‘You don’t have other teachers to bounce ideas off’

Report from SiMERR Victoria

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EXPLORING BOUNDARIES

Whether breaking down data from national and international testing, looking at data concerning state examinations or participation in post compulsory science, ICT, and mathematics, or analysing the results of the SiMERR National Survey, two things are clear. First, students in rural Australia are significantly disadvantaged compared with their metropolitan counterparts. Second, the degree of disadvantage varies considerably depending on the degree of rurality (mainly conceived of as remoteness) and the nature of the school community. Causes of disadvantage include access issues such as cost of boarding schools or daily transport and quality issues arising from subject choice, educational delivery, educational opportunity, and resource provision (DEST, 2002; Stokes, Stafford & Holdsworth, 2000).

One of the issues to be considered when discussing science, ICT, and mathematics in rural and regional areas is the question of boundaries. The first type of boundary that is relevant concerns geographical divisions between metropolitan, regional, rural, and remote schools. There is considerable variation in the relative isolation of schools and the types of communities that they represent. Thus, there are related variables such as town and school size, proximity to major community facilities in major centres, and socio economic indicators that interact with the more obvious rural features of isolation and community focus. This all makes for a complex story. The choice of schools in Victoria for this study was made in order to reflect these variations. The effect of location on student learning and achievement is complex and is not easily predicted, and these interrelationships will form part of the analysis of data in this chapter.

The second type of boundary is between science, ICT, and mathematics, and the school curriculum generally. A lot has been written about the rural school experience, but the focus of the questions and the analysis here will be particularly on science, ICT, and mathematics. Nevertheless, many of the issues being addressed would apply to other areas of the curriculum, and the school culture in general, so teasing out subject-specific issues is one of the tasks of this report.

A further boundary often referred to in relation to rural education is the 'digital divide' (see, for instance, Cresswell & Underwood, 2004). This is not only a question of the availability of, and expertise with, computers and software – for both school and home machines – because Internet speed, cost and availability are the basis of significant equity issues in rural and remote communities (Besley, 2000). These forms of access also relate to the socio-cultural status and university education of parents – both significant factors affecting the likelihood of students having Internet access at home (Besley, 2000; James, 2002). This boundary is particularly relevant because information technology is generally seen as the medium that will lead to the 'death of distance' and to fuller participation of rural students, citizens, businesses, and institutions in the knowledge economy (Caincross, 2002).

This chapter reports the results of an exploration of rural school teachers', students', and parents' experiences related to life and education in rural Victoria. Six schools were studied, with three focus groups – of parents, teachers, and students – being conducted at each. A focus group was also undertaken with seven Victorian Regional Project Officers who are managing the *School Innovation in Teaching* initiative in science, mathematics, and Technology.

PROFILING RURALITY

The Victorian context

Victoria has 25% of Australia's population, with over 70% of the people living in Melbourne and its outer suburban areas; 34% of all Victorian students attend regional, rural, and remote schools; and 49% of the state's government schools exist outside Melbourne along with 50% of non-government schools. However, with only 3% of Australia's geographical area, Victoria has few regions that could be categorised as remote, and at the start of the 21st century there were only 67 students studying full time with distance education centres as 'isolated' students (HR&OE Commission, 2000).

The focus groups

In each of the six schools focus group discussions were held separately with parents, teachers, and students. Each group comprised between two and eight members. The issues pursued dealt with community characteristics; perceptions of science, ICT, and mathematics at the school; and views of the conditions for quality education in these subject areas. We also probed what these groups considered to be appropriate measures of success in these subject areas, i.e., their perceptions of the subjects' chief purposes, and asked groups to consider the differences – both positive and negative – between the rural and metropolitan experiences of teachers and students. Having attempted to capture details about individual cases, this analysis will attempt to identify patterns in the responses to determine the issues occupying the minds of these participants with regard to rural experiences of schooling in science, ICT, and mathematics.

In addition to the 18 school focus groups, a discussion was held with a group of seven regionally based Regional Project Officers (RPOs). These have been supporting schools and teachers with professional development provision and as critical friends, as part of the *School Innovation in Science* initiative and its Mathematics and Technology sequels. Because they interact with so many rural teachers, the RPOs are in a powerful position to provide insights into the teaching of science, technology, and mathematics in regional Victoria. This focus group explored issues of teaching and learning, effective programs and, in particular, professional development provision.

Profiles of the schools

The six schools represented in this study were chosen partly at random, based on convenience, but also on a wish to represent a range of school circumstances and to explore how different dimensions of regionality and rurality interact and influence student learning. The schools were all rural in the sense that they were not in Melbourne or regional towns, but they differed considerably in terms of size, degree of isolation from larger centres, types of community represented, and the degree to which each could be considered to be the focus of local communities, and in their proximity to a variety of geographical or human resources.

Laneway Secondary College[8] is in a town on the Victorian coast, remote from Melbourne but within a half hour's drive of other sizeable towns. The local population is about 5000. The school has a history of innovation in its Year 7–10 program and has recently extended to offering Victorian Certificate of Education (VCE: matriculation year) subjects. The local community is diverse, with fishing and tourist industries, increasing numbers of retired residents and a sizeable population on government support.

Echidna Secondary College is one and a half hours from Melbourne in a predominantly farming area. The school has an established VCE program. The area has a community of about 3000 people who chose it for lifestyle reasons and because of the relatively lower cost of living.

