

Professional development for biology teachers in the knowledge economy

by Simone Eiser and Bruce Allen Knight

Increasingly the general media covers new advancements and research in the field of biology. Stem Cell research, emerging diseases and bioethics are some of the common issues gaining public attention. The rate of increase of these new developments creates additional challenges to teachers of biology as they try to remain abreast of new information and look for efficient ways to achieve this. Given that recent media attention has also focused on the quality of science teachers and science education in Australian schools, the issue of ongoing professional development for science teachers is important.

This research reports on a survey of the professional development (PD) practices of biology teachers in Central Queensland. The focus of the survey is to investigate how biology teachers maintain a current knowledge base. This survey will provide a snapshot of current practices in a regional area and identify challenges teachers face whilst trying to maintain this knowledge base.

Introduction

“Recent years have seen a growth not only in biological knowledge but also, and more significantly for teacher education, in the types of knowledge manifested in biology” (Reiss, 2006, p. 121). On a weekly basis there are images and stories in the media about issues of a scientific nature. Cloning, stem cell research, the human genome project, global climate, H5N1 are now regular news features and a topic of conversation and debate for politicians, religious leaders and school students alike. The rate of increase of these new developments creates additional challenges to already time-poor teachers as they try to remain abreast of new information and look for efficient ways to achieve this. “It could therefore be suggested that there is a significant need for the development of suitable strategies for ongoing teacher PD with an emphasis on the emerging knowledge areas in science” (Eiser & Knight, 2006, p. 92).

The audit of Science, Engineering and

Technology skills (SET) conducted by the Department of Education, Science and Training (2006) identified a number of issues of concern regarding the future of science and science education in Australia. Of interest here was the finding that there is “a strong perception that Australia lacks suitably qualified secondary school science teachers, which impacts adversely on student engagement in SET” (Australian Government: Department of Education Science and Training, 2006, p. x). Whilst the qualifications of teachers may refer to initial training, what is also relevant here is the provision of ongoing professional development to assist all science teachers to maintain a current and relevant knowledge base that they can use to engage and stimulate students. The Australian Science Teachers Association (ASTA) raised “serious concerns about the ongoing provision of professional development for teachers of science” (Australian Science Teachers Association, 2006, p. 10) in their submission to the SET

audit. ASTA raised concerns that without the provision of this ongoing training, science teachers may not be well equipped to promote science careers to students (Australian Science Teachers Association, 2006). Given the current debate in the media on performance based pay for teachers, the brain drain of our best and brightest and Australia’s desire to be recognised as a viable knowledge economy, we need to seriously consider the future of sciences in our schools and tertiary institutions. If Australia is to remain competitive in an ever increasing technological global community, it needs to attract and retain quality teachers of science who are prepared to stimulate the interest of students (Dekkers & DeLaeter, 2001). Tytler (2007) in his recent Australian Council for Educational Research (ACER) report highlighted the new background scientific knowledge that has not previously been part of scientific curriculum and the challenge this poses for the model of teachers as the expert knower in classrooms. How do teachers

access this new knowledge and what does this knowledge look like? "It is a struggle for teachers to keep abreast of all the current research especially in the area of cell and molecular biology" (Tunniculiffe & Ueckert, 2007, p. 51). This paper particularly examines how new knowledge is accessed by biology teachers in two large Queensland regional education districts – Mackay-Whitsunday and Fitzroy- Central.

The Queensland context

Currently, what is taught in senior biology classrooms in Queensland is determined by the Queensland Studies Authority (QSA). "The Queensland Studies Authority is a statutory body responsible for the provision of a range of services and materials relating to syllabuses, testing, assessment, moderation, certification, accreditation, vocational education, tertiary entrance and research" (Queensland Studies Authority, 2007). The QSA is governed by representatives from all school sectors, parents, teachers and tertiary organizations.

In each district of Queensland, there is a District Review Panel that comprises a group of experienced biology teachers. These panel members apply formally for their positions and are the first point of call for schools and teachers for issues relating to moderation and work programs. The District review panels are overseen by the State Review Panel which ensures consistency across school sites. The moderation process is the quality assurance process whereby work samples from all schools are compared at district and state review panel meetings. This transparent process aims to ensure that results for same subjects are comparable across the state. Teachers in schools work with their district panel to create a school work program. This work programs outlines the course of study, assessment instruments and the timing of this assessment. Work programs for all schools must be approved by the State Review Panel.

