Supporting and resourcing secondary science teachers in rural and regional schools

by John Kenny, Andrew Seen and John Purser

This paper reports on the outcomes of a pilot project to support secondary teachers of science in rural and regional Tasmania. The pilot project involved eight regional schools and was based on the provision of a kit of materials and an associated learning program that used brine shrimp or 'sea-monkeys' to test for water quality. The unit was developed as one of a number of small projects organised by the Tasmanian SiMERR Hub. It involved collaboration between staff from two faculties at the University of Tasmania (UTAS): the Faculty of Science and the Faculty of Education. Two local secondary teachers were seconded to develop the teaching materials.

The outcomes of the project were that, while the teachers appreciated the resource materials, there were some barriers which reduced the effectiveness of this approach to supporting the professional development (PD) of teachers. The findings are then considered in the context of relevant literature concerning teacher PD and the effective use of Information and Communication Technology (ICT) to support the PD of teachers in rural and regional areas.

Introduction to the project

The study of science in schools is linked to national prosperity and economic development, yet there has been a steady decline in the percentage of senior students studying science at senior levels in school and at university (Goodrum, Hackling & Rennie, 2001, pp.39-41; Lyons, 2006; Ramsay, Logan & Skamp, 2005). The causes of this shift away from science are complex but are linked to traditional approaches to teaching science and the perception of science as difficult and only suitable for smart students. While student attitudes to science in school are often negative, much of their perception is derived from outside the classroom Skamp (2008). The result has been a steady fall in numbers studying science in senior school and at university, which is predicted to have a negative bearing on the economic future of the country in the longer term (DEST, 2003; Goodrum *et al*., 2001; Ramsay *et al*., 2005).

New curriculum approaches to teaching science advocate more emphasis on the relevance of science to students' lives and society, as opposed to more traditional approaches concerned with the understanding of scientific concepts and knowledge as a discipline (Osborne, 2006; Curriculum Corporation, 2006). 'Scientific Literacy' is advanced as the key rationale for school science and is considered to be central to students' ability to understand their world and participate as active citizens (OECD, 2003; Goodrum *et al*., 2001).

The problems facing science as a subject in schools are likely to be even more pronounced in regional and remote schools. Attracting and retaining qualified science teachers is significantly more difficult. One factor contributing to this is 'professional isolation' and increased difficulty for teachers of accessing professional development (PD). Lyons, Cooksey, Panizzon, Parnell & Pegg, (2006, pp.v-vii) recommended 'the development of improved systems and strategies for collaborative face-to-face and online modes of professional development for teachers in rural and regional locations.' They went on to point out that:

> *Science teachers in provincial and remote areas indicated a significantly higher unmet need for a broad range of professional development opportunities than did those in provincial cities or metropolitan areas.*
>
> Lyons *et al.* (2006, p.vi)

As would be expected, these problems spill over into student performance, as indicated by the fact that students in remote areas generally achieve lower mean scores than those in metropolitan schools. One contributing factor to this situation may be linked to the fact that the likelihood of non-specialist teachers teaching science 'increases with distance from a major centre' (Lyons *et al*., 2006, p.3).

Providing PD support for science educators in rural and regional areas was a key goal of '*Supporting Secondary Science Teachers*', a project set up in 2006 in Tasmania, as part of the national initiative called *Science, ICT and Mathematics Education in Rural and Regional Australia* (SiMERR). The rationale for the project was to draw on expertise from the Faculty of Science, Engineering and Technology and the Faculty of Education at the University of Tasmania (UTAS) to support secondary teachers, through the development and provision of authentic science activities and associated resources. The co-authors of this paper were the academic staff involved in the project.

The volunteer teachers in schools were provided with materials, including a kit of all the necessary equipment and consumables, along with a CD-ROM containing a set of teaching resources and access to a website with further background information, located on the website of the UTAS Faculty of Science, Engineering and Technology. The email contact details of a teacher, who had assisted in the development of the teaching materials in 2006 were also provided, to offer a form of peer assistance for the participants.

It was hoped that the range of supports offered would prove to be a cost-efficient method of delivering educational resources to teachers, by enabling the participating teachers to work independently and minimising the need for direct ongoing contact with academic staff. This paper explores the outcomes of the project and evaluates the strengths and weaknesses of this approach in the light of current literature.