Madura Primary School is in a rural setting 15 minutes drive from a large regional city of 250000. It therefore does not suffer the same isolation as some of the other schools. Nevertheless, its situation is such that there are a number of issues relating to community, size, and location characteristic of the general outer-regional experience.

Rolling Primary School is located in an outer suburb of a large regional centre. The area is severely under-privileged with an extremely high incidence of unemployment. Social problems are very common and for many families unemployment has been endemic with parents and grandparents not working. There is a very high incidence of single parenting as well as separated and blended families.

Runningbrook Primary School is in a town of about 1000 people, more than an hour's drive from any regional centre. It draws Catholic students from Runningbrook and surrounding country towns as well as the mixed farming region. Many Catholic children in the area now go to their local state schools, so the school tends to attract those seeking a strong religious education and pastoral care. Although there are few disabled children, the school has six integration aides, and a heavy emphasis on individual reading tuition. Fewer families on farms and smaller numbers of children in families have also led to a declining school population. Socio culturally, the town is fairly homogeneous – predominantly Anglo-Saxon, with a good employment rate. Like many rural schools with between 50 and 90 students, the school runs three composite classes (P-2, 3-4 and 5-6).

Moorabool Primary School has a population that varies greatly (from a base level of 7000) because of seasonal influxes of fruit pickers and processors, many with immigrant backgrounds. The transient nature of these families has affected student learning as children come and go on a seasonal basis. Many go and don't return, or return confused and unsettled from being in a different education system. Consequently, for teachers there is a continual settling-in and re-establishment aspect that needs to be incorporated into their teaching program. Generally, children from these low socio economic families are not well supported

[8] School names and names used for focus group participants are all pseudonyms.

educationally at home and require extra attention from teachers. According to the teachers interviewed, this leads to a disproportionate amount of time needed by different student groups, as many children do not read well and can be disruptive.

THEMES ARISING FROM THE FOCUS GROUPS

A number of important features of these school communities emerged as a frame for understanding student learning in science, mathematics, and ICT in rural settings. Briefly, these features were:

- *The size of the school community*, which has an effect on personal relations, access to funds, the ability to provide curriculum variation, and the diversity of students' peer groups.
- *Location*, including proximity to community resources (such as museums, excursions and visitors to schools), to local businesses (with implications for resource access, and potential student project investigations), and to other schools and teachers (with implications for professional development opportunities, mutual support and student interaction).
- *The nature of the community*, including socio economic indicators that have implications for school resourcing, role models, support for students, and students' educational expectations.

On the basis of this study, the 'one size fits all' view of science, ICT, and mathematics experience of regional and rural schools cannot adequately capture the range of circumstances of teachers and students in these schools. Similarities and differences between ideas expressed in the various schools' focus groups are discussed below with reference to themes identified from the interviews.

Living in rural Victoria

Almost all the teachers and parents in the primary school focus groups had rural or regional backgrounds, as did the secondary school parents. The secondary school teachers, on the other hand, were nearly all from Melbourne or large regional cities. However, when talking about the reasons for choosing to live and work in regional or rural Victoria, or for sending their children to rural schools, a coherent pattern emerged.

The rural advantage

Overwhelmingly, teachers, parents, and students talked of the lifestyle advantages of regional living, and the sense of community. They mentioned the same factors identified by Education Queensland (2005): pastoral care and support from the local community, a strong sense of belonging and safety, and the potential for creative links to community organisations and businesses.

Parents focused particularly on the advantages of community support, for example, being known by shopkeepers; accessing babysitters and the pastoral care available for children. Parents and students mentioned safety as a significant advantage:

> Kids can wander from a young age. (Effie, Runningbrook parent)
>
> It's quiet. We can leave the back door open, can leave stuff outside. (Belinda, Madura PS student)

Students in particular talked of space and outdoor facilities. There is 'plenty of room and places to go' where they 'can race bikes', and 'the river is at the back door'. However, some regretted that there were 'not so many things to do' and 'better shops' in Melbourne, and mentioned the need to travel to regional centres 'for ballet and music classes' or 'to borrow books from the library'.

While some teachers had moved to the area to follow a partner's career, most mentioned the relaxed lifestyle, the proximity of home to work, affordable housing, and the advantages of country environments for bringing up children. For Moorabool and Madura primary schools, some of the teachers lived in large regional cities close by, and hence combined the small school working environment with home environments that were more metropolitan in character.

Attraction of rural schools

In keeping with the community-focused views of rural living, regional and rural schools were seen to offer advantages in this respect. For teachers, the close relationships forged with students, parents, and other teachers were cited, and comments about 'being acknowledged in the street and shops' were common. Teachers felt that 'you are part of their life, instead of just doing a job' and that parents were 'on board'.

Working in small schools was also seen to confer developmental advantages because of the multi-skilling entailed in taking a range of responsibilities. The support of staff was also generally held to be a strong feature of country schools, although two teachers felt vulnerable and 'needed more professional stimulation' because of very limited staff numbers.

