



By Frances Steel



By Kevin Watson



By Les Vozzo



By Peter Aibusson

▶ Retraining Teachers to Teach Science Is it a Good Idea?

Les Vozzo has over 20 years teaching experience in secondary schools in NSW. In the area of science education, Les played a leading role in the Fulbright Education Symposium, titled Partnerships in Science Education and Bioastronomy in 2002 and recently led the Science Retraining Program for physics teachers at UWS. Both roles have been a culmination of his work in science education. Les is currently completing a doctoral study that investigates his professional identity as an educator and facilitator of teacher professional development. This work has resulted in teachers undertaking practitioner research in schools and writing narratives about their inquiries.

Kevin Watson is a Senior Lecturer in Science, Technology and Environmental Education at the University of Western Sydney and a member of the Enabling Communities Research Group (ECRG). Previously, he taught science (K to 12) in schools for 16 years. At present he teaches in the primary and secondary programs, both undergraduate and postgraduate and is working with schools to identify and implement strategies for teacher professional learning, which are in synergy with student teacher education. Kevin is also exploring models of teacher education in developing countries.

Fran Steele trained as a biochemist and spent ten years as a researcher with CSIRO before becoming a science teacher. For her M.Ed (Hons) she conducted research into the teaching of biotechnology in NSW. Recently she was involved in an evaluation of Primary Investigations and has worked as a research assistant on a project evaluating a teacher retraining program.

Peter Aibusson is Associate Professor in Science Education at University of Technology Sydney and a member of the Teacher, Learning and Development research group (TLD). He was a school science teacher for ten years and now lectures in science education. In his work he collaborates with teachers to investigate science curriculum, teaching strategies and approaches to science education. His current research interests include science teacher education and student interest, motivation and achievement in science.

This paper summarises our research into a program where teachers from diverse subject areas retrained as science teachers. With help from a network of mentors and the benefit of their existing pedagogical knowledge these teachers were able to develop the skills they needed to 'manage a practical safely', one of the key differences between teaching science and teaching other subjects. Overall the retraining was successful although the process was often one of survival rather than enjoyment. However, we question whether the cost of retraining, in time and money, makes this a useful approach to teacher education.

Introduction

One year ago when browsing through the aisles of Coles I met a friend who is a teacher of English. She asked me where I was working and I mentioned that I was about to begin work as a research assistant on a project evaluating a teacher retraining program. I explained that this program was designed to fill a shortfall in physics teachers and the recruits, teachers from primary and secondary backgrounds, were to be given an intensive course in this subject before being sent into schools. As parents of students in secondary school, and as teachers, my friend and I shared a sceptical look. Trying to look on the bright side, we agreed that such a transition might not be impossible if the right candidates were chosen. I don't think either of us were convinced by that argument, or would have wanted the retrained teachers teaching our children. We discussed the fact that physics is a very specialised subject, and, in our own experience, quite difficult to get across to students. We felt that the type of students that studied physics were the ones most likely to want top marks in their final exams, and the ones most in need of teachers with a strong knowledge of their subject. Although

neither of us wanted to be too pessimistic, both of us had reservations about the value of retraining as a way of providing schools with much needed teachers of physics.

Evaluation of Science Teacher retraining Program

At the outset of the Science Teacher Retraining Program the teacher educators associated with the delivery of the course had similar reservations. The course convenor commented:

I don't believe that the best way to train teachers is to do it in six months. Essentially deep down, I don't believe that is the way to go, but I was committed to make it work. That provided a tension.

All of the lecturers felt that the time allocated to them was too brief for them to provide the depth of background knowledge that they would like to offer to prospective teachers of their subject. All felt that the graduates of the course would be unprepared for the realities of school, that they would meet with scepticism in the workplace and they would find their transition to science teaching very difficult.

Our evaluation of the course and a report of the experiences of the graduates during their first year of

teaching has now been completed. Data was obtained from three interviews with the students, interviews with the university staff involved, email traffic between the university mentor and the students, and from a portfolio produced by the students as part of their ongoing study. An analysis of this data showed that many of the predictions about the retraining program were accurate. In a paper that reported the outcomes of the program, we concluded that:

- The first year of teaching was one of survival because the graduates lacked the content knowledge they needed to teach junior science;
- The course needed to be longer and cover the content of the entire syllabus. The course also needed to make better links between the science content and the school syllabus.
- Some graduates met with scepticism from their colleagues and this made their transition to science teaching very difficult.

These results might suggest that my friend and I have been vindicated, and we were right to think that retraining would not produce a cohort of good science teachers who could fill a need. However, despite the established shortcomings of the course, the findings of our evaluation suggest that by the

end of the first year of teaching the majority of graduates of our program were motivated, organised and effective science teachers. The course convenor is a strong advocate for the retrained teachers, and openly declares that he is "very proud of these people". Their first year of teaching was one of survival but most of the retrained teachers overcame the obstacles, and now consider themselves to be competent teachers of science. What I would like to be able to explain to my friend is the complex set of factors that enabled them to reach the point where we would welcome them as teachers of our children.