Background to the project

An invitation was extended to teachers across Tasmania in late 2007, to participate in the trial of the environmental science unit, '*The Water Looks OK, But Is It?*' The targeted teachers had previously been identified from participants from a group who attended a workshop on the project, conducted at the annual Conference of the Tasmanian Science Teachers Association (CONSTAT) in 2006; and also from teachers who attended a series of workshops conducted by the UTAS Faculty of Science, Engineering and Technology in connection with a related project conducted under the auspices of an initiative called the Australian School Innovation in Science, Technology and Mathematics (ASISTM) Project.

The project discussed in this paper involved the use of brine shrimp or 'sea monkeys' as an indicator of water quality. The scientific techniques involved both biology and chemistry skills. Firstly, the brine shrimp needed to be successfully bred and kept alive. When added to pre-determined test solutions, with known concentrations of pyrethrum, the survival rates of the brine shrimp in each solution could be determined. The students were then able to use these results as a measure of water quality in an unknown water sample.

This paper reports on the outcomes of the project based on feedback from the participating teachers, through an interview and a questionnaire. The outcomes of the project are also considered against a theoretical framework for effective teacher professional development (PD) and the discussion concludes with recommendations that may be of relevance to similar projects in future, particularly in relation to implementation in rural and regional schools.

Literature review

The literature indicates that formal PD activities, particularly one-off formal sessions, are not always considered effective as they do not necessarily address the needs of the participants (Henderson, 2006; Westling, Herzog, Cooper-Duffy, Prohn & Ray, 2006). Garet, Porter, Desimone, Birman & Yoon (2001), in a study of teacher professional development investigated the links between self-reported change in over 1000 teachers and the characteristics of the PD undertaken by them. Their study considered various dimensions of PD including 'structural features' linked to the design of the PD activities and 'core features' concerned with the substance of the PD (See Table 1).

Structural features of PD included the form, duration and degree of collaboration of the activities. The core features included the degree of focus on subject-specific content knowledge, the extent to which it provided opportunities for active learning and the coherence of the activities with other demands, needs, and expectations of teachers.

In applying this framework to the brine shrimp project, it is clear that it would be classified under 'core features' as having a 'content' focus, because its purpose is to improve the subject-matter knowledge of the teachers by the provision of the science kits. Garet *et* al. (2001) reported that, while a focus of PD activities on content is important, it should be associated not just with discipline knowledge, but with improving teachers' subject-specific knowledge and skills in how children learn, or what Schulman (1987) referred to as 'pedagogical content knowledge'.

Garet *et* al. (2001) also drew a distinction between the effectiveness of the most common form of PD, the structured workshop approach, widely criticised as being ineffective, and 'reform' activities, comprising study groups of teachers, mentoring and coaching:

> *By locating opportunities for professional development within a teacher's regular work day, reform types of professional development may be more likely than traditional forms to make connections with classroom teaching, and they may be easier to sustain over time.*
>
> Garet *et al.* (2001, p. 921)

Garet *et al.* (2001) also pointed out that PD models involving longer duration are likely to be more effective than one-off PD sessions because they enable greater opportunities for the teachers to engage in active learning processes such as the chance to trial new ideas, to observe and be observed, to discuss outcomes and to obtain feedback from colleagues:

> *…professional development is likely to be of higher quality if it is both sustained over time and involves a substantial number of hours.*
>
> (Garet *et al.*, 2001, p.933)

While considering learning approaches that would build the confidence of pre-service teachers to teach science, Howitt (2007) advocated a 'holistic approach' which linked pedagogical content knowledge to a range of other general forms of teacher knowledge, and argued that, due to the complexity of teacher learning, it is best done by active learning in a meaningful or 'authentic context'. Webb, Robertson & Fluck (2005, p.629) made similar recommendations in regard to effective PD for teachers in ICT, claiming 'that professional learning should be closely aligned with the development of communities of practice'; occur close to where the teachers work; should focus on improving practice; should be

Table 1. *Characteristics of Teacher PD (Based on Garet* et al., *2001)*

Structural features	Core features
Form: the type of activities involved: workshops, or reform activities such as mentoring **Content:** the degree of specificity of content of PD (e.g. subject specific or more general teaching)	
Duration: the span of time involved in the activity **Active learning:** the degree of discussion, planning and practice included in PD	
Collective participation: the degree of emphasis on groups of teachers learning together **Coherence:** the degree to which PD fits with broader educational agendas to reform teaching	

a collaborative exercise; and should be seen as a process rather than an event.