> There's not enough staff to form a professional community to have really good discussions about curriculum matters and maths teaching. (Carol, Laneway SC teacher)

Teacher attraction and retention

In none of the six schools was teacher retention felt to be an issue. Madura and Rolling Primary Schools' teachers explained that it was hard to find positions in the areas because teachers tended to stay, partly because of the attractiveness of the area. 'There are thousands of teachers out there who would love a job here,' was a point of general agreement in a Rolling PS focus group.

> One of the reasons young staff stay is that staff are supportive and help one another. This is not so in city schools. (David, Laneway SC teacher)

> (Retention is) not an issue. We have got younger staff who tend to stay because of collegiality, homogeneity of staff. Some mix socially. It's not so far to Melbourne, and has good weather and wineries. A good atmosphere. (Graham, Echidna SC parent)

However, in several focus groups, longer-term employment in the same school was seen as a potential disadvantage. For example, teachers at Laneway and Echidna talked of having a core of older, more experienced teachers, and the need to attract and retain younger teachers, 'as it is critical to be able to offer ongoing positions to attract young staff with families'.

While teacher retention at the focus group schools was not a problem, the group of Regional Project Officers (RPOs) who deal regularly with Victorian rural schools also clearly spelt out problems of retention that echoed this feeling:

> (There are) serious problems with attracting and keeping teachers who are well qualified in the various sciences, maths, and IT. This not only affects quality of teaching, but expectations for students to study maths, science, and IT at higher levels. (Graham, RPO)

Of course, the situation varies considerably depending on the school and the region. It was mentioned by one teacher that 'well-qualified teachers of the enabling sciences are in demand in city schools', and they 'usually get to teach their favourite subjects at senior levels'. She noted the danger of considering teachers to be qualified to teach in all subject areas because 'kids are so easily turned off in middle school levels if teachers don't know the content and how to teach it well'. This raises the question of how best to attract and retain well qualified teachers of science, ICT, and mathematics to regional and rural areas for primary, lower secondary and upper secondary levels.

Similarly, student drift varied as an issue, with Moorabool PS and Rolling PS experiencing drift at disruptive levels because of seasonal work in the areas:

> (Drift is) fairly high – fruit pickers and seasonal workers. The children coming and going causes disruption. (Anna, Moorabool PS teacher)

> Some parents move to try to get work. Lots of split families. It has decreased in recent years, but still a big turnover. There is some seasonal work with spuds, orchards. (Bob, Rolling PS teacher)

At Laneway SC, drift was associated with transient families moving because of changing economic factors. In the other three schools drift was not an issue. These more settled communities were in agricultural and tourist areas where few seasonal workers were employed.

Student expectations

The quality of guidance for students and their parents to ensure that capable students undertook higher-level mathematics courses was another factor. This was noted by Bottoms and Carpenter (2004) as being a vital aspect of rural success. The teachers and parents who participated in the focus groups generally seemed to have high expectations in this respect.

Students' educational aspirations affect their subject choices and, in particular, they are not as likely to develop a keen interest in the enabling sciences (including ICT and mathematics) if they are not intending to undertake post-compulsory schooling and higher-level studies. Given this situation, it was pleasing to note that – contrary to the general perception of rural employment patterns – most students in the focus groups had expectations that they would undertake tertiary study.

Students in the primary school focus groups mostly imagined themselves in careers that involve TAFE levels of education[9] (carpenter, electrician, pilot) or had expectations of

[3] It could be that the students and parents invited by schools to participate were not representative, and it seemed that some bias did occur with the decision to ask articulate students, and a tendency to ask parents who were involved in the school to some extent.

university education (scientist studying extinct animals, teacher). Two who spoke about taking over family farms said that they intended to undertake agricultural science courses, and one said that she would study 'Management'. The secondary school students were planning on tertiary studies (e.g., biomedical science, sound engineering, massage or physiotherapy, graphic design, veterinary science). Only one student had 'no idea'.

James et al. (1999), in a survey of 7000 senior secondary students, found that such expectations arise largely from family and community attitudes and that these are more powerful in shaping rural students' aspirations than factors such as isolation and losing touch with friends. The parent focus groups exhibited a similar profile of expectation, with most mentioning university as the preferred option. Extracts from the Runningbrook PS group represent well the range of opinions expressed by parents asked about educational aspirations for their children:

> University – it is important to go, even if they come back afterwards. (Zahil)
>
> University …but it is up to them – we will support whatever they want to do. (Rhonda)
>
> Probably university or TAFE or the Forces. His brother and sister are both at university. (Peter)
>
> Agricultural college of some sort. (Janine)
>
> Year 11-12, then apprenticeship. He is interested in doing a trade. (Sana)
>
> I can't imagine him living in the city or working in an office – he's an outdoor boy. (Lita)

Kenyon, Sercombe, Black and Lhuede (2001), in a study of Australian rural communities, found that while few rural people have tertiary qualifications, they tend to see 'education as a conduit for ideas and innovative thinking that may ultimately impact on the family farms and rural communities' (pp. 34–35). This became the topic of short discussions in one focus group:

> He will own the farm one day, but we expect him to get a good education first. Farmers need to be well educated these days. He is interested in Chemistry or Vet. Science. … I take the kids to the city each year and they choose where to go – Scienceworks, museums, the zoo. We go to university open days as they get older, but we have to stay overnight. … The older ones stay with their aunty while they do work experience for school, so that they get used to the city and using public transport, and see a different range of job opportunities from here. (Runningbrook PS parents)

However, about 15% of students in Australia who plan to go on to university do not (Khoo & Ainley, 2005), and many subtle factors have an effect on actual outcomes. In this same school several parents and teachers thought that boys in particular might not consider tertiary education, because of a wish to play football:

> It depends if he wants to stay in the area for sport. Hopefully he will play for the local football team. (Lita, Runningbrook PS parent)

This is consistent with the statement by the Higher Education Council (in James et al., 1999, p.iii) which claimed that:

> … the pull of the local community and peer group, even of the local football team, can in some cases be the difference in deciding whether a young country person – particularly a young man – tries for higher education or not. More interestingly, such intangible lifestyle factors may have as much, if not more, sway than the more obvious factors such as cost and expense, and distance from home.