Of relevance here is the QSA's provision of the Senior Syllabus for biology. This Syllabus states that 'new understandings are continually arising and current understandings may be challenged by the scientific community, and modified or replaced' (Queensland Studies Authority, 2004, p 1). The Syllabus contains four general objectives, with the most relevant to this research being 'Evaluating Biological Issues (EBI)'. The

aim of this new objective is for students to gain an understanding and evaluate new biological issues as they emerge. In order for teachers to effectively facilitate this learning, they themselves must be provided with opportunities and tools to help them maintain their content knowledge.

Currently, teachers of biology in Queensland can access PD relating to work program construction (derived from the syllabus), assessment and reporting issues, by attending QSA workshops and liaising with their district panel members. These workshops are not compulsory and are only offered on an irregular basis. The one workshop offered in December 2006 in the Mackay district was well attended, however there were none scheduled for 2007 and none so far on the calendar for 2008. Limited PD relating to content knowledge is provided by the Science Teachers Association of Qld (STAQ) for a membership fee. Given the low rate of STAQ membership in the study area and the infrequent offerings of PD opportunities, it could be suggested that teachers in regional and remote districts have little opportunity to regularly update their knowledge. The traditional 'one-off' nature of the PD sessions (as offered by the QSA) offered to teachers contradicts current research recommendations on the most effective ways for teachers to learn. In fact, "there is universal condemnation in the research literature on professional development for the one-shot 'INSET' day as a method of bringing about any real change in teaching practice" (Adey, Hewitt, Hewitt, & Landau, 2004, p. 161). It is generally accepted that PD completed over longer time frames, with opportunities provided for reflection and discussion are more appropriate (Eiser & Knight, 2006).

The onus is on teachers and schools to access PD to update their content knowledge and the often regional and remote location of Queensland teachers means that this often proves to be challenging. This is especially the case when sessions are mostly offered in the traditional 'face-to-face' format. This issue is particularly important given the rapid rate of increase in new knowledge in the field of biology. It is imperative that teachers have the opportunity to access PD, in a range of forms, to regularly update their content knowledge. A relevant question here is: How often are classroom biology teachers accessing PD to enhance this knowledge base? In order to find out

the frequency of participation in PD and the types of PD accessed, a survey was conducted of teachers in regional and remote schools in Central Queensland.

The survey

This research project involved a survey of the professional development practices of biology teachers in Central Queensland. The focus of the survey was on how biology teachers maintain a current knowledge base and access new information as it emerges from the scientific community.

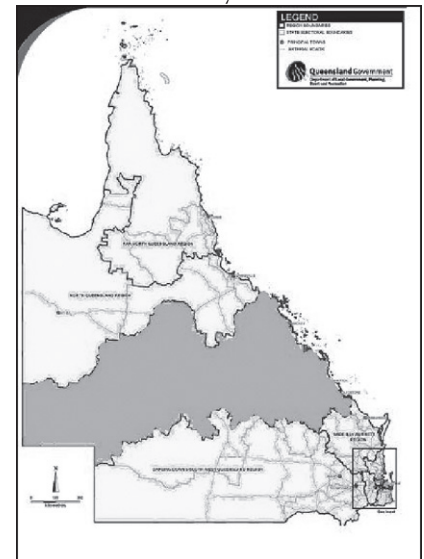


Figure 1. Geographic study area

The results of this survey provide a snapshot of current practices in a regional area and identify the challenges teachers face whilst trying to maintain this knowledge base.

The geographical study area (see Figure 1) extends from Bowen in the north to Gladstone in the south and west to the Northern Territory border. This area comprises approximately 50 secondary schools that offer biology and over 80 teachers of biology. Teachers in State and Catholic schools were surveyed.

School Principals were sent the surveys via the post for distribution to biology teachers, with replies returned between February and June 2007. The return rate was 41.25% (n = 32).

The survey focused on the following areas:

- Academic Qualifications
- Number of years teaching biology
- Town population
- Most recent PD relating to this subject area.
- Participation in PD relating to the new QSA biology syllabus.
- Participation in other PD – e.g. subscriptions to journals/scientific magazines, on-line and

memberships in professional groups.

- How content knowledge in the area of biology is currently maintained – including how teachers currently access relevant information that allows them to connect their students to current scientific research and breakthroughs.
- Areas of interest (relating to biology content knowledge) for future professional development.
- Teachers self perception of their current knowledge base.
- Factors limiting the maintenance of a relevant knowledge base.

Respondents were also asked questions relating to membership of the Queensland Studies Authority Panel for biology and other professional groups such as the Science Teachers association of Queensland (STAQ) and the Australasian Science Educators and Researchers' Association (ASERA). The full survey is set out in Appendix 1.