The idea that ICT could play a significant role in the development of a 'community of practice' was also strongly advocated by Henderson (2006). One area the framework of Garet *et al.* (2001), did not consider, however, was the use of Information Communication Technology (ICT) as a mechanism to support PD for teachers. This aspect will be discussed further below.

The calls for more extended ongoing PD, occurring close to their place of work, and involving interaction with and feedback from peers, raises obvious challenges for the design of PD activities for teachers in more remote settings. In evaluating the distribution of a science teaching resource to remote and rural schools in Western Australia, Schibeci, Ditchburn, Lake & Leslie (2007) questioned the impact of materials sent to schools without associated PD activities.

Supporting teachers to implement change or reflect on their practice is a complex process involving their social, emotional and professional needs. In such circumstances, the literature indicates that effective PD needs to be sustained over time and allow teachers to offer mutual support to overcome problems and barriers (Henderson, 2006; Westling *et al*., 2006). The lack of effectiveness of one-off PD events is linked to the fact that they usually occur a long distance from the schools of the participating teachers, and do not promote ongoing professional interaction (Webb *et al*., 2005).

The use of ICT to provide support would seem, at first glance, to be a possible solution for the delivery of PD and to facilitate ongoing contact between the schools, but the use of ICT can present its own difficulties, due to technical problems, and reliability issues with Internet connections (Oliver, 2005; Rabbitt & Pagram, 2003, 2004). These issues aside, reliable technology can play a role in the PD of teachers by improving access to colleagues and information, but teachers themselves see it as a 'second best' solution to face-to-face interactions. Thus the effectiveness of ICT can also be limited by factors such as the confidence of the teachers to use it, accessibility, and the availability of the equipment and software (Brinkerhoff, 2006; Iringas-Bistolas, Schalock, Marvin & Beck, 2007).

Forming 'communities of practice' recognises that transformative change is more than acquiring technical competence. Developing such a community is not a trivial matter: it takes time to develop the relationships which are at its core. Henderson (2006) described an approach to PD that involved teachers working on mutual projects. He maintained that the joint responsibility for a project led to a sustainable community by promoting a sense of accountability or obligation to one's colleagues. Logically, it would seem to be more difficult to meet these requirements for effective PD for teachers in remote locations, due to increased difficulties of physical access to colleagues and access to relief teachers and support services.

For busy teachers, more immediate pressing demands often distract them from PD activities (Henderson, 2006; Iringas-Bistolas*, et al*., 2007). In Henderson's 'community cohesion model' of PD, social interaction was considered very important, as it provided 'opportunities to explore and shape both practice and identity. As a result, in this approach, social engagement is as important in shaping the identity of the practitioner and validating practice as engaging in purposeful situated tasks'. Issues have to be 'continually re-negotiated', thus the desire to maintain the relationship becomes a subtle form of accountability to their colleagues (Henderson, 2006, p.12). In the terminology of Garet *et al.,* (2001), the 'structural features' of the PD are as important as the 'core features'.

The literature indicates that relationships built with colleagues, and maintained through ongoing interactions and involvement in joint activities and shared experiences, can work to counter the barriers experienced by teachers when working back in their schools (Henderson, 2001, p.13). In the community cohesion model, a support person or 'community broker' was provided, to facilitate ongoing engagement and encourage participation. While this person had to be professionally 'credible' (Henderson, 2006, p. 12), the support offered should not involve judgements about performance of individuals (Westling *et al*., 2008).

Research questions

Two research questions were addressed in this paper:

How useful do teachers of science in secondary schools find science resource kits and related resources?

What processes are most effective to support teachers, particularly when their schools are located in rural and remote areas?

Methodology

An interpretive, qualitative study was conducted, involving an initial questionnaire (Appendix One) and follow-up interviews with the seven participating teachers (Appendix Two). Each of the teachers was in a stand-alone secondary school within a regional or remote part of Tasmania and each was sent a resource kit, as well as supporting teaching materials and the contact details of a school-based support person.

A brief questionnaire (Appendix One) was circulated by email to gauge the progress of the trial around late 2007, and four teachers responded. The preliminary responses indicated that only two of the four had actually implemented the unit in their class and that a variety of problems and barriers had been encountered. One teacher reported she had had insufficient time to implement the project, due to other commitments. Another respondent revealed he had actually replaced the original trial teacher, who had gone overseas. This teacher had discovered the kit in his school after he arrived and was intending to trial the project later in 2007.