Almost all secondary school parents had university aspirations for their children. However, some talked about the difficulty of country students attending university in the city, away from home:

> It's a huge disadvantage for parents if children have to go to the city to study, and a huge social learning challenge for the children. City kids are wiser and more knowing – country kids would start in the city at uni with a social disadvantage. (Ron, Moorabool PS parent)

Because socio economic background is the major factor associated with variations in students' perceptions of the value of higher education across Australia (James et al., 1999), it was surprising that the educational aspirations of students and parents in the focus groups were uniformly high. At least one parent argued that financial considerations do not affect children's career aspirations:

> Kids don't think of the money side of things – it's not an issue as such. They see university as the norm. (Sani, Laneway SC parent)

More subtle influences of the rural school community in shaping students' aspirations are discussed in a later section. It was noticed that there were some differences between student/parent aspirations, and teachers' assumptions about these. For example, in a school where all children had talked about their intentions to undertake tertiary studies, and parents also had relatively high expectations, teachers generally agreed with a colleague's statement that 'The parents are generally employed in agriculture and service industries, and their children will have the same opportunities, so expectations are not high and the children are generally not striving for a different future.' Such statements supported Alloway, Gilbert, Gilbert and Muspratt's (2001) finding that rural teachers and parents are inclined to express more negative views than students about what lies ahead.

Science, ICT, and mathematics in these schools

The focus groups explored students' experience of, and attitudes to, science, ICT, and mathematics in their schools, as well as teacher and parent perceptions of current strengths in these areas.

Students' experiences of science and mathematics

Students were asked to nominate their favourite school subjects and, in particular, to talk about what they liked in mathematics and science.

The students generally expressed a liking for mathematics, or at least some aspects of it. Apart from popularity votes for topics ('I like division and multiplication, don't like algebra,

graphs, hate fractions'), there were two factors that seemed to feature in students' attitudes to mathematics. The first was satisfaction arising from success or feelings of competence:

> I'm good at it. It's easy. (Luke, Moorabool PS student)
>
> Assignments are good. We can go at our own pace. (Rota, Laneway SC student)
>
> I like maths in general but not the difficult bits. (Pauline, Echidna SC student)
>
> I like maths in secondary school because you can focus. (Dianna, Echidna SC student)

The second was students' appreciation of mathematics learnt in relevant contexts.

> It (a special program on 'Money Maths') relates to real life, it relates to business, it teaches you how to buy things; it's relevant to adult life. (Minnie, Rolling PS student)
>
> Mummification is good, at the moment (maths and science and SOSE integrated). (I like) the maths and garment design. (Simon, Echidna SC student)

When asked to whom they went for help with mathematics, the general consensus was first to their friends and then to teachers.

Science sat very differently in students' views. Primary students found it difficult to identify what science they had done, and often had to be prompted. This finding was in accordance with those of Goodrum, Hackling and Rennie (2001) who reported that science is often under-represented in the curriculum. One student claimed that they 'do not study science because they have no Bunsen burners'. For the children in one primary school, a visit to a secondary school science laboratory was an exciting occasion, but there was some indication that this didn't happen often.

Nevertheless, the students generally made it clear that they enjoyed the hands-on aspects of science, although in some cases poor behaviour deterred some teachers from including many opportunities. Comments included:

> The best thing was 'oobleck', and making icecream. (Freda, Madura PS student)
>
> We have science every second week. Experiments are great but we don't get to do many since if one person mucks up we don't get to do them. Kids are always stuffing up. (Madura PS student)

There was some recognition that rural environments offered a different focus for science activities, both at home and at school:

> I help Dad all the time with the scientific records ... cattle feed, medication, weight of the animals on their diets, bags per hectare, weed sprays – it's all on computer and we put it in the graphs and keep a scientific record. Milking too, and feedlots. (David, Runningbrook student)

The secondary students were all reasonably positive about science, with the Echidna SC group commenting particularly on a leaf hopper biological control project that they had done with support from CSIRO.

Teachers' and parents' views of school science and mathematics

For teachers and parents, the strength of staff and the capacity to plan and work together was a major theme in talking about the strengths of mathematics and science:

> Through IMYMS [Improving Middle Years Mathematics and Science – an ARC and Victorian Education Department jointly funded Deakin project] we are organised to share planning and resources across the cluster. … We have gone from text-based maths to problem solving activities. … The recent cluster based PD [professional development] has strengthened maths. (Madura PS teachers)

> (There is a) core of dedicated staff. Lately people retiring and younger teachers hanging in. Good conditions for them. … We've reviewed maths thoroughly over the last few years. Lots of hands-on projects, goal-based assessment. … Activity-based work in science and maths is part of every unit. (Laneway SC teachers)

> [The greatest strength is] being able to talk and work or plan with other teachers. (Carole, Moorabool PS teacher)

There was generally a feeling that in these rural schools there was closeness among staff and a level of mutual support that did not exist to the same degree in city schools. This advantage has been noted previously in US studies (e.g., DeYoung, 1987; Fan & Chen, 1999).

