

Archived at the Flinders Academic Commons:

<http://dspace.flinders.edu.au/dspace/>

This is the publisher's copyrighted version of this article.

The original can be found at: <http://www.asta.edu.au/resources/teachingscience>

© 2008 Teaching Science

Published version of the paper reproduced here in accordance with the copyright policy of the publisher. Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to reuse any copyrighted component of this work in other works must be obtained from the publisher.

Turning the tide: transforming science learning and teaching in rural and remote schools

by Carol Aldous

A recent national study into Science, ICT and Mathematics education in rural and regional Australia (SIMERR) highlighted the disadvantages faced by rural and remote communities in terms of science learning and teaching. Focus group interviews conducted in rural primary schools in South Australia identified a lack of resources and of access to services and facilities as being contributing factors. By way of contrast, a cluster of schools in a remote location of South Australia turned the tide on this perspective. They did this by successfully connecting the science that already existed in the local environment with their curricular practices. What they taught was not 'city' science but 'local' science in context. As a result, the science teaching and learning in this cluster was transformed. This paper reports on how this was done and why it was so successful.

Defining isolation: an absence of relation

The tyranny of distance associated with living in rural and remote communities can mean that isolation is an important factor when it comes to meeting the educational entitlement of young people living in geographically isolated areas. But what does it mean to be isolated? Isolation can be defined as 'being considered without regard to relationship' (Sykes, 1978). Isolation can also be defined in terms of the physical or emotional states of 'separateness or apartness'. Separateness itself may be physical such as geographical separateness, or emotional arising from complex social factors (Reber, 1995). Thus in defining isolation, one needs to be cognisant not merely of the physical, but of social and emotional elements as well. This raises the question, 'Does isolation—an absence of relation—matter in the learning and teaching of science?'

Data collected in two major international studies, the OECD Program for International Student Assessment

(PISA) (Thompson & De Bortoli, 2008) and the Trends in International Mathematics and Science Study (TIMSS) (Pegg, 2005) would seem to indicate that such an absence of relation does matter, and at all levels. In both these international studies, Australian students in rural and remote schools were found to be performing at a level lower than their metropolitan counterparts. Reporting on the Australian perspective in the PISA study with respect to scientific and mathematical literacy, for example, Thomson and De Bortoli (2008) stated that:-

Students attending schools in remote areas were found to be achieving at a level about a year and a half lower than their counterparts in metropolitan schools
Thomson & De Bortoli, 2008, p.15

Thus it seems that Australian students in remote locations are indeed failing to flourish in mathematics and science and that the effects of isolation are significant.

If this is the case, a study made of a remotely-located cluster of South Australian schools which are flourishing with respect to science learning and

teaching, was both timely and relevant. This paper reports the findings of such a study. Furthermore, the comparisons made were not with teachers and students in metropolitan schools but with teachers and students in similar rural and remote schools.

Background

A national survey (Lyons, Cooksey, Panizzon, Parnell & Pegg 2006), along with a series of state-based case studies (Lyons, 2006), was conducted into the educational needs of rural and regional schools with respect to science, ICT and mathematics learning and teaching. The survey sought to discover why the achievement of students in geographically isolated areas was lower than that of their metropolitan counterparts. Findings related to concerns about teacher supply, professional development requirements, resourcing needs, availability of support staff, student learning needs and parental involvement

Compounding the isolation problem was the more general PISA (2006) finding

that Australian students, irrespective of location, do not like science and do not identify strongly with future involvement in science when compared with their international counterparts (ACER, 2008). This made an investigation of a cluster of schools in a remote location of South Australia that were turning the tide on student engagement in science all the more sharply pertinent. It should be noted that this cluster of schools was awarded an Australian School Innovation in Science, Technology and Mathematics (ASISTM) grant in 2005. This grant served to extend the set of partnerships and relationships that were already in existence within the school community. For the sake of anonymity this cluster of schools will be referred to as Blue View cluster.

Blue View cluster

Blue View cluster comprised three schools, all located several hours drive from Adelaide. Two were on the coast, one a reception to Year 12 school of around 450 students, the other, a primary/middle school of about 90 students. The third, a reception to Year 12 school, was located some distance inland and had a student population of around 180. These three schools served communities largely dependent on farming or fishing. A growing industry in tourism, particularly ecotourism, was also in evidence.

Purpose of study

The purpose of the study was to identify those factors that enabled successful science learning and teaching to be demonstrated within a geographically-isolated community. The research questions were:

1. How does a successful cluster of geographically-isolated schools respond to the issues of isolation as identified by the South Australian case study schools (Aldous, Barnes, Clark, White & Moroney, 2006)?
2. What factors enable successful science learning and teaching to be demonstrated in this cluster of geographically-isolated schools?

