

Science Education: Innovation in Rural and Remote Queensland Schools

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Abstract: Outside its heavily-populated south-eastern corner, Queensland is a huge administrative area with many small, remote communities that can be separated by hundreds of kilometres of dirt road, or, in other areas, not accessible by road. In this study, parents, students and teachers in nine schools from rural and regional Queensland were interviewed about their perceptions of school science.

Teachers, parents and students defined remoteness by reference to their social ties, as well as the social capital and resources they drew on to teach science meaning that not only did different groups differ in their interpretations of remoteness; different teachers in similar circumstances also responded differently.

Science teachers' responses to remoteness were related to their perceptions of school-community communication and their perceptions of their freedom to innovate. Teachers who felt that remoteness gave them more freedom and recognised opportunities to utilise their environment created innovative and relevant science programmes. Teachers who felt their remoteness gave them less freedom felt isolated from the community were less likely to innovate.

Keywords: Science education, rural and remote, innovation, indigenous

Introduction

The definition of rural, and related terms like remote, has long been debated in education (for example Whitaker, 1983). Heterogeneity rather than homogeneity seems to be the defining factor of *rurality* although rural is frequently determined by being the *other* to urban or suburban. (Khattri, Riley, and Kane, 1997; Franklin and Glascock, 1998). Although there is a contrary view where the other of rural life is warm and appealing: an *other* to experience through tourism or school camps before return to a *real* life in urban and suburban settings (Evans, 2003) most researchers and government authorities lists of typical features of rural areas are outlined in deficit terms: remoteness from administration, resources, expertise and the like (for example Dewey, 1960; Turpin *et al.* 2002 and, in Australia, Stokes, Stafford, and Holdsworth, 2000). Science teachers in rural schools are seen as inferior with fewer qualifications, less experience (Carlsen and Monk, 1993), unwilling to undertake professional development and working with limited resources and inadequate facilities, (Baker and Ambrose, 1985). Communities are seen as antipathetic to the schools and unwilling to embrace the school science, perceiving potential risks but no benefit (Berns *et al.*, 2003). Moriarty, Danaher and Danaher (2003) term this a 'pathological discourse'.

In an Australia-wide survey that paralleled this study Lyons *et al.* (2006) reported that, in comparison with metropolitan areas, remote school principals were about six times as likely to report annual staff turnover rates of science teachers over 20% and four times as likely to report difficulties in filling vacant teaching positions in science. Furthermore:

Teachers in remote areas were more than three times as likely to be required to teach a science subject for which they were not qualified ... and ...indicated a significantly higher unmet need for a broad range of professional development opportunities, ... resources and assistance including ICT support and maintenance, learning support, and resources to cater for student diversity. ... Primary teachers and secondary science teachers indicated a significantly higher unmet need for their students to have access to a broad range of learning experiences including opportunities to visit educational sites ... [and] ... a significantly higher level of unmet need for alternative activities to suit gifted and talented, special needs and Indigenous students.’ (pp. 3-4)

Queensland is arguably the most rural state in Australia with about thirty percent of all state school students classified as rural and remote (Higgins, 1994). This rurality is characterised by its diversity between and within communities where, contrary to popular belief, the majority of families do not usually live on farms (Sher and Sher, 1994).

This study set out to identify how some remote Queensland schools were utilising environmental opportunities and social capital in science education. It questioned the deficit discourse that discounts the local social and environmental opportunities available to remote schools, particularly in teaching science.

Method

The study deliberately sought out diversity within the school system sampling parents, students and teachers from seven very remote and two outer provincial Queensland schools. Queensland is geographically and ecologically diverse, with coastal communities well connected to a ribbon of large regional centres along the coast, inland communities linked to smaller centres to the west of the Great Dividing Range, and island and Indigenous communities without bitumen access to any major regional centre. The communities serviced by the schools ranged from coastal horticulture (2) and inland grazing (2) to five primarily indigenous communities.