Parents also highlighted the quality of staff and smallness of the school as particular advantages. They pointed to the importance of the relation between staff and students.

> The school's greatest strength is the enthusiasm of the teachers. Maths and Science Coordinators are passionate about their work. (Sani, Moorabool PS parent)

> Teachers seem good in maths and science. Of all subjects these get the most homework. If kids want to push themselves they are supported. (Oprah, Laneway SC parents)

> The teachers try to get to know the family background so they can identify needs. (Sandra, Rolling PS parent)

> Staff know every kid. … It's more personal. (Echidna SC parents)

Nevertheless, there was some concern from parents in three primary schools that science and technology were not adequately represented, and were poorly resourced – an opinion shared by some of the teachers. One teacher commented that '… city schools are much better resourced because they have more parents and industries that they can get money from in fundraising and more school fees to buy equipment over the years'.

There was also a concern expressed in both primary and secondary schools that city schools would have more teachers with subject specialisations – a factor that supports day-to-day

professional development arising from sharing ideas, team curriculum development and lesson planning, and mentoring of new staff members. The existence of strong professional departments within secondary schools is one factor that leads to effective teaching (Ingvarson, Beavis, Bishop, Peck & Elsworth, 2004), so this raises a question of how such links could be made, and professional communities developed, within clusters of relatively small rural schools.

ICT and computer use

There was little evidence or mention of ICT courses in these schools and the depth of discussion on the use of computers varied considerably.

> ICT has varied. At the moment grade teachers take ICT and we struggle with resources for the lab. We want to keep computers in rooms. PD (on Intel) has impacted on all areas. Being close to [a regional centre] allows PD access. PD in ICT is run in the school. (Madura PS teachers)

> ICT is not driven by a teacher specialising in ICT, whereas all maths and science teachers are trained. (Rose, Echidna SC teacher)

> Students use the Internet a lot. … It's a good chance to use computers. … The *Maths 1,2,3* software sent home was good. (Madura PS parents)

Students provided the best evidence on the state of computer access in their schools and their home usage. Except for Rolling PS, most of the students seemed to have more access to computers at home than at school. With respect to school use, students talked about particular units of work.

> Year 7 Microworlds was really fun. … Computer studies is basic, boring – making a website, typing, Excel – but movie making was good [and] editing. (Echidna SC students)

> The computers here [school] are hopeless. Slow, slow. They break down all the time. At home we have fast broadband and a new model. (Samantha, Runninngbrook PS, student)

> [There is] poor access at home. One boy has Internet access (dial-up), one girl knows there is Internet access on their computer but is not permitted to access it. Others have no computers, or only very old slow ones but no Internet. (Researcher, Rolling Primary researcher report)

The frustrations of using computers at school was a common theme with students:

> The computers at school – they freeze, [it's] frustrating. … If you don't save, you lose work. There is a slow shutdown at the end of lunchtime and you can lose work. It can be very slow if there are lots of people, okay if not. … We got broadband wireless last year. (Echidna SC students)

> Don't get much chance to use computers at school. … If we use them at school, we use them for searching for information, typing, writing stories, games. (Rolling PS students)

School size was felt by some teachers to be a major influence on computer access. One primary teacher noted that in bigger schools there would be 'teachers with technical expertise and probably someone in charge of maintenance' as well as 'lots more software than we can afford'. On the other hand, at the small Madura Primary school, teachers were satisfied with the level of support provided through a cluster sharing arrangement and parental support:

> The technicians are fantastic; we have high level access for a half-day and low level access for two days ... we (also) have a parent who is an IBM worker. (Jill, Madura PS teacher)

Nevertheless, the students did have access to computers almost everyday at school, which corresponds with the finding of Cresswell and Underwood (2004) who noted little difference in access to computers between students in city and rural students across Australia.

Issues in science and mathematics provision

The list of concerns generated by teachers is at least twice as long as the strengths mentioned. There were numerous interconnecting dimensions of the rural experience that were regularly identified in all groups. These are described below, prior to a discussion of the ways they interact.

Remoteness

While special events such as excursions, visits by scientists, and mathematics competitions are not part of the mainstream curriculum, they do provide variety and can be effective in stimulating student interest and knowledge as well as illustrating practical applications. However, there are not many such options available to isolated communities (Murkins, 2001).