Success in this study was defined as active student and teacher engagement in science learning and teaching as identified and recognised by two or more external authorities or bodies.

Methodology

A qualitative approach to the analysis of data was adopted in line with the recommendations of Cresswell (1998)

and Ratcliff (2003). The exploratory work was carried out in three stages. The first stage involved conducting focus group interviews with four rural and remote SIMERR case study schools in South Australia. The findings of this component have been published elsewhere (Aldous *et al*, 2006). The second stage involved collecting and analysing data from the Blue View cluster of schools. The nature and sources of these data are listed in the following section. The final stage involved synthesising a set of descriptive comparisons between the South Australian case study schools and the Blue View cluster to clarify the implications for learning and teaching.

Sources of data

In drawing inferences concerning the 'nature of relation' in effective rural and remote schools data were drawn from a number of sources. These sources were:-

- National survey reports and case studies on rural and remote education
- Focus group interviews with parents, teachers and students in SIMERR-SA case study schools
- Informal interviews with the ASISTM project coordinator, teacher associates and principals
- Teacher and parent survey data for the ASISTM project
- Student-prepared materials such as CDs, DVDs, drawings, artwork
- Mid and final ASISTM Project reports
- Student behaviour management data and subject choice data for the ASISTM cluster
- Anecdotal records of journal notes of meetings with ASISTM project personnel including teacher associates, classroom teachers, parents, students and scientists
- Informal observations of students and teachers conducting field work activities
- Award applications.

The following table describes the number and kinds of individuals from whom data were collected in the second stage of the study. These data were collected between August 2005 and October 2007.

Framework for analysis

The National Framework for Rural and Remote Education was used as the framework for analysis. This Framework identifies six essential enablers for the

provision of quality education in rural and remote locations. These are:

- personnel—teachers, administrative and classroom support, specialists
- relevant curriculum
- information and communication technologies (ICT)
- multiple modes of delivery
- environments formed through effective community relationships and partnerships
- resourcing

(MCEETYA Task Force 2001, p. 9)

These six enablers formed the framework against which the response to factors associated with geographic isolation were analysed and compared. These enablers were grouped under the following headings:

- Personnel and resourcing
- Relevant curriculum and environments
- ICT and multimodal delivery.

Results

Personnel and resourcing

SA Case Study Schools

Retaining appropriately qualified staff, teachers teaching outside their area of expertise, and having access to relieving teachers were concerns identified in common among South Australian case study schools (Aldous *et al*, 2006; Lyons, 2006). Teachers also identified a need for greater access to professional development:

'There's not enough offered to country teachers and so much emphasis on teachers going to Adelaide for PD'
(Aldous *et al*, 2006, p. 36)

In addition, primary teachers in the case study reported a paucity of resources and a lack of confidence in the teaching of science, features which did not necessarily separate them from their metropolitan counterparts (Goodrum, Hackling & Rennie 2001).

Blue View cluster

The Blue View cluster of schools shared many of the difficulties described above. However one feature that distinguished the cluster was the presence of an inspirational leader, with a vision for engaging as many students as possible in science. The teacher was a former principal and now Year 2 teacher. This teacher had a thirst for knowledge about the local marine and wetland environments and was fired with a passion to conserve their natural wonder and beauty. His vision encompassed primary and secondary students as well

as adults within the wider community. He worked alongside other like-minded individuals within the wider community to forge a network of relations that included the resident marine biologist, enthusiasts within the Native Fish Association, scientists working for the South Australian Research and Development Institute, personnel

in the local Natural Resources Management Board, individuals within the Department of Fisheries, people working for the Department of Primary Industries South Australia, local tour operators, fishermen, resident artists and parents.

This teacher-leader undertook a series of initiatives in which local personnel were called upon as a resource in a planned and ongoing program that involved children in community action. Scientists, technologists and other community members worked alongside students and teachers to deliver a contextually relevant science curriculum.

The implementation of the program would not have been possible without the foresight of the cluster management team in resourcing a leadership position (project coordinator), and the part-time employment of a consultant scientist. This resourcing ensured that the program had currency within the community.

The initiative also meant that teachers in the Blue View cluster were given the opportunity to partake of *in situ* professional learning in their local environment. One such teacher commented:

'I was unsure if I could teach the students about native fish when I had no idea about them. I jumped headfirst into the project and after two days of theory and practice I was ready for the challenge of teaching the students and then taking my class out into the field ... I could see the potential for the boys being engaged. We were joined by ... consultant marine biologist, ... a local fisherman, ... Barramundi project manager... All students were engaged and involved in discussions ... Without realising they ... were making predictions and educated judgments and working together'

Year 4 and 5 teacher

In an oral survey of 19 Blue View primary and junior primary teachers, 14 stated that their confidence had increased (ASISTM, 2007).