Table 1. *Schools and focus group participants*

School ***	Type	MSGLC Category	Approx Student pop'n	No. Teachers	No. Parents	No. Students
Frigate Secondary	Island 8-12	Very Remote	350**	5	7*	7*
Frigate Primary	Island P-7	Very Remote	450**	3	3	
Talawa Primary	Island P-7	Very Remote	150**	5	5	8*
Mimosa Secondary	8-12	Outer Provincial	300	8	4	7
Osborne Primary	1-7	Outer Provincial	20	1	3	21*

Arial School	State	P-12	Very Remote	300	2		6*
Banora School	State	P-10	Very Remote	70	6*	4	12*
Sawtooth School	Bay	P-12	Very Remote	200**	6	1	8*
Blackrock State School		P-10	Very Remote	900**	3	2	21*

*More than one focus group involved ** Over 50% Indigenous enrolment *** Pseudonyms only

Even in small schools there was a wide diversity of perspectives within the local community. The schools with majority Aboriginal and Torres Strait Islander enrolments also catered for children of public servants transferred to the area and other non-indigenous residents. Mimosa Secondary enrolled a substantial group of students from Indo-Chinese ethnic groups.

Since we were interviewing students on the school sites, we were unable to access students who did not attend a school. In particular, students who rely on distance education were difficult to reach. However, we did manage to include past students of distance education (and several parents) who were able to make comparisons. Schools can tend to select more articulate students for interviews and often these students can be more academically successful than other students. However, in two cases (Osborne Primary & Banora State School) we were able to interview the entire cohort and in one case (Mimosa Secondary) our sample was drawn from the non-academic stream.

Teachers in the study reflected the full range that might be found in rural and regional schools. New teachers were present in all schools visited except Mimosa Secondary, the high school in the larger centre, and the one-teacher school (Osborne Primary). We were also able to interview experienced teachers in each school. In three schools a number of teachers had entered the profession through alternative routes, and in one case without formal qualifications.

Since parents were co-opted by the school, most of their focus groups tended to include those who were most often in the school, those who interact most with the school, and those who were available during school times.

Findings

The majority of issues about science teaching in rural and remote schools raised by the parents, teachers and students during this study were not specific to science teaching. These generic issues have been discussed elsewhere (Lake *et al.* 2006) and will only be summarised here to provide an introduction to issues that relate specifically to science teaching. Particularly prominent issues were communication (and the lack of it) between school and community, and school choice for both teachers and students.

Whitaker (1983) has highlighted the closeness of the physical relationship between rural school and rural community. This awareness was evident in the responses from our parent and teacher informants.

Wherever you go you see kids from school, or their parents will bail you up

and want to talk about their kids because they can, because we socialise with them. (Teacher, Banora State School)

In some schools, neither side felt that the other valued their contribution to the communication. Parents often reported a lack of interest in the social capital that they could bring to the curriculum, particularly in indigenous communities.

Parent: There's a lot of people with that sort of [science curriculum] knowledge that we've not identified. ... They all have the knowledge and skills but not realized that this is Science ... people are willing to be involved and teach. I mean people are known, like men especially with their knowledge and very willing to share their knowledge. They just need to be asked. (Frigate Island Primary)

Conversely, teachers often felt that the community did not support them, often attributing the lack of support to a lack of available social capital.

Teacher1: Yeah some kids come in and say oh I don't do that at home because Dad says I should be doing chores, school work's for school and stuff like that you know. ... A lot of the families living out here have lived here all of their lives and there's generations that have lived here and never lived anywhere else bar here and I just think they don't know what it is like outside of our community so they lack the life experiences that some of the other children who come in, maybe the transient population like teachers and those children bring into this school. You often find they read more widely. *Teacher 2:* The kids are limited here to what their parent's value if they don't value reading and writing, Maths, Science. That sort of stuff is not valued. (Banora)

Fortunately, many schools actively involve the community to reduce this communication barrier leading to productive relationships where community needs informed the science curriculum, and community expertise was recognised and engaged to make the curriculum relevant and motivating for students. These are the cases I will discuss later.

Some schools also had difficulty linking science content with community engagement. The literature suggests that rural students are more inclined to seek locally available trade qualifications than university degrees, and may be poorly informed about what university options are available. The large majority of our town-dwelling student respondents were seeking a trade qualification, What is disappointing is the number of students wishing to become electricians, mechanics or similar who felt that school science was irrelevant for them.

[I want to be an] Electrician, I did work experience with an Electrician down here and I liked it so I'm going to try and get an apprenticeship or school based or something. I think you need English, Science and Maths really ... I'm doing English but I don't really like English, Science, I don't really like Science, Maths, I'm getting better at Maths ... At the start of this year we were in the same class and most of the class would write out the prac, and everyone has to write out pages from the textbook and for the people who didn't write up the pracs, that's really boring. You did it and then you'd have to write up pages anyway. (Year 10 Student Mimosa)

By comparison, most of our small community-dwelling student respondents sought university qualifications, many in science disciplines, but their choice was linked to seeking ‘the bright lights’ than the science content.