The six schools varied considerably in the degree of remoteness from Melbourne or large regional centres. The issue of remoteness came up regularly in relation to a number of disadvantaging factors. For teaching and learning it showed up in relation to difficulties in accessing community resources such as the Scienceworks museum (a well resourced interactive science and technology centre) and regular access to a range of visiting speakers. Remoteness also featured in determining students' levels of familiarity with science or mathematics-related sites or professions, and opportunities to explore future education pathways:

> [The Shire Office] is a long way for visitors so it is hard to get them here to talk with the students. City kids have all that close by (industries, justice, parliament, museums). (Alice, Runningbrook PS teacher)

> The facilities are not so good. There's no easy access to programs for students, for example, a genetics program at Melbourne University was 2.5 hours each way, and expensive. (Gillian, Echidna SC teacher)

> [One obstacle is] not having a Dick Smith's [electronics store] down the road, or a hobby shop. Staying up-to-date with movements; discipline knowledge is an issue. (Don, Laneway SC teacher)

> In terms of the avenue into post secondary, it's harder for rural kids to go to [university and TAFE] open days. (David, Laneway SC teacher)

> With classes, you can't walk to visit small businesses. … Bus costs are enormous so excursions are difficult. … The Scienceworks excursion to Melbourne was expensive even with the (state government rural) subsidy that we could get. Country kids usually have to stay overnight and for my parents that money is hard to find. (Madura PS students)

School Size

Size is a significant factor shaping school organisation as well as forms of teaching and learning in rural schools. In small primary schools, teachers teach up to seven grade levels, and rural secondary schools often amalgamate classes or reduce the variety of subject offerings. Lana, one of the RPOs, observed that 'composite classes are common in rural areas, and often unworkable'. This is particularly the case for higher levels of secondary mathematics, resulting in the potential for talented students to suffer from lack of 'performance cohort association' (Murkins, 2001).

At all secondary levels it appeared common to have staff teaching out of their areas of specialisation, a factor that encourages schools to employ part-time teachers to maintain flexibility. Unfortunately, specialist teachers of the range of sciences, as well as mathematics and ICT, are not often found in small towns. Focus group members commented on the fact that there were fewer staff to interact with than in cities and regional centres, and with part-time staff there were fewer opportunities to work in professional learning teams. In fact, the small numbers of both teachers and students affected teaching and learning in specialist areas:

> The use of part-time teachers is very common in rural areas, bringing some problems including no access to them on off days, little participation in PD, they cannot be used to cover absences for PD or excursions, and it makes a nonsense of forming teaching teams around subject areas. (Linda, participant in the Regional Project Officer focus group)

> You don't have people to bounce ideas off with [only] one teacher at each grade. You don't get the opportunity to liaise with other teachers from other schools, which can lead to isolation. (Madura PS)

For small schools, particularly in low socio-economic communities, it was held to be difficult to form a critical mass of academically committed students who could interact with and support each other. This was particularly an issue with the secondary school focus groups. There were some comments about classroom environments not being conducive to effective high level learning:

> In a small school, a few students who hate school can destroy opportunities of others. … Children can be stuck with the same peers all through school. (Runningbrook PS teachers)

> Having fewer high achieving kids is a major issue. … Kids can't afford to display aspirations to achieve. (Echidna SC parents)

> Children at higher levels have a problem – there isn't really a love of learning being fostered. (Madelyn, Madura PS parent)

> There's a large range of kids in ability and attitude. Middle-range kids miss out a bit. The school does well at the lower end but doesn't challenge high performers. In a small community, kids don't want to stand out – to be seen as nerds. (Chris, Laneway SC parent)

> Our school is laid back. They don't pressure us much. We're not pushed as much as city schools. Not much homework. (Laneway SC students)

> There are fewer kids for the opportunities available. The downside is no chess club for instance. They can't go to the museum or to art exhibitions. In the city you have a full range of resources like this and there is nothing to compensate here. (Echidna SC parents)

Influence of community characteristics on student outcomes

Student orientation to study and achievement was an issue that came up regularly in the focus groups. We have seen that university education seemed to be a common aspiration of students and parents in this study, but the question of student orientation and application to academic tasks was more generally held to relate to the nature of rural communities.

The concern that the nature of rural communities diminished student aspirations took a number of forms. These were associated with the lower socioeconomic profiles of rural communities and the lack of variety in industries and professions. The causes were seen to include parental aspirations for themselves and their children, parental ability to help students with their science and mathematics homework, and a lack of role models for science and mathematics-related employment:

> Role models for subjects are different. There is more access to role models in the city. The local community use technology, but they don't make it. The technology round town is not mainstream tech. Kids don't see the usefulness of maths – there's no history of jobs here that use maths. (Thai, Laneway SC teacher)

> Limited exposure to the full range of jobs and educational opportunities. (Carmel. Runningbrook PS teacher)

> Many parents model unproductive patterns of behaviour (focus on sport, acceptance of unemployment). (Jan, Runningbrook PS teacher)

The observation that rural communities often lack role models relating to science, ICT and mathematics is consistent with reports that rural students have 'fewer images from which to draw in envisaging what they might become' (Alloway et al., 2001, p. 249).

Several parents and teachers, though, expressed the need for parents to have higher expectations and to be supportive of their children's aspirations. Chris, a parent from Laneway SC considered that 'Parents and peers developing interests is critical in supporting practice in science and maths'.

Resources

Two types of resources were identified as issues in all of these rural schools. The first were community resources such as science centres, people such as scientists or other professionals, supply points such as for the purchase of electronics, local secondary schools to provide laboratory experiences or equipment, and local schools and teachers to provide or share professional development. This aspect was described previously as part of remoteness, but it also relates to community factors in that access to parents, local professionals and technological sites is restricted in regional centres with low socioeconomic features and/or a limited range of employment and types of business. Thus, many of the professions that a science/ ICT /mathematics background would lead to are simply not in evidence or available

in many rural communities so there are limited opportunities for drawing on local expertise and industry.