The responses to the questionnaire were used to develop questions for a follow-up semi-structured interview in 2008 (Appendix Two). The follow-up interviews were conducted early in 2008 and each was recorded as an audio file. Some were face to face and some were by telephone (for the more remote schools) and they lasted between 20 minutes and 45 minutes. The participation rate for the interviews proved to be more successful than the questionnaire, with 6 out of 7 participating teachers interviewed. Despite several attempts, the seventh teacher was unable to be contacted. The discussion below draws on both the interviews and questionnaires.

Analysis and discussion of the data

Of the seven schools, two were larger high schools in the suburbs of Launceston, a regional city in Northern Tasmania; two were in major centres (defined here as a population of 30 000+); one was ten minutes away from one of these centres and two were located in more rural settings away from major centres, including one on an island in Bass Strait.

Of the six teachers interviewed, four had actually undertaken the activity. Three of these four were trained science teachers, with two having more than 10 years teaching experience. Regardless of their experience, all four teachers who used the material felt competent and confident with the activity, and appreciated the completeness of the teaching resources and kit.

Although it was expected that the teachers and students might have the greatest difficulties with the chemical aspects of the brine shrimp bioassay (e.g. preparing pyrethrum solution dilutions), it was in fact the biological skills component that provided the greatest difficulty (i.e. difficulties in breeding the brine shrimp and keeping them alive until required). The teachers used a variety of strategies to overcome this problem. For example, in one school, a laboratory technician was given the task of breeding the brine shrimp for the students. In another, very remote, island school, there was no laboratory technician, which put extra pressure on the teacher to prepare the materials. He really appreciated the fact that the kit was self-contained and he had success in breeding the brine shrimp after several attempts. Another school sought extra guidance from university staff and eventually obtained live brine shrimp from the university. In another school the problems associated with breeding the brine shrimp became the focus of the activity and the unit was used to highlight the 'real life' issues associated with science (i.e. it does not always follow 'the script'):

> *The difficulties we had in managing the brine shrimp and the design of the bioassay led to much debate about the use and validity of bioassays…I was very pleased*
>
> Teacher 2

From a technical science point of view, the breeding of the brine shrimp appeared to be the main issue for teachers using the activity, and this was a common problem, regardless of whether or not the teachers were science trained or the level of teaching experience they had had.

From the point of view of PD support, the teachers reported a need to become familiar with the resources and to master the techniques. Most teachers also cited timetable restrictions in the school and other competing demands as barriers to implementing the unit. All six teachers felt the kit was well presented and appreciated the resources provided.

When asked if a formal PD session at the start of the unit would be a good idea, the four teachers who actually used the materials agreed. The other two teachers had not engaged with the materials, and so did not offer an opinion. One teacher commented that a formal session for teachers running the project would be a good way to get the message through, as dissemination of material to the school does not always reach the right person.

The teachers of science saw the formal PD session as a chance to become familiar with the kit and see the techniques demonstrated. It was evident that even trained science teachers do not necessarily have expertise and confidence in all areas of science. For example, one participant, a physics teacher, despite 35 years of teaching experience, still rated 'biology as a weak point'. He saw the brine shrimp bioassay technique as a 'novel experience' and he was comfortable teaching this activity due to the adequacy of the resources provided.

When asked about the value of meeting with other teachers to share ideas, the four who had used it saw some value in the idea, but two teachers thought it would be a low priority because other more pressing tasks would be likely to dominate their time. In contrast, a first year science-trained teacher in the remote island setting was looking to make contact via email with other science teachers in the region, to share ideas more generally. It is possible that the more experienced teachers might not have seen the need for support networks as a priority for a number of reasons: they might be more confident; or might have already established their own supports. Indeed, one very experienced teacher said she actually avoided seeking support, but preferred it to be face to face when it happened.

Five of the teachers who received the kit and materials cited time or timetable constraints as an impediment to their participation. Among the reasons offered were the requirement to teach a range of subjects other than science and demands of school events such as sports carnivals:

> *Some time ago I realised that I was unable to continue with the project as I had hoped. Time and other commitments got the better of me and I withdrew, sending all the equipment back…*
>
> Teacher 4

Two teachers referred to broader community-based influences on their decision not to participate in the trial. One described a culture of resistance to science in the school, due to the location of the school in an area dependent on the logging industry. Another reported that her school was a 'community-based' school that had a very flexible timetable which made planning for extended science activities unpredictable.