Results

The survey and initial analysis is largely descriptive, as the aim was to provide a snapshot in order to inform future research in the area of PD practices. The intention of the survey was to create an insight into PD practices of a range of senior biology teachers in a large regional study area. Whilst the sample size for this research is small the return rate of 41% (n = 32) provides evidence of the trends (Creswell, 2008) of PD practice in this regional area and serves the purpose of the surveys intent. It is difficult to compare the demographic data of this sample with published research findings. Whilst there is ample research on Australia wide trends in the science teacher population (Lyons, Cooksey, Panizzon, Parnell & Pegg, 2006; Harris, Jensz, & Baldwin, 2005) it is difficult to translate this data to a regional and remote perspective.

Seventy-one percent (n = 23) of the 32 respondents in this survey were female, with most from the State sector. Thirty-two percent (n = 10) had only been teaching biology for between 0 and 2 years. Most (80%, n = 26) had not been a member of the QSA panel, only 34% (n = 11) were members of STAQ, and over half (53%, n = 17) of respondents came from a town with a population of 25 000 or less.

Figure 2 shows the relationship between number of years teaching biology and non-participation in PD relating to Content knowledge.

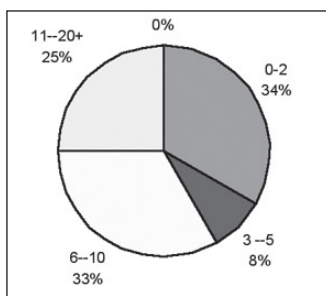


Figure 2. Relationship between the number of years teaching senior biology and those (as a percentage) that have never participated in PD relating to content knowledge

Whilst the largest group to have never participated was those who have taught biology for less than 2 yrs, the more interesting result was the 25% (n = 8) of teachers who had taught biology for 11 or more years and never participated in PD related to content knowledge. This, combined with those in the 6 – 10 years of teaching group (33%, n = 10) provides an interesting insight into how many experienced teachers have never undertaken PD in the area of biology content knowledge despite the exponential growth in knowledge in this area. There may be a number of reasons for the low rate of participation in PD by more experienced teachers.

It is acknowledged that whilst they may have never participated in traditional models of PD, they may however be updating their knowledge via online methods etc. Whilst many identified the internet as the source of their new information, it is not clear how they verify the authenticity/accuracy of these sources. Discovery Channel and ABC TV were commonly identified as sources of new information. Another relevant point here is that 87% (n = 28) of respondents when asked to assess their own level of content knowledge relating to biology rated it as good or better (excellent) (see Figure 3). Not a single respondent rated themselves below adequate.

Of relevance here is the finding by Harris, Jensz and Baldwin (2005) in the 'Who's Teaching Science' report that biology teachers "were the group with the highest tertiary-level qualifications

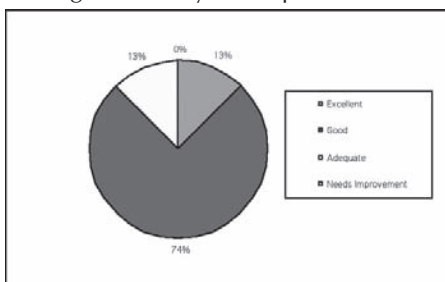


Figure 3. Respondents self perception of content knowledge

specific to their discipline" (p. 17). The implication of this is that when compared to other senior science subjects such as Physics and Chemistry, biology teachers have completed more advanced level courses in their pre-service education. Whilst this is promising, and may account for the high self-evaluation of content knowledge, it still does not guarantee that teachers will maintain this knowledge base as they progress through their teaching career. In fact what teachers learn during their pre-service education is "not necessarily the way their students will need to be taught in the 21st Century" (Neiss, 2005, p. 509).

It could be suggested that those who have taught the subject for less than 2 years may be recent graduates and therefore have recent tertiary study (as discussed above) to draw upon (in fact, given that around 60% of respondents had a Bachelor of Science degree – this is a likely cause). It could also be that like many beginning teachers, they are spending most of their time trying to "survive" in the classroom and have little time to consider PD. They could also be relying on the experienced teachers to guide them in their knowledge. What is also interesting and perhaps an area of concern is the number of these teachers who are new to teaching biology who are also located in small regional towns often with a population of less than 10 000 people which would also indicate that they are the ONLY biology teacher in that school – with little opportunity to access a mentor.

Teachers were asked how long it was since they had participated in PD relating to biology pedagogy and biology content knowledge (see figure 4).

Whilst most had participated in pedagogy related PD in the last 6 months, 42% (n = 13) of respondents had never participated in any PD relating to content knowledge.