Nevertheless, the resource aspects of remoteness were not all in deficit. There were other sites and facilities mentioned that were more accessible for rural schools:

> Access to chemistry resources is a problem but there are good resources for biology for instance. We have units on aquaculture, environmental science. (Russel, Laneway SC teacher)

> We have advantages like trees, creeks, yabbies, farms, the Water Treatment Plant, etc. (Danah, Rolling PS teacher)

> Rural schools can get out more readily to look at salinity, erosion, geoscience, land care. (Danni, Echidna SC parent)

> There is sufficient flexibility to adapt the curriculum to a rural setting. In science this happens. For instance the marine park excursion, the camp at the Foreshore. Maths can be adapted also. (Lin, Madura PS teacher)

> My hobby is distilling ti-tree oil, and that has a lot of science, to grow the right type as well as distillery conditions and packaging. I could not do it in a city. (Bek, Runningbrook PS student)

It was also noted that there were opportunities that teachers did not take advantage of. One student claimed, for example, that he could teach his friends a lot of science from the work he does in dairying. Some teachers said that they had never considered linking up local industry and events to enrich their teaching, despite being able to name potential sites for science-based visits, guests and practical activities. This raises the question of practices that rural schools could adopt to improve the learning opportunities for and the aspirations of their students by building smaller communities' capacities for creating supportive relationships, new learning environments, and the efficient sharing of resources.

The second type of resource identified was equipment, particularly for the teaching of science and ICT. All of the schools felt that they had 'adequate' numbers of computers, but access to other sorts of equipment relates in a complex way to isolation as well as to community type and size:

> [Our] teaching suffers from a lack of equipment – stop watches, calculators, CDs, basic science equipment – that would be available in bigger schools. (Rhonda, Runningbrook PS parent)

> Finance is a problem. With a small school you can't run specialists. Fundraising is difficult. … The school is isolated from local industry and shops that would help with fundraising. … There is no real town or city to relate to. (Madura PS parents)

The interconnections among these various factors are discussed in more detail below.

Effective programs

The teacher and parent groups were asked to identify effective science and mathematics programs, and teachers were also asked about the professional development activities they felt had been effective for them.

School programs

Responses to the issue of remoteness from community resources can be seen in the programs nominated as effective. Teachers were more knowledgeable about the programs that were effective, but parents were also aware of such programs, and the views of the two groups were compatible and overlapping. Programs could be broken into two types: special events and longer-term pedagogical reforms.

Some special events, such as excursions, have been mentioned previously.

Regular visitors to these schools included the 'Mr Gizmo' science program, Science Works, and a planetarium. While the children had very detailed memories of travelling science (and other) shows, both parents and teachers commented on the rarity of these events and the difficulty of meeting expenses.

More encompassing and longer-term jointly planned curriculum and pedagogical reforms discussed by teachers highlighted the way that teams of teachers in rural settings can work with each other in the interests of students, in ways that would be more difficult for large metropolitan schools.

> The way we've organised maths this year with a coherent structure, planned as a team. There is a good feel amongst the team. … Kids here who are in danger of dropping out are local and teachers understand them – we can provide better following up and pathways. (Laneway SC teachers)

> The forming of teacher teams has been a good outcome of the school's integrated approach. (Ross, Echidna SC teacher)

Teacher professional development

Stern (1994) reporting on urban/rural differences in course materials and mathematics programs, found that rural teachers generally have less professional preparation or ongoing professional development. In the focus groups, a number of professional development initiatives were described that had been judged successful. Most schools seemed to have a regular professional development event, which was varied in its mode, from visiting experts, to sharing expertise within the school, to networking with other schools. Teachers talked of the difficulties of getting to conferences, but there was at least one description of the Mathematics Association of Victoria running a highly regarded regional conference. While noting the time and expense involved in travelling to major centres (often requiring overnight accommodation), they also spoke very positively about network meetings and cluster models of professional development. In general, while difficulties were acknowledged, there was not an impression given of an isolated and moribund set of teachers.

> We had new software provided by the Regional Project Officer (RPO). A PD session was held at a local café. (Ruth, Echidna SC teacher)

> The best form of PD is giving papers at conferences, but the concept is difficult for country teachers. Travel is difficult. … The Intel PD was successful. The 'gourmet' PD was good, with shared provision between local schools. … We signed up for four nights. … MAV came to [regional centre] with a full day regional conference. (Laneway SC teachers)

> A cluster 'muster' used to happen regularly, with six regional secondary schools but was stopped in favour of more focused PD. (Ruth, Echidna SC teacher)

> One teacher is involved in YELP, a program for accelerated learning which has really boosted our motivation and the children's. … It is Koori funded, and the area has been targeted in the state. (Moorabool PS teachers)

While teachers spoke positively about collegial support evidenced in smaller schools, they did concede that they can feel relatively isolated, usually with no colleague at their grade levels, or no other subject-area specialist with whom to share ideas. One commented that she craved more professional stimulation and the engaging pedagogical discussions that she had previously experienced in a larger school.