While parents and students were concerned about which school to maximise future prospects, teachers concerns about their school placements were secondary to social issues. Young teachers reported putting relationships on-hold for the period of their country service. Where parents and community members wanted teachers who were prepared to become part of the community, and use it in their teaching, teachers from metropolitan centres lacked social ties and so remained independent from other social capital in the community. Integration was particularly important for parents in Indigenous communities. Perhaps as a consequence, teachers in these communities are most clearly polarised: either remained distant from the community or seeking means to bring the community into their teaching. This latter group have developed some exciting, relevant innovations in their science programmes.

Making science relevant

Interviewer: How far do you need to go in school to be a Scientist?

Yr 4 student: As far as you can. (Osborne Primary)

Positive attitudes about communication and placement underlie the success of remote schools in providing a relevant science curriculum. Innovations can make the curriculum more relevant to the students in the area, or the social and physical environment bearing in mind the diversity within the communities, particularly indigenous communities:

‘They are very individualised and it is pretty hard to get a program for all teachers in the Cape, to suit individual schools, because it is so unique, each community. You can't compare [community 1] to Blackrock and then [community 2] to [community 3], they are totally different places, different cultures, some similar histories for sure and similar things running through the community but Yeah!’ (Teacher, Blackrock).

...Relevant for whom?

As might be expected, students respond to ‘hands-on’ activities in science.

Interviewer: What do you enjoy most about Science? *Student 1:* The hands on.

Interviewer: Anything that you find really difficult in Science? *Student 1:* No.

Interviewer: What would you like to see more of? *Student 2:* Hands on.

Interviewer: What about you? *Student 3:* The same. *Interviewer:* Are there anything that you have heard about that you would like to be doing that you haven't done? *Student 4:* Cut up a rat. (Year 11 Students Frigate Island High School)

Parents felt that practical activities are more important in rural areas where the environment plays a critical role in students’ development. However, many teachers deliver science activities vicariously through the internet rather than through direct environmental experiences, and use the availability of computing facilities, provided by government initiatives for rural schools (see for example Stokes, Stafford and Holdsworth, 2000), as an index of the relevance of their lessons.

Teacher: I'd say the greatest strengths we've got would be the fact that we've

got a computer per kid for ICT virtually; there's always access. The resources we've got compared to the number of students is a good thing (Banora Yr 7- 10 teacher: a school that also has a new, fully-equipped science laboratory.)

Despite the teachers' pride in the high levels of computer use (and the inferred relationship to motivating educational experiences), many students perceive ICT in science as dull, however high tech it may appear to teachers:

Oh, we just mainly use the computers when we're doing assignments ... if anyone needs to use it in a lesson the teacher will just let us go to the computer lab and do research. (Student, Arial State School)

and it is the practical activities that students report positively to their parents.

They find hands on stuff very fun... as a parent seeing them come home, they mainly talk about hands on stuff or other activities, new activities they have learnt. New stuff they like. If you come home with the same boring stuff every day they won't talk about it to me. (Parent Badu)

Disturbingly, there is evidence that practical motivating activities are not occurring in many science classes.

Interviewer: What have you done recently in Science? *Student:* We haven't started. *Interviewer:* You haven't started Science? So when you were using the Bunsen burner. Was that last year? *Student:* Yeah. *Interviewer:* So what did you do last year in Science? *Student:* I went to boarding school last year. ... *Interviewer:* Do you remember what you did with the Bunsen Burner? (Silence) *Interviewer:* Can't remember? *Student:* No. *Interviewer:* Any other experiments or things you remember doing in Science? *Student:* No. (Blackrock Student Year 7, interviewed at the end of the school year)

This lack of practical activities was not limited to rural primary schools:

Interviewer: How often do you do prac? *Student:* ...We don't do prac. *Interviewer:* And you're into Term 4? Was that in Year 9 and Year 10 or just Year 10? *Student:* Oh Year 9 we did about three pracs. *Interviewer:* In the whole year? *Student:* Yeah. (Year 11 student Mimosa)

Where practicals do occur, students recall independent activities rather than part of a conceptual framework:

Student 1: We do experiments and we're doing CSI at the moment... Fingerprinting. *Student 2:* Gun wounds and -, that's when you touch something and stuff, where you put the powder stuff over it and dust it off to see if you can find fingerprints. ... And we did an experiment so we had onions and dishwashing liquid (Banora Yr 7-10 Forensics class)

and students equate scientific theory with mechanical writing:

Student 3: Yeah, pracs are good, theory's bad. *Interviewer:* What do people mean by theory? *Student 4:* The writing. *Interviewer:* Tell me what's bad about writing reports? *Student 2:* Because you should just be able to read it and do the prac while you're reading it, instead of having to write it all down and you forget what happened in your prac anyway. You've got to go over it and read it again to see what you've learned. *Interviewer:* What do you put in the reports? *Student 2:* Like you write down the method. ... *Interviewer:* What about the conclusion? How do you find the conclusion? *Student 1:* Like what happens? *Interviewer:* What's the difference between results and conclusions then?

Student 5: Nothing, it's the same. *Student 1:* You have to write it out like the week before and then and by the time you get to do it, you have to go through it and really work out what to do again. (Year 11 Students Mimosa)

In these circumstances it is not surprising that low literacy students find science difficult, and low literacy levels were seen as a major issue in most of the schools visited, by parents:

When they do the Years seven, five and three tests, the kids from here haven't achieved any outcomes because of the understanding. Because their English is a second language and they find it difficult to understand what is written. (Indigenous Parent, Talawa Island Primary)

and by teachers:

Teacher 1: You tend to see a higher proportion of students with lower literacy levels for a start and I presume that would be similar with your technology based expectations on the big stuff. *Teacher 2:* Yeah well you've got a smaller group of kids you know but you still have your ones that are bright but there seems to be a small proportion that are just below state level. (Banora)

Literacy is seen as a particular problem in indigenous communities where English is not the first language for the vast majority of students.

Down in Brisbane, Cairns or wherever they don't see how many ESL speakers we have ... we are very, very different because 90 per cent of our kids have English as a second language, so then when you are talking about class size and how we can actually improve the student outcome in any subject, then ...you are struggling when you have got 25 kids ...EQ have this special formula for staffing. They use that formula when they are sending teachers out to school ...in migrant education, the ratio is 1:15 or 1:12 so why are we different even though our kids don't speak English; English is a second language. So why can't we have that formula in our schools? (Indigenous Teacher, Talawa Island Primary)

Not surprisingly low English literacy impinges on science achievement where "language is the key for a lot of your science subjects anyway, the kids have got to be very literate to be able to go ahead". (Blackrock Teacher)

You have to break it down, like I said, mainstream it. They want to get from [Education] Queensland; write up everybody on the same level. When it comes down to Indigenous people, different language barriers then are obviously going to have different levels. You cannot help that level to come in the Straits. So obviously that subject below level of mainstream has to fall to bring this one up. But I don't know, maybe through education, maybe though you guys, can bring that one up again. (Indigenous Parent Frigate Island HS)

Innovative teachers are developing literacy-throughout-the-curriculum approaches in their science programmes, often report feeling inadequate through their lack of specialist training.

I think it comes back to some of those things around the ESL and the fact that the majority of the teachers that come in from universities, are coming to us have no exposure in how to teach ESL or Indigenous students. The fact is that ESL impacts on their behaviour ... we often forget that kids are constantly code switching in every class between two languages, and the mental power

that zaps for seventy minutes at a time. (Science Teacher Frigate Island HS)

Many requested ESL support teachers to work as collaborators, but government policies had worked against the indigenous communities.

Well the first [change required] looking at the big picture, is to look at the school as an ESL school, because if you picked up our whole school and put it on the mainland ... on EQ [Education Queensland] papers, we wouldn't be anything any different, because our enrolment matched with another school down in Brisbane, Cairns or wherever. They don't see how many ESL speakers we have, in the same context, so we are very, very different because ninety per cent of our kids have English as a second language. So then when you are talking about class sizes, and how we can actually improve the student outcome in any subject, then you know, you are struggling when you have got twenty-five kids. But you would normally have (because EQ have this special formula that they do) staffing. ... I think in a migrant education, the ratio is 1:15 or 1:12 so it seems why are we different even though our kids don't speak English, English is a second language. So why can't we have that formula in our schools, in our context, so then that would give us more staff that would lower the class sizes and it should give us, free us up in all these other areas that we can improve student outcome. ... Whoever makes the decision, you know classification of schools, then we should be classified as an ESL school to start with and then I think it should improve the operational side of things because we would have more staffing. (Indigenous Teacher/Administrator Frigate Island Primary School)

In some primary schools, community members who have trained as teachers through special university programmes are important innovators in linking science and literacy.