It should be noted that due to the implementation of a new biology Syllabus in Queensland, the QSA had offered Professional development workshops relating to this new syllabus, in this study area, during the second half of 2006. These PD sessions may account for most survey respondents nominating QSA workshops as the source of their pedagogy PD in the last six months. These pedagogy related workshops mostly addressed the development of assessment items that linked to the four new objectives. These workshops in fact tend to relate to assessment items and issues connected to moderation samples rather than teaching strategies.

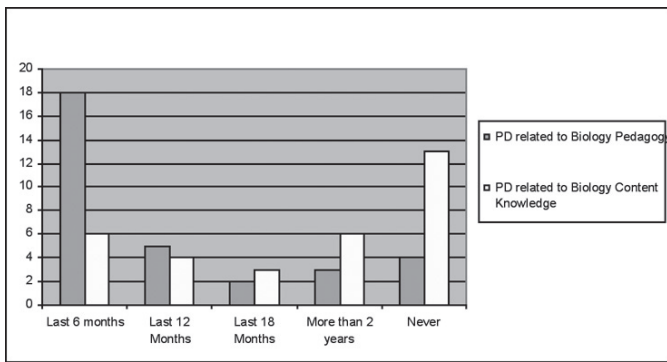


Figure 4. Time since last professional development in biology.

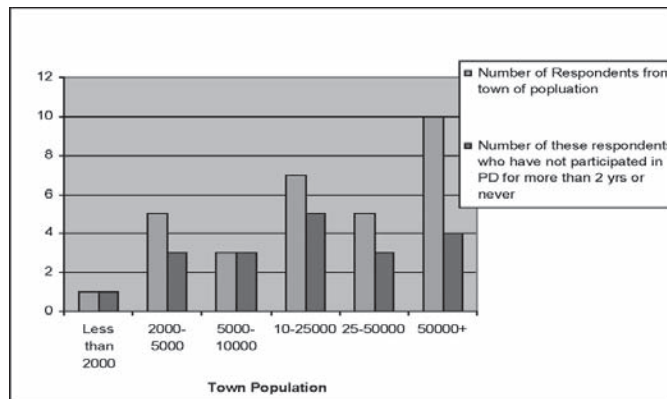


Figure 5. Relationship between town size and participation in PD related to content knowledge.

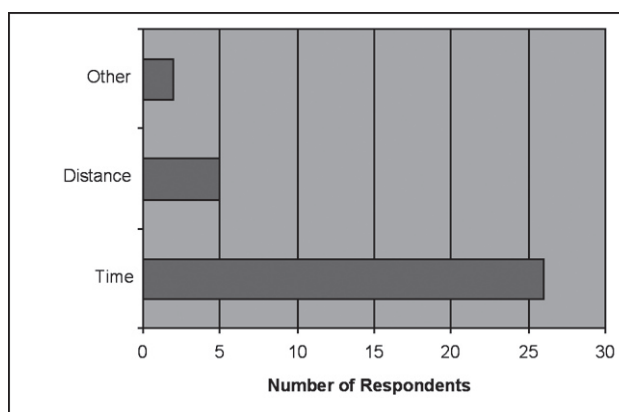


Figure 6. Barriers to maintaining and enhancing biology content knowledge – as identified by respondents.

The survey results showed a possible relationship between town size and participation in PD related to content knowledge (see figure 5).

More than half of all respondents from towns with a population of 50 000 or less had not participated in PD of this type for more than 2 years or not at all. Respondents from towns with a population more than 50 000 fared better. The regional aspect of this study is important. It could be suggested that the often remote location of teachers limits their ability to access PD.

The regional location of many teachers in Queensland highlights one of the limitations teachers face when trying to access suitable PD (see figure 6). When asked about factors that limit their participation in PD, a large proportion (78%, n= 25) of respondents identified time followed by the remoteness of their location.

The 2006 Science, ICT and Mathematics Education in Rural and Regional Australia (SiMERR) national survey confirms this observation. The professional development needs of teachers from diverse locations across Australia were compared and it was found that “science teachers in Provincial and Remote Areas indicated a significantly higher unmet need for a broad range of professional development opportunities” (Lyons, Cooksey, Panizzon, Parnell & Pegg, 2006, p. vi).

This SiMERR survey supports the results found in this small regional sample and emphasises the urgent need for action to address the challenges that face teachers in these communities.

The results of this survey indicate that despite biology teachers in Central Queensland teachers rating their content knowledge as good or better, they are willing to participate in PD (most identified a number of areas they are interested in learning more about), but they have limited time to do so. Many use the internet to access a variety of resources, however many also indicate that they do not always incorporate this new information into their classrooms. If they do, it is often in the form of class discussion. Given these factors and the often isolated location of teachers in Queensland it is clear that a creative solution is necessary.