Table 1. Number of survey and/or focus group participants.

Data Source	Type	Student Population	Primary students involved* or responding	Secondary students involved *or responding	Teachers + Associates Responding	Parents Responding
Blue View					(3 associates)	
School 1	R- 12	450	256*	153*	17	8
School 2	R - 9	86	63*	11*	5	2
School 3	R- 12	175	59*	40*	9	3
SA Case Study						
School 1	R -12	450	2	5	6	7
School 2	R-7	68	6		6	4
School 3	R-12	239	2	6	11	8
School 4	R-7	438	10		5	10

* Indicates number of students participating in the ASISTM project. Behaviour management and subject enrolment data (where applicable) were gathered as an indicator of student engagement of these participants, and documented in the ASISTM final report.

Summary: Implications for learning and teaching

Expanding the thinking about ways in which a science curriculum can be resourced influences how it is delivered. The Blue View cluster of schools responded to their isolation or 'absence of relation' by forging a network of relations within their own community. The network of relations was wide-reaching and vital in enabling an innovative science program to be implemented. In particular the community relationships were used to supplement personnel and resources through the employment (voluntary or part time) of community-based scientists and professionals. This meant that unlike SA Case Study schools, teachers had access to *in situ* professional learning and this impacted on their perceived confidence in teaching science, particularly at the primary school level.

Relevant curriculum and environments

SA Case Study schools

Interviews with teachers in the South Australian Case Study schools highlighted their commitment to and enthusiasm for the profession. This was endorsed by parents who 'considered the commitment and enthusiasm of teachers to be one of the greatest strengths of their children's school' (Lyons et al, 2006 p. viii). During science lessons in the junior years students were involved in hands-on activities and participated in topics such as sound, water, measuring time, making and using land yachts and the solar system, to mention a few examples (Aldous et al, 2006). Indeed one teacher commented:-

'I don't know that what I teach would be any different from what I would teach if I was in a metropolitan school to be honest'

For this teacher, good science teaching involved the notion of teaching 'city' science. That is, the decision about what was interesting and relevant tended to be made from a metrocentric perspective.

Blue View cluster

By way of contrast the teachers in the Blue View schools took the position that relevance to the local community should be the focus of the curriculum. This required local knowledge which arose from within the community itself. The delivery of the science curriculum involved scientists and other members from the community working alongside students and teachers. But how was this relationship achieved? The answer had its genesis in an alignment of needs.

The non-school partners needed to collect base-line data to monitor environmental impacts. This involved collecting information on a large scale and at multiple points within the environment. Including students within the program of study provided an expanded workforce of data collectors. Conversely, schools also benefited with students being given authentic opportunities to collect, collate and analyse real data. Students gained skills in the use of scientific equipment and a deep appreciation of the purposes, processes and limitations of scientific method. Teachers benefited from an injection of ideas into the curriculum and an upskilling of knowledge in some cutting-edge science. The context also provided teachers with a purpose for teaching and students with a reason for studying science.

'I was very confident in the quality and quantity of data that the students collected. Students were so engaged with the native fish, it was an adventure for them ... I'd come to the classroom and a student would say "I learnt something yesterday and I want to learn more" ... We were all learning together'

Consultant marine biologist

'I have never come across an education program so closely approaching my ideal of what education should encompass; that is young people being guided by teachers and other experts who are learning alongside them directly from life in a context which encourages them to value what they already know, and what they can learn from each other and their environment.'

Volunteer Teacher Associate

This program required a range of initiatives that allowed multiple entry points for students and teachers from reception to Year 12. Thus, lower-primary students were involved in beach monitoring programs studying the intertidal zone at a series of local beaches, studying rock pools, beach combing and bird watching as a measure of the health of the ecosystem. Upper primary to lower secondary students were engaged in auditing native fish numbers as an indicator of the health of the local waterways. This involved devising ways to trap, tag and recapture fish on a series of field studies, as well as devising ways to breed native fish for restoring local streams. Senior school students were engaged in using new technologies to monitor the dolphin population of the region. Chemistry students were involved in the chemical analysis of water samples to measure the impact of different substances in the food chain. Others made a study of the local pelican population. Cross-curriculum links were made with areas such as mathematics, studies of society and the environment and art.