The regional project officers, who run professional development for large regions in Victoria, argued strongly for long term school-based professional development that matched school needs:

> PD needs to be school-based: learning in context. Projects need built-in assistance over a longer-term journey of changing cultures. Time release is needed to allow ideas to develop, reflection on progress, planning, etc. Facilitators need to go into schools. (Kate, Regional Project Officer)

> Some facilitators have become leaders in the field, providing new opportunities for teachers. (Lana, Regional Project Officer)

Professional development in Victoria is financed by individual schools. All government schools must have a budget line for professional development and there is a minimum dollar amount per teacher that must be expended per annum. However, this amount does little more than employ emergency teachers for two days per year. All government schools have a few 'curriculum' days, when the school is closed, and the teachers can undertake some whole-school development. These days may also be used for other purposes such as co-ordinated syllabus planning.

Images of success

The teacher and parent focus groups were asked what they would consider an appropriate measure of success for judging their school's science, ICT, and mathematics performance. The views of the two groups were very similar. First among the factors was the fostering of a love of learning, and interest and confidence in learning.

> Being excited is important – individual children are different. Some show more outward interest than others. Being eager to extend themselves at home, ask more questions. (Janine, Moorabool PS parent)

> Leaving primary school still liking these subjects. Enjoyment of learning and looking forward to high school. Basic skills for life (3 Rs). Different levels need catering for individual needs – each child needs to be challenged, and needs to achieve competence. (Karen, Madura PS parent)

This was coupled with emphasis on building up the necessary knowledge and skills to keep opportunities alive as well as helping students to achieve their goals.

> Kids should be conversationally knowledgeable and have their interests stimulated. They should have a positive experience, be confident to the point they are willing to take on VCE maths. They should want to learn and be positive. They need the basics of maths. (Danni, Echidna SC parent)

> Getting kids through to their goals. A mix of problem solving, modelling, hands on, skill is needed – for kids who choose physics or chem. – so that long term goals are met. Build the capacity for life long learning. (Chris, Laneway SC teacher)

> That all students can move into what they want – to open up choice. Skills and knowledge are both important. … An interest in science that will continue. … to succeed at VCE. (Echidna SC teachers)

Overall, while the focus group participants were aware of challenges in managing multi-age curriculum development, they were also aware of many and varied opportunities to offer relatively individualised learning contexts and to draw on their small communities in this endeavour.

DISCUSSION AND IMPLICATIONS

The factors described by the focus group participants do not exist independently. There are obvious interactions between approaches to and arrangements made for student and teacher learning. These include the effects of location (degree of remoteness), school and town size, and community profiles on student learning; manageable access to and uptake of different types of teaching, learning, and developmental resources and opportunities; and student opportunities, attitudes, and aspirations.

The range of discussions from these 19 focus groups demonstrates that, while there are broad themes that we need to address when dealing with regional and rural science, ICT, and mathematics education, there is considerable variation in schools' experience depending on a range of factors outlined above. To different degrees, these schools were advantaged or disadvantaged by location, by size, and by the nature of the communities they serve. Rural education is faced with a complex series of issues that have an immediate flow-on consequence for learners in those schools. The complexity is extensive and interwoven with issues such as student numbers in mathematics, science and ICT; attracting passionate, well-qualified and experienced teachers; resources; PD support; and facilities. These issues are not mutually exclusive – 'fixing' one issue may also depend on addressing another to successfully redress the inequity for learners in rural schools.

Many of the issues raised in the discussions are broader than the teaching and learning of science, ICT, or mathematics. Nevertheless, they are thrown into specific and sharp relief for these subject areas partly because of the particular demands of each. These subjects are perceived to be relatively difficult and prime measures of academic achievement because they are, in many respects, 'gatekeepers' for high stakes assessment and university entrance, and because their study enables access to so many occupations that are important for the development of Australia in general as well as rural and regional areas in particular. Thus,

they have the potential to pose particular challenges for communities without strong educational and professional histories.

The three main causal factors in these analyses have been identified as the degree of remoteness (with implications for access to resources), the nature of the local community (with implications for student aspirations and opportunities) and size (with resource and classroom culture implications). We need to understand these different factors better but, in particular, we need to promote research that seeks out productive ways to deal with these essentially rural circumstances and explore ways of supporting innovative practices in regional and rural schools generally.

Out of this study, we would nominate the following questions to be particularly worthy of further examination:

- What policies and practices can rural schools adopt to improve the learning opportunities for and aspirations of their students?
- How can schools increase support networks that will put students potentially interested in science, ICT, or mathematics in touch with appropriate role models and activities to stimulate their interest and build their learning capacity?
- What particular features of rural schools and communities can be productively harnessed to develop curricula and pedagogies that will engage and challenge students in science, ICT, and mathematics?
- How can rural schools attract and retain quality teachers of science, ICT, and mathematics?
- What modes of professional development are best able to support science, ICT, and mathematics teachers in rural (and especially remote) areas?
- What community circumstances and unique approaches lead to some rural and remote schools consistently doing better than the majority in broad-based test programs?

To answer these questions there is a need to identify schools or clusters of schools that are engaged in innovative and successful programs and that demonstrate high levels of student achievement and other outcomes, in order to explore the nature and causes of their successes. Once having identified parameters of successful innovation, there is a need to work with schools to develop robust models of rural practice that will address learning disadvantages currently experienced by students in regional and rural Australia.

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