It is of course recognized that a limitation of this study is the small number of respondents. Although 41.25% of all eligible teachers in this geographic region responded to the survey, this amounted to only 32 responses and cannot be generalized to other teachers in metropolitan locations. However, the data describes how biology teachers in Central Queensland maintain their knowledge base and therefore may be applicable to other regional and remote geographical areas.

Conclusion

The literature indicates that we have a problem in science education in Australia. Enrolments in the sciences are on the decline and there is a recognized shortage of suitably qualified teachers (Australian Government: Department of Education Science and Training, 2006; Fullarton, Walker, Ainley, & Hillman, 2003; Lyons, 2006). These issues have the potential to impact heavily on our future as a knowledge economy. In fact, “Australia’s productivity and success in the highly competitive global market is increasingly reliant on science” (Australian Government: Department of Education Science and Training, 2006, p. iii). What is required now is an investigation into how employing authorities can provide opportunities for biology teachers (particularly those in regional and remote schools) to access PD that will have a direct impact on their classroom practice.

As outlined earlier, Queensland teachers are not directly provided with PD in the area of content knowledge through the QSA. The QSA is primarily

concerned with syllabus development and assessment and reporting. Biology teachers generally have the opportunity to access PD in these areas via QSA workshops once a year. The usual focus is assessment instruments.

For those teachers wishing to access formal PD relating to biology content there are some resources available through STAQ. Given that only 34% (n = 10.8) of the respondents for this survey are members of STAQ, it could be suggested that the resources provided are not regularly utilized. In 2006 in the Mackay region, the Biotechnology Online Professional Development program (a joint initiative of the Australian Government and STAQ) was offered to secondary science teachers. Whilst the focus was on Middle School Teachers, the content and resources are easily transferable to senior biology. Only 2 teachers expressed an interest in attending the free workshops (which included free resources) and the sessions did not proceed. It could only be assumed that teachers do not have the time and/or could not see the value (as suggested by the above survey results) of attending these workshops.

Currently in Queensland there are a number of governing bodies determining what happens in schools, namely the QSA and the relevant school sectors, Education Queensland, Catholic Education and the Independent sector. There is a connection between the QSA and these sectors in the form of the district and state panels. There is currently however no direct link between the schools and teachers and providers of PD relating to new and emerging issues in science. STAQ provides this opportunity, however it is suggested that this resource is underutilized. The QSA provides a link to 'useful biology websites' in the biology Syllabus section, but again it is unclear how this is managed or how often it is utilized.

One of the authors recently participated in the Australian Government Summer School for Teachers of Science as a workshop facilitator. Anecdotal evidence from highly motivated science teachers indicated that whilst they engaged fully with the PD and found it highly productive, they were still not quite sure how to transfer this new knowledge into practice once they returned to their school communities. Many were returning to schools in regional and remote areas.

The results of this survey, suggest that

the current infrastructure and resources available for senior biology teachers, may not be the best way of promoting the development of their content knowledge. New technologies such as pod casts and video streaming may prove valuable in accessing new biology knowledge for teachers in regional and remote areas. How this should be done needs exploring in further research.

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Are you a member of any of the following organisations?

Science Teachers Association of Qld (STAQ) Yes / No
Australian Science Education Research Association (ASERA) Yes / No

How often would you read any of the following publications? (Please circle)

New Scientist Magazine (published weekly)
Every issue Once a month 4 times a year twice a year Never

Australasian Science (published monthly)
Every issue 4 times a year twice a year Never

Cosmos (published bi- monthly)
Every issue 4 times a year twice a year Never

The Helix (published bi- monthly)
Every issue 4 times a year twice a year Never

Others _____

Is the knowledge you obtain from reading these magazines applied in your biology classroom? (Please circle)

Often Usually Seldom Never

If so, please list some ways this new knowledge is incorporated

How would you rate your level of CONTENT KNOWLEDGE for teaching Senior biology?

Excellent Good Adequate Needs Improvement

How do you currently keep abreast of latest developments and new information in the field of biology?

If you were to attend a Professional Development session related to CONTENT KNOWLEDGE in biology, what areas would interest you?

- Genetics
- Gene therapy & Stem Cell research
- Cloning
- Emerging diseases
- Bioethics
- Animal biology
- Botany
- Field work techniques
- Others (please specify) _____

What are the barriers to you maintaining and enhancing your CONTENT KNOWLEDGE in biology?

If you would like to discuss this survey further please provide your name and contact details below:

Many thanks for taking the time to complete this survey.