'There's no way you can compare it to anything else we do or even have the opportunity to do—the chance to get out of school and learn about dolphins (yay!) and everything that comes with them; computers, cameras, videos, maps, the environment, marine creatures, human impact and lots of weird science stuff that I need extra elaboration to understand but understand afterwards! How many schools and students get to do that?'

Year 10 female student

Summary: Implications for learning and teaching

Expanding the thinking about what knowledge is valued can impact the relationship that students have with the science curriculum. In contrast to the SA Case Study schools, which offered more traditional curricula, the Blue View cluster reinterpreted the curriculum to align it more closely with community needs, thus enhancing its relevance. This reinterpretation involved implementing a science program around issues of concern to the rural and remote community. In this way students were

no longer isolated from the science curriculum, but were actively engaged in forging intellectual and psychosocial relations with the processes and content of science. Indeed, students and teachers in the Blue View cluster were integral to the formation of new science knowledge.

ICT and multimodal delivery

SA Case Study Schools

In general, teachers within the South Australian Case Study were satisfied with the level of ICT in schools, although more would have been better (Aldous *et al*, 2006). However technical support was highlighted as an issue, particularly in relation to networking issues. This was exacerbated by the distance from Adelaide or from a large regional centre.

Blue View Cluster

The Blue View Cluster, in contrast, orchestrated additional technological support. In particular the teacher-leader of the cluster lobbied constantly for IT, satellite and hardware solutions to connect this geographically-isolated community with the globe as he held the *'...belief (confronting for some) that IT should be in students' hands, enhancing learning, with appropriate training and support ... student-managed not in administrators/teachers' control.'*

A series of 'learning forums' were conducted with national and international participants using *Centra* webcasting technology. This technology allowed students in the field (e.g. on ocean vessels watching dolphins, or in river estuaries catching native fish) to link up with scientists in other parts of Australia and the globe, to share findings visually and to discuss points of mutual concern. In this way the research findings of this local community were taken directly to a national and international audience.

'We are convinced that the model pioneered through this program—connecting students, the community, local business and civil society—is a powerful force for change and can be migrated to other parts of the world.'

Science Community Associate

The ongoing collection of base-line data from a range of projects in the local environment also necessitated the development of a database that needed to be simple enough for students to use yet sophisticated enough for non-school partners to benefit from its contents. The expertise for this came from private industry specialists who became part

of a growing network of national and international partners.

Summary: Implications for learning and teaching

Expanding the modes of delivery impacts on the range of audiences with which students and teachers relate in the science curriculum. In responding to isolation this cluster of schools not only forged a new set of relations within the local community, but also set about expanding these relations to include national and international partners. These partners in turn, brought with them national and international recognition and with it additional funding. This funding then enabled the purchase of new ICT and equipment. For teaching and learning, the establishment of national and international relations meant that both students and teachers had an authentic audience, which served to validate and authenticate psychosocial connections to the curriculum.

Discussion and conclusion

Response to the issues of isolation: Redefining relation

The Blue View cluster responded successfully to the problem of geographical isolation. This response can be examined on two levels—the physical and the psychosocial.

On the physical level, the face of isolation in this community was transformed through a redefining of significant relationships and a shift in focus from metrocentric to rural-cum-global. Replacing a remote relationship with metropolitan Adelaide was a series of strong and effective relationships with local science-based government, industry and community partners. Furthermore, these relationships, while not exclusive of the metropolitan region, expanded to include partners from other parts of the nation and the globe. These were used to supplement both personnel and resourcing in the design and implementation of an innovative curriculum. Community-based scientists and professionals worked alongside teachers and students in outdoor classrooms to collect, collate and analyse scientific data for authentic purposes. In so doing students were involved in the creation of new knowledge and gained new understandings of the limitations and purposes of science.

The TIMSS Video study (ACER, 2006b) constructed an ideal blueprint of effective science teaching in Australia.

Six characteristics were identified:

- Students experience a curriculum that is relevant to their lives and interests within a supportive and safe learning environment
- Classroom science is linked to the broader community
- Students are actively engaged with inquiry, evidence and ideas
- Students are challenged to develop and extend meaningful understandings
- ICTs are exploited to enhance students' learning of science
- Assessment facilitates learning and is focused on scientific literacy.

(ACER, 2006, p.12)

This paper has presented evidence in support of the demonstration of at least the first five of these six characteristics. In a very pragmatic sense, by transforming the very nature of relationship, this cluster of schools had 'turned the tide' on the learning and teaching of science. A number of factors can be identified as enabling the demonstration of successful science learning and teaching in the Blue View cluster:-

- A vision about how things can be rather than accepting the status quo
- Effective leadership that is prepared to collaborate and network with a wide range of community members
- Identifying an issue of community concern about which individuals are passionate
- The capacity to reconceptualise the science curriculum, broadening the number of individuals involved in planning and implementing it
- A school community prepared to innovate and create
- Understanding about the place of community relationships in learning, teaching, and actively seeking out entrepreneurial activity
- A focus on science as a way of knowing, modelling, thinking and inquiring
- Tangible outcomes and recognition when a project is complete.