The other supports offered with the kit and materials included a website and a facilitator, who was one of the teachers who had developed the learning materials. To facilitate mutual support, email contact details for all seven participants, and the facilitator, were circulated to all involved. The evidence reveals little use was made of either of these supports. Only one person reported using the website and one reported making contact with the project facilitator. One teacher however contacted the University directly, for some technical assistance with growing the brine shrimp.

None of the teachers reported particular problems with accessing the Internet or ICT equipment, but only two of the teachers indicated any attempt to use ICT. The first-year teacher from the remote island school, who had picked up the program by chance, made use of a digital microscope to help with observing the brine shrimp. He was unaware of the other support materials, but as he had not been an original participant in the study, this is understandable. He suggested that a demonstration PowerPoint, DVD or video would have been useful to show the techniques for handling the brine shrimp. He described the need to share ideas with other science teachers as 'fundamental'.

Three of the other teachers indicated that they were not all that confident with using ICT in their classes. Two of the more experienced were not sure what a digital microscope was. These teachers tended not to consider the use of ICT in their teaching, or were unaware of its potential. In this project, awareness of and confidence with ICT, rather than access to it, seemed to be the main barriers to its use.

An initial PD session would have been appropriate to address the lack of confidence or awareness of the teachers with any potential uses of ICT to enhance the teaching. A formal PD session would allow appropriate ICT to be demonstrated. Equipment such as a digital microscope or interactive whiteboard could be used to great effect and would have benefits beyond this project. Those teachers lacking confidence with ICT would be likely to find this aspect particularly useful. It would also enable the demonstration of the website and facilitate the establishment of a discussion board, blog, or other communication mechanism to support ongoing contact between the participants.

The face-to-face contact might also have facilitated ongoing contact between the participants and facilitator. As reported earlier, only one of the six participants made any contact with the peer teacher who acted as the project facilitator. This tends to support the findings of

Henderson (2006). To be effective, a facilitator would need to take more of a leading role in any PD to help establish relationships and a degree of credibility.

A formal PD session would also enable the project facilitator to be introduced and, if appropriate, to negotiate some common goals that would provide a rationale for ongoing communication between the participants and the use of ICT. An example of a mutual project might be facilitating students from different schools to share their results.

Discussion in relation to teacher PD framework

In attempting to maximise the learning from this project, the data collected will be interpreted within the theoretical framework for effective PD discussed above. The PD framework offered by Garet *et al*. (2001) described PD in terms of its 'structural features' and 'core features'. As pointed out earlier, their framework did not consider the place of ICT in a PD program. Their framework should be modified, for example, to include ICT as a 'structural feature' where it could be used to increase options for the form of the PD (e.g. a blended delivery model). This would also increase the possibility of longer duration PD activities and more 'collective participation' aspects. ICT could also fit in under 'core features' as an extension of content (e.g. use of digital microscope or digital curriculum resources); it could facilitate active learning by enabling discussion and sharing of ideas; and act as an element of coherence due to its relevance to the National Curriculum.

The low confidence with or awareness of ICT displayed by a number of the teachers in this trial would indicate that its use should be explicitly structured into a PD program, preferably through face-to-face activities in the early stages, but also as suggested by one participant, as a DVD demonstrating the techniques, which also has the potential to support those unable to attend a formal PD session.

As noted, the local community was specifically mentioned by two teachers as influencing their decision not to participate in the trial. Again, the PD framework does not account for this possibility, which could fit as an aspect of 'collective participation' where the community may need to be consulted as part of a PD program (e.g. a new reporting system). Community influences might also link to 'coherence' in certain contentious issues for a community (e.g. sex education).

This potential for community attitudes to influence teacher participation in a PD program needs further research. It is likely to be present at some level in most schools, but this data indicates the extent of its influence may vary from community to community, and indeed from teacher to teacher. For example, the teachers from the larger schools in this study did not seem to be concerned with community issues in regard to the trial, and it was not mentioned as an issue by the teacher from the remote island school.

The findings here indicate a one-off formal PD session would have been beneficial for the participants to familiarise them with the techniques, build confidence and awareness of ICT and possibly introduce the project facilitator. This claim is at odds with much of the PD literature explored, which strongly advocates ongoing active learning features in a PD program over formal one-off sessions, and therefore needs some further consideration.

