight from the bus move swiftly towards the creek to sweep for macro-invertebrates using the special net supplied by the Regional Water Authority. After each sweep

Table 4. Summary of Challenge Projects

School	Brief Description of Challenge Projects in Context
1	Year 9 students and their science teacher undertaking an investigation into water quality changes in the local creek caused by the rural town's diminishing supply of water in the lake. The students and teacher worked with the Regional Water Authority and Local Council.
2	Year 10 students and their teacher investigating biodiversity in the large local flora and fauna reserve located close to the school. The students and teachers consulted with staff from Parks Victoria and were interested to understand how rapid population growth in region may be impacting on biodiversity.
3	Year 9 students and their teacher decided to investigate the distribution of weeds and land management in their rural location. The students were able to utilise expertise from the local Landcare group.
4	Year 9 students and their teacher investigated fluctuations in fish populations in the local creek. The students consulted with staff at a fish hatchery to examine the possibility of replenishing diminishing fish numbers.

they carefully place the contents of the net into a tray where two other students identify and investigate the diversity of invertebrate life in the creek. The students' excitement levels are high as they find another specimen of a small fish they had found previously in the creek, much to the surprise of the Regional Water Authority. According to their consultations with staff at the Authority this specimen is an unusual find for the creek and indicates all is not normal with the water quality. Word of their discovery has passed around the school and the town and one student comments 'now we're famous scientists'.

Another pair of students commences measuring the temperature and pH of the water at various points along the creek. They work beside a pair of students who are analysing the level of Dissolved Oxygen in the creek water. These students are also using equipment supplied by the Regional Authority and they exercise care as they know their data is contributing to a local understanding about the health of the water systems. Their confidence in using the equipment has been gained by their work with staff from the Regional Water Authority who, several weeks earlier, had provided some 'hands-on' instructions for the students and Ms Smith on how to perform the tests using the equipment provided. Later, when the students return to school, their data is promptly recorded in spread sheets and they commence analysing it for trends over the previous weeks.

As these Year 9 Science students go about their investigation of their local creek to determine its health as an aquatic system their industrious efforts demonstrate a genuine engagement with learning science. The data they have collected is also used by the Regional Water Authority and eventually posted on the Regional Council's website for public access.

DISCUSSION

Discussions with students and teachers participating in the Science Challenge demonstrate there are clear benefits to be gained for Middle Years students' and teachers participating in the 'hands-on' investigations associated with the Science Challenge. The levels of Year 9 student engagement with scientific concepts such as pH, Dissolved Oxygen and biodiversity, reinforced the teachers' initial beliefs that students at this level would respond very positively to the Challenge. Further discussions with the students also indicated that they perceived the science they were learning as a part of the Challenge to be meaningful because of its capacity to contribute knowledge that was also valued by the wider community. The students perceived they were 'doing science rather than just learning facts from a text book' and that 'this way of learning was much more fun'.

It is also clear that the partnerships formed between science teachers and organisations such as the Water Management Authority are essential for supporting the Challenge with specific knowledge and resources that otherwise may inhibit schools from participating in such authentic hands-on investigations. The community organisations also serve a very important role in assisting students to understand the value attributed to the knowledge they are producing as a part of their investigation. On this point the researchers believe there is potential for the students to differentiate between the objectivity required in order to undertake scientific investigations, and the subjective meaning that is then attributed to the knowledge produced by their science.

Although there is evidence of some success being experienced in the individual schools by encouraging students to undertake meaningful, 'hands-on' investigations in partnership with community partners, the full potential of the Science Challenge is yet to be realised through the establishment of a wider network of school-community partnerships and a community of practice to support it on a regional level. However, a new network has now emerged in the region specifically to support Science and Maths Education by facilitating better partnerships between schools and community organisations. The network includes science educators from schools, the local Technical and Further

Education (TAFE) institution and the University sector, as well as representatives from the wider community, such as the Biotechnology Industry, whose core-business involves an application of science.

It is also clear that while increased levels of Year 9 students' engagement in science is a positive consequence of the Science Challenge, there is also a need to further investigate other important issues such as: effective strategies for assessment to support the authentic nature of their learning; exploring possibilities for better integration of the Challenge across the different components of the Victorian Essential Learning Standards (Victorian Curriculum and Assessment Authority, 2008), including:

- *the processes of physical, personal and social development and growth;*
- *the branches of learning reflected in the traditional disciplines; and*
- *the interdisciplinary capacities needed for effective functioning within and beyond school.*

There is also a need to further examine strategies that maximise the partnership arrangements between schools and community partners on a regional level. The partnerships that appeared to form most easily were those related to environmental science applications, such as a school working with the local Regional Water Authority to investigate water quality. Although the teachers were very interested in potential projects involving the local biotechnology industry, they were less confident with the science involved with this industry and struggled to establish a clear project their students could realistically investigate.

CONCLUSION

The researchers' intention of creating a rural and regional Science Challenge in South West Victoria has stirred the interest of community organisations and middle years science teachers in the region. The teachers, in particular, see value in using the Challenge to engage middle years students in science through 'hands-on' learning projects that focus on real-life issues. Staff from the community organisations also see the Challenge as an opportunity to address important issues related to their core business in the community. The Challenge has worked most effectively when teachers have been able to align the Challenge to curriculum time allocated for 'hands-on' learning projects in a school. Additionally, when teachers have worked closely with community partners to support the Science Challenge, there is significant potential for scientific resources and expert knowledge to be shared and teachers' professional learning to be enhanced.

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