Parent 1: [Indigenous teacher] was teaching a science subject on – it's a big word – where how air circulates, what we breathe in and out and stuff like that. They found it amazing when explained that animals in the sea that breathe.

Parent 2: Because stuff like that they found interesting. He has to break it down more too – where they find dugongs interesting. Stuff like that: Our cultural stuff. And he has to break it down more [than the non-indigenous teachers]. Whereas when he was explaining stuff: “When we breathe, a tree needs that circulation”. They didn't find that much interesting but when he went to the sea stuff, – when you go to science, you need to break it down more to where they find it interesting. (Badu Island)

...Relevant for where?

Remoteness has many meanings. It may be remoteness from social ties, administration, or remoteness from technical or discipline-relevant expertise and resources: Each form of isolation is context-dependent, and some remote schools are innovating to make themselves less 'isolated' than many urban schools.

Social isolation?

Community members are by definition close to their social ties, but not the majority of teachers. Indigenous parents particularly expected teachers to merge into the community's social fabric.

If they are fully committed, they will stay longer. You need the older ones, not the younger ones because the younger ones are only experiencing the lifestyle up here and once they have seen it, they have done it, they are going to go. They are not going to stay. (Parent, Frigate Island Secondary)

Teachers recruited from cities on short-term contracts find this difficult.

I've been here three years now. I moved from the Sunshine Coast. It is my first posting as a qualified teacher up here. ... I have enjoyed it ever since. I don't really want to go but I want to go home for my family. ... Yeah, I miss my family and friends. (Teacher, Talawa Primary)

Administrative isolation?

Remoteness may also mean remoteness from administrative centres. Many teachers felt uneasy about their separation from policy makers making them tentative about innovating with their science teaching.

Also the area in science I think has probably been an area ... that isn't as good but I think that is part of the whole school or the teachers dealing with the new basics curriculum that we have been working on. We have probably let that science area go, wrongly so, but that has been an area where I think the children have missed out a little bit on. (Teacher Frigate Island Primary)

While professional development, and money to fund it, was generally available:

Money was like, whatever we wanted, like all our books are laminated and bound, those are the books that we produced. Probably also they did give us some time, so that the lady I work with, we can plan together... Brisbane really tried, because that is where rich task stemmed from, but really we were trialling it so we had to create it because nobody really knew what the end product looked like. (Teacher Frigate Island Primary)

inservice still posed other major time and resource concerns for rural science teachers.

Some schools really, really struggle with spending that money ...because people don't want to go away. Because for us to go to regional [centre], that's a three day trip because it's a day to get there, we go there for our PD for one hour, we have to overnight, and then we drive home the next day, or drive to [place] and then come home. So that's three days for what could be a two hour conference. (Teacher, Arial State School)

On the other hand, other teachers are using their 'remoteness' from administration and the availability of special funding as an opportunity to implement local innovations that would not be possible elsewhere.

In the area I'm teaching, marine studies, there is a huge amount of potential... There are things that can be done here. That are opportunities I wouldn't get in any other school. Just because of the accessibility of funds from being up here. There is no way in another school I could... We are looking at doing for example, getting something like a sea cage of barramundi next year at the pearl farm up around the island. (Teacher Frigate Island High School)

Several school administrators felt this was a feature of the rural school, and the ability to use it was the best determinant of a good teacher.

My philosophy is if you're a good teacher in a rural town, you'll be a great teacher anywhere, but if you struggle in a rural town, you'll be a hopeless

teacher anywhere you go and, I'm sorry, but I don't care how much support is given to you, because if you can't see leadership potential in someone who's doing everything and sort of say let's work on your management skills and embed all of those thinking strategies into someone they're going to just expect to go to a school where... everything's already done, policy, procedure. We're not so tied up in all of that. We can be quite flexible and go 'well this isn't working for these kids at the moment so no one's sort of looking over our shoulders to say what we have to do and let's just change it' so long as we stay within the constraints of the guidelines. (Deputy Principal, Arial)

Isolation from technical expertise and resources?