Much of the literature explored was concerned with PD that involved higher levels of professional learning than was expected in this project. As the main focus of this trial was for the teachers to acquire new science skills, the program did not expect the teachers, already competent with science, to change their practice or adopt new pedagogies: they were simply extending their technical skills in their chosen area of expertise. The researchers believe that, based on the evidence here, a one-off formal PD activity would have been effective. Henderson (2006, p.9) considered PD that was qualitatively different to that required in the brine shrimp trial project: the PD program in his study was described as 'a personally transformative experience' for the teachers concerned.

The range of features present in the PD framework of Garet *et al.* (2001) underpins the complexity of the teacher change process. This study indicates that the different features are likely to have varying emphases, depending on the purpose of the particular PD program. As the main focus of the brine shrimp activity was to enhance specific science skills and content knowledge of the teachers, there was no need to engage in 'reform' types of PD activities. Active learning and ongoing PD and communication strategies would have been redundant to a large degree for the teachers in this situation. In terms of the 'core features', it is likely that the need for ongoing contact would be low, once the equipment and techniques were mastered. This might also explain the ambivalent response to this suggestion from these teachers.

In summary, it appears that the goals of the PD should influence the design of a PD support program. Where high order teacher change is required, for example, where teachers are expected to move out of their comfort zone and engage in new pedagogies, ongoing PD built around 'reform activities' that offer collective participation, and opportunities for active learning would appear to be more effective.

This presents its own problems in designing and structuring PD activities for more remote schools. ICT would be an obvious means of building and maintaining communities of practice to support and encourage teachers as they attempt to introduce high-order change in practice within their own schools. The 'community of practice' approach, through its use of joint projects, offers the potential for ICT to be a helpful means of maintaining ongoing networks of teachers engaged in such activities.

By definition, however, projects are finite activities created for a specific purpose. The approach described by Henderson (2006) is based on developing a mutual project, and this implies that the reason for the existence of any specific 'community of practice' will end. His model implies that a new community will have to be created for each new initiative. This seems an inefficient and arduous exercise to go through for each new project. Is there a sustainable way to facilitate the development of communities of practice? Is it possible to establish and maintain a 'background level' of networking and teacher contact, especially in remote locations, that would facilitate the creation of PD communities as required? Subject associations could be vital in establishing background networks that other agencies, such as the Education Department, could link into when appropriate.

The authors believe that the prior existence of such a network for teacher support would have assisted in the dissemination of a small curriculum project, such as the brine shrimp activity, to more remote locations, but would the existence of such a network also facilitate the establishment of communities of practice for higher order PD programs?

This raises a number of related questions that would need further research. Does the experience gained by teachers in one community of practice carry over into another project? Would their experience facilitate the establishment of a new community for another project? It also raises the question of the role ICT would play in linking and maintaining these networks and PD communities.

Conclusions

Supporting teachers in schools is a complex task that can only be more difficult for more remote schools. One-off PD sessions have limited value, but ongoing involvement in PD is difficult to manage due to various constraints, cost and other demands on teacher time. In response to the research question on the value teachers placed on the PD resources, the small sample means general conclusions are limited.

The teachers in this study placed great value on the materials, particularly the resource kit. The completeness of the kit appealed to teachers as it saved time in sourcing equipment and setting up the activity. In terms of engaging with the materials, four of the seven teachers actually used the resources. The interview data revealed that a number of the teachers adapted the teaching materials to suit their situation, but their awareness and use of the range of other resources provided was low, which could account for the under-use of the website and project facilitator. All four reported difficulties with the techniques of handling the brine shrimp. Teacher 3 pointed out that, being in a very remote island location with no laboratory technician, the time required to prepare the brine shrimp for the activity was 'overwhelming'.

These teachers agreed that an introductory PD session would have been useful to clarify the techniques and allow them to become familiar with the activity under guidance. A PD session would also raise their awareness of the other resources available, including the website and CD-ROM. It would also them to meet the project facilitator, who could take an active role in the session. One teacher suggested a DVD of the techniques would be useful to refer to.

A number of the teachers in this study commented on a range of time pressures and organisational problems in their schools which make committing to ongoing PD difficult. In certain circumstances, community influences may also be a factor in the effectiveness of PD in remote schools that deserves further research.