So what can rural and remote schools do to facilitate the development of such factors and the redefinition of significant relationships? Some strategies are to:

- pool resources across a cluster of schools to assign a leadership position for the implementation of a contextually relevant and innovative science program

- appoint as a coordinator a visionary who is passionate about improving science learning and teaching and whose job it is to work across the cluster
- as a cluster of schools identify a science-based issue of community concern about which individuals are passionate
- use coordinator time to forge a network of relationships within the local community around this issue of mutual concern
- identify possible teacher associates and potential sources of funding locally, nationally and internationally
- plan the science curriculum around the issue of mutual community concern, involving community-based personnel as appropriate
- allocate resources for teachers to meet across the cluster to plan and discuss curriculum issues and participate in professional learning activities.

Developing effective community relationships and using community resources takes time and effort to ensure worthwhile outcomes. However, these relationships can redefine the face of isolation and the potential benefits for student engagement in science are profound.

References

ACER. (2008). *Exploring scientific literacy: How Australia measures up: The PISA 2006 survey of students' scientific reading and mathematical literacy skills*. Australian Council for Educational Research. Retrieved: www.ozpisa.acer.edu.au [2008, 23rd may].

ACER. (2006a). *PISA in brief from Australia's perspective: Highlights from the full Australian report: Facing the future: A focus on mathematical literacy among Australian 15 year old students in PISA 2003*.: OECD, Programme for International Student Assessment (PISA).

ACER. (2006b) *Highlights from the TIMSS 1999 video study of year 8 science teaching* p 1-16 Available www.timss.acer.edu.au

Aldous, C., Barnes, A., Clark, J., White, B., & Morony, W. (2006). There's not enough offered to country areas and ... so much emphasis on going to Adelaide for PD. In T. Lyons (Ed.), *Science, ICT and Mathematics Education in Rural and Regional Australia, The SIMMER National Survey State and Territory Case Studies Companion volume to the SIMERR National Survey* (pp. 30-43): National Centre of Science, ICT and Mathematics Education for Rural and Regional Australia University of New England.

ASISTM. (2007). *Final Report January: Australian Schools Innovation in Science Technology and Mathematics*.

Creswell, J. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: SAGE.

Goodrum, D., Hackling, M., & Rennie, L. (2001). *The Status and Quality of Teaching and Learning of Science in Australian schools*. Canberra, ACT: Department of Education, Training and Youth Affairs.

Lyons, T. (Ed.). (2006). *The SIMERR National Survey. State and Territory Case Studies: Companion volume to the SIMERR National Survey*.: National Centre of Science, ICT and Mathematics Education for Rural and Regional Australia University of New England.

Lyons, T., Cooksey, R., Panizzon, D., Parnell, A., & Pegg, J. (2006). *The SIMERR National Survey Prepared for the Department of Education, Science and Training*. National Centre of Science, ICT and Mathematics for Rural and Regional Australia, University of New England [2008, 22/05/08].


MCEETYA. (2001). *National Framework for Rural and Remote Education: Ministerial Council for Education Employment Training and Youth Affairs (MCEETYA) Task Force on Rural and Remote Education, Training, Employment and Children's Services*. South Australian Department of Education Training and Employment.

Pegg, J. (2005, December). Paper presented at the SIMERR National Summit, Australian Science and Mathematics School, Adelaide, Australia.

Reber, A. S. (1995). *Dictionary of Psychology* (2nd ed.). London: Penguin Books.

Sykes, J. B. (Ed.). (1978). *The Concise Oxford Dictionary of Current English* (sixth ed.): Oxford at the Clarendon Press.

The Design-based Research Collective, (2003) *Design-Based Research: An emerging paradigm for educational inquiry* *Educational Researcher* 32: 5-8

Thompson, S., & De Bortoli, L. (2008). *PISA in Brief from Australia's Perspective: Highlights from the full Australian Report: Exploring scientific literacy: How Australia measures up. The PISA 2006 assessment of students' scientific, reading and mathematical literacy skills. Programme for International Student Assessment*. ACER. Retrieved: www.ozpisa.acer.edu.au [2008, 28-05-08]. 

About the author:

Carol Aldous is a senior lecturer in science education at Flinders University. She is the science coordinator of SIMERR-SA.