Remoteness from suppliers and service providers results in delivery and maintenance delays making planning a high priority:

We don't have the access to the materials like some of the modules in the source books. You have to be extremely well prepared if you want to do them because you have to order in all of those materials. It's not like you can just pop down to the shop and get some of the materials if you want to do a spur of the moment thing. You have to go on children's interests and follow up and do investigations based on their interests, which is a here-and-now concept, but you can't be here-and-now in a small community because ... you have to ring somewhere like [regional centre] and get it sent out. (Teacher Banora)

and imported resources are more expensive.

For example, a third of anything we buy goes in freight.... The replacement costs of resources. The cost of buying storage equipment for example is just very extravagant; to buy cupboards here, to get them sent up by freight.' (Talawa Island Primary)

Some technical remoteness is created by inappropriate administrative procedures. For example, computer maintenance for each instrumentality in a community is provided by that instrumentality - Education, Railways, Health etc. Each technician in one town services an area of millions of square kilometres.

Our technician, our official school technician is a district technician who goes from [place] which is many ks down that way up to Doomadgee and all the way down to Birdsville. That's his area. And he's got to cover all of the schools in that area and it's just ridiculous to expect one person to do it. [name] will only get him out when she thinks it's something she can't fix, I think we're one of the better schools in the area at getting access to him. And the other schools, well they call him up and can't wait but he's got such an area to cover that it takes him ages to get to them. (Teacher, Arial State School)

Collaboration between instrumentalities could provide one full time technician per community and save over fifty per cent of time and money by removing duplicated travel between centres.

Isolation from discipline-relevant expertise and resources?

A relevant curriculum needs content that reflects locally available resources, both physical and social. The natural environment was readily accessible in all but one of the schools visited: beach, bush and other environments less than two minutes walk from the classrooms. While high

schools often lacked access to larger scientific enterprises, most towns had hospitals, engineering workshops and government departments that could be visited.

However, just as many metropolitan schools run camps in rural areas (Evans, 2003), some rural schools deliberately chose topics remote from the community. So, students at inland schools take marine studies, and groups from small towns organise annual trips to large city laboratories and factories.

Taking students to distant resources is expensive and time consuming. However, remoteness is not relevant where the school utilises local resources. Several rural schools visited have done this to good effect.

Well the unit of work that we are doing at the moment with the year one class is the sea, so that is probably THE number one example, but it is not just, I mean the unit I am doing now, I would do it entire different if I was down south. Like you talk about the kind of, the traditional sea animals and that up here, you relate to the island and what the kids know about the different beaches and places on the island, you just try to tie it back to everything. But not keep them in their little world either, you still, you don't want to do that but you try and [get them to] be interested, and then you take it from there. (Frigate Island Primary Teacher)

With the active support of the principal, the nearby high school made this the core of their science teaching with innovative and motivating science programmes.

They have got what is called marine aquatic practices which they have had for a number of years now and the main focus is more the practical side, just like the boating and snorkelling, but mainly just boating. We started marine sciences this year which is year eleven and twelve and that is more the science side of marine biology and the aqua culture and the marine management and all that sort of stuff. Which surprisingly the kids have taken to very well, and they are doing quite well in it. As I said before, they have got a really good natural knowledge, which is quite good. That is eleven and twelve and year ten as well, we are staying transition year ten for their senior subjects. ... Yeah. I love it here. I enjoy it. It is great. Frigate Island HS)

Remoteness also provided an impetus for schools to use the social capital available within the community.

They will do the seagrass stuff and the scientist will come and be tell them "This is the path you can take to do what we are doing for a job in the future, but you need to do this and this". Other people come in and tell them what they doing. They feel pretty good about that. (Teacher, Frigate Island High School)

Nonetheless, some teachers have not recognised the opportunities provided by the remote environment:

They just have no knowledge of life outside Banora. Yes, they can go out on a property and ride motor bikes and round up cattle and do all of those sort of things and probably tell you how a GPS, a Global Positioning System works

and all that sort of thing and they can probably get a room in however many minutes but they just have no knowledge of any of that other sort of stuff. Different life skills and they are terrified of bigger towns (Primary Teacher Banora). This school, which is located near an internationally renowned dinosaur fossil site, had written a unit on Dinosaurs. Its worksheets, drawn mainly from the internet, made no mention of any local, or even Australian, discoveries.)

Indicators of Innovation

So what makes teachers prepared to innovate? The common elements drawn on by successful innovators were:

- their own backgrounds and interests,
- the availability of funds to develop them, and
- the recognition of the opportunities provided by the local environment and the community.