In considering effective PD for teachers in remote locations, again caution must be exercised in drawing conclusions of a general nature from this small sample, but these results indicate that a formal PD session at the outset of the trial would have been of benefit. As science teachers, the focus of the participants was understandably on enabling them to become familiar with the materials, and try out the techniques with guidance. At such a session, in addition to hands-on experience with the materials, the teachers would have become aware of the range of other supports available, and built their confidence and awareness of useful ICT resources.

The researchers believe that the design of a PD program should be fit for purpose. In the brine shrimp program, the participants were not expected to engage in new pedagogies or change their practice, but they were extending their science skills and techniques. A one-off PD session would likely be sufficient in this case.

Contrary to the conclusions here, there is general agreement in the literature that the most effective PD is ongoing, relationship-based, occurs close to where the teachers work, and encourages the sharing of ideas. This dilemma warrants further consideration.

Where calls for the establishment of relationships and the creation of communities of practice occur in the literature, as a basis for on-going PD, the projects involve higher order learning goals and changes in pedagogical practice.

In these cases, PD programs should be based around ongoing action-based learning centred on establishing mutual projects. Establishing these projects, however, is likely to be particularly difficult in remote locations. Further research should be conducted to explore whether the prior existence of a network of science teachers, supported by ICT, would provide a means of disseminating information to teachers in remote schools and facilitate the creation of communities of practice for PD requiring higher-order teacher change processes. This research should also explore the most appropriate structure and organisation of such networks to ensure its effectiveness.

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A pdf of Appendices 1 and 2 is available on the ASTA website www.asta.edu.au/resources/teachingscience

About the authors:

Dr John Kenny is a lecturer in primary science education at the University of Tasmania (SiMERR TASMANIA). His research interests include authentic experiences for pre-service teachers and higher educational policy.

Dr Andrew Seen is a Senior Lecturer in Chemistry and coordinator of the Environmental Science degree at the University of Tasmania. His research interests are industrial, analytical and environmental chemistry.

Dr John Purser is Head of Department at the National Centre for Marine Conservation and Resource Sustainability at the University of Tasmania. His research interests include fish husbandry and feeding.

Appendix 1– Evaluation Questionnaire

Evaluation: SiMERR project "Resourcing secondary science teachers in rural and regional areas of Tasmania" Dr Andrew Seen and Dr John Kenny.

1. Name ______________________________ **2. Sex** ______________

3. School ______________________________

4. Science qualifications and teaching background.

____
____
____

5. What were you hoping to get out of your involvement with the project?

____
____
____

6. The project provided three main sources of support: facilitator, the testing kits and the website. Please rate the usefulness of each resource. *(Please circle)*

Very useful Hardly used Not used Not known about

6a Facilitator for advice for those doing the project? *(Please circle)*

Very useful Hardly used Not used Not known about

6b. Website *(Please circle)*

Very useful Hardly used Not used Not known about

6c. Testing Kits *(Please circle)*

Very useful Hardly used Not used Not known about

7. With what year levels did you use or intend to use the resources?

____
____
____

8. How effective do you think the resources were at engaging students in science? Explain.

____
____
____

9. What could be done to improve program and make it more effective?

____
____
____

Appendix 2 – Proposed Interview Questions

1. **Demographic data: Name, school, age, sex,**

2. **What are your background, qualifications and experience in teaching experience in:**
   a) Teaching science
   b) Using ICT

3. **How would you rate your confidence in teaching science (scale 1-10: 1=very low, 10= very high)**

4. **How valuable were the background knowledge and other resources that were provided with the Brine Shrimp project? (Resources: Kit of equipment, information on website, discussion board, project facilitator).**
   For each resource:
   a) Explain how you made use of the resource.
   b) Specifically what support did it offer you as a teacher
   c) Describe your level of awareness of the various support materials provided as part of the project.
   d) What form of communication would be most effective to make teachers more aware of the resources?

5. **How would you described the accessibility to ICT in your school?**
   a) Is ICT easily accessible to support your science teaching?
   b) Do you have access to equipment such as data projectors/ interactive whiteboards/ digital microscopes?
   c) What value would these add to your teaching?
   d) Are there any science topics for which you think ICT is the most practical or preferred means to study? Explain.

6. **What barriers did you encounter in implementing the project? (e.g. Time, curriculum, other demands, etc.)**

7. **What suggestions do you have to make the program more effective?**
   a) Were there any other supports you feel you would have found helpful? Explain.
   b) Would a formal PD session be of any value?
   c) Would a means for teachers to share ideas and support each other be useful?
   d) Would ICT play a role in this