Innovative teachers used their own backgrounds and interests as self-motivation. One secondary trained science teacher who chose to teach science in a small, single teacher school explained:

And of course I lean on my Science. ...I do everything with Science, even Ancient History, explorers – anything, English, Spelling, everything's done with Science. And the kids say oh we're doing Science again, and I think we'll you can think we're doing Science but we're actually doing Spelling or Grammar. ...Well, for me, it gives me a crutch to lean on but I could have also been a History Professor and I could have used History as I would Science to structure all my lessons around History because that would be where my knowledge was. You've got to have a scaffold to put everything on but, because it happens to be Science then it just happens to be Science – but yeah, it's very important to me, I couldn't do without it. If you said to me now, Steve I want you to do all your lessons and there's no Science to be involved. Grammar's got to be grammar, forget Science, you know, I'd be stuffed – oh, I'd do it but I'd struggle and the kids wouldn't enjoy it and I wouldn't be able to entertain them with ideas and the knowledge and the stories so yes it's important to me. (Teacher Osborne)

It is also necessary to have the funds to implement innovations. The innovative teachers accessed a variety of funds to develop innovations that often required entrepreneurial acumen:

The money for doing that is through PCAP [Priority Country Area Programming] funding does all the flights and what not. I've got some other money that I can draw upon. I won a small grant a couple of months ago which helps me to pay for students who do a range of other stuff if there is shortfall in the school funds. (Teacher Frigate Island HS)

although some funding did come with strings attached limiting its value.

They'll fund travel, as in the bus and hire of the bus to a certain point and accommodation to and on the way back if you've got to stay somewhere overnight while you're travelling and the rest is pretty much put in through the P & C, the kids pay and the school pays and fundraising. Yeah and it's a drain

on the community too like I mean like it was this year, it was about an eight thousand dollar camp and we got fifteen hundred ... and then the rest has got to come from the community and it's a big job. (Teacher, Banora)

Innovative teachers were also able to recognise local environmental opportunities. One school accessed adjoining rainforest regularly, and another the local beach. An island school with power generation limitations, linked data-loggers to local solar generators.

Finally, innovative teachers used the available human social capital from their community. The police force was coopted to provide forensics advice in one school. In another:

I get [scientist] and [scientist] from JCU [university] but also the CRC [Cooperative Research Centre] and the DPI [Department of Primary Industries], I integrate a lot of their stuff into my class. We do the CRC seagrass watches through my senior marine studies classes. We regularly visit the DPI Fisheries guys. We are going next week. We are going to Cairns for four days to visit their aquaculture facilities ... as well as the DPI research places. There have been a few places, JCU, which have an interest in a couple of my students to share areas in aquaculture and stuff like that and marine science once they finish school. There is a [indigenous] guy there at DPI Fisheries ... who regularly comes up and talks with my kids ... and tells them about how he got where he is. And all the kids are extremely interested. (Teacher Frigate Island High School)

Of course programmes are dependent on innovative staff, and high staff turnovers can place well-articulated programmes at risk when the developer departs. In two schools interviews, aides made teachers aware of entire rooms of science equipment left behind, unused, after an innovator left. Innovators can also leave insufficient documentation and teachers preferred formulating their own programmes remaining reluctant to use material that reflected another teacher's style or expertise. One solution might be to grant innovators limited ownership over resources they develop. This may be more cost-effective and would mean that innovators arriving in a new schools will have materials available immediately.

Another approach to foster innovation has been to fund a specialist teachers with a history of innovation as consultants to service a cluster of schools.

He actually spends a lot of time getting together resources and innovative ways of teaching, mainly in middle schooling. Investigation kits and stuff that these kids do. They have got all these games and puzzles and investigations to do with that unit and then ...you meet with the teachers ... and you give them a direction to head towards because sometimes if you have just got a few ... teachers, they are not really sure of where they are heading to. [He] can direct everybody to a certain goal and also develop those resources that are invaluable to these kids. (Teacher, Frigate Island)

Conclusion

Teachers in remote Queensland schools harbour perspectives on remoteness that determine their capacity to innovate. Some see their schools as remote from administrative and teaching

resources and find it difficult to deal with their situation. Others view remoteness as relative: remoteness from limiting administration, but with ready access to local social capital and environmental opportunities. These have embraced the remoteness to develop exciting science programmes that recognise the special attributes of their students and their environment.

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