From the findings of our evaluation we suggest that these complex factors fall into three broad areas:

- The recruits themselves;
- The network of assistance and
- The school context.

In one paper we have analysed the nature of the retraining experience, and elaborated on the importance of the school context (Watson, Steele, Vozzo & Aubusson, 2003). In another paper we described the network of assistance that supported the professional development of our graduates (Vozzo, Aubusson, Steele and Watson, 2003). Our third paper reports on aspects of character and background, and the interaction of these within a particular school context (Aubusson, Steele, Watson & Vozzo, 2003). Here we summarise the accumulated understanding generated during our research.

The nature of the recruits

All of the university staff interviewed as part of this research commented on the enthusiasm and dedication of the teachers in the retraining course. To use one lecturer's words:

The enthusiasm of the students really struck me. Various people have said at various times, what were these people like and did I think they would be any good, and all these sorts of questions, and I think that any minor deficiencies in their technical background will be more than made up for by their enthusiasm because their enthusiasm will transfer itself to their students and it will also mean that if something is not familiar they are going to find out about it.

In the final interviews that took place early in the second year of teaching, the retrainees were asked about their

strengths and weaknesses as science teachers. All agreed that there were still a lot of content areas where their knowledge was limited. Yet a number were in agreement with Steve, who commented that:

It's been a really great career move because it's just so stimulating because of the newness. While I was stressed in the first instance I really like that feeling. And part of the success I have had, I am almost seeing it through their eyes. Not quite and there are times when I have felt because I have established a knowledge it is almost a weakness because I have been too flippant with the information I have got on how to solve problems. I have found it stimulating to find out all the information myself you know, and I don't want to lose that, because if I lose that edge I might become a person who just gives them all the answers.

For many of these teachers, some of whom joined the program because they needed a change, the need to learn new content was a challenge that kept them motivated and allowed them to take a fresh look at ways of presenting science to their students.

Several retrainees faced the dilemma of whether to tell their students about their background, or whether to pretend that they knew all the answers. Three of the teachers who elected to trust their senior classes with the full extent of their lack of knowledge found the students to be very supportive, and the climate of openness and investigation that resulted was beneficial. Again, for these retrainees their lack of a science background could be a strength in some ways if it remained a weakness in others. However, one retrainee experienced significant difficulties in getting his senior class to work for him once they found out that he had previously taught English and history. This retrainee was working in an environment that was hostile to the principle of retraining, and his class were responding to opinions expressed by teachers and parents. Deciding how much to reveal and how much to conceal was often a matter of judgement, and depended on the school context.

The experienced teachers in this program often found their background in other areas of teaching to be an asset when teaching science. Three of the teachers who had a primary

background agreed with the comment of Gemma that:

Primary training is the best training to have for secondary teaching, you have behaviour management behind you, you know how to structure the class in such a way that you're addressing all levels, if you need to drop the way you're talking so that they can understand, you can do that.

Behaviour management was a source of concern for almost all of the retrainees, despite their experience as teachers. In particular they found running an experiment safely to be difficult. For Steve, his experience as a physical education teacher helped him think of ways of approaching practical activities with problem classes.

When I first began teaching PE nearly ten years ago I found a similar situation existed then. Those that complained loudest about not enough 'prac' would promptly sit down when offered the very thing they had nagged about. After a while I realised that lack of effort was mainly due to lack of skills and techniques, which needed to be consolidated well before I saw them in year 9. In order to change this I abandoned the traditional drill methods of teaching skills and started teaching the students how to play and have fun. When this was achieved I modified the play so that certain skills were encouraged without having to be executed perfectly. I also encouraged students to create their own rules and invent their own games.

Steve used this experience in PE to increase the use of practical activities in his classes by slowly introducing skills, and make science "more than a copy from the board bludge".

In summary, we can say that the prior professional experience of the recruits to the retraining program was of value in a number of ways. They had a conviction about what they wanted to do, an ease and rapport with their students and a confidence in their ability as teachers that allowed them to overcome many of the obstacles generated by a lack of content knowledge.

The network of assistance

The small size of the group, the course design that meant they had to interact for many hours each day with the lecturers, and the relative maturity of

the students all combined to give the retraining course a collegial atmosphere. Students and lecturers agreed that there was a cohesiveness, even a sense of combining against adversity, created by the intensity of the workload and the perceived opposition of 'others' to the concept of retraining. The university staff, and particularly the course convenor, encouraged and participated in the collegiality. At the end of the six-month course the eleven retrainees and the course convenor spent three days on an excursion to the telescopes at Parkes and Coonabarabran. This helped to establish relationships that later offered a source of support. While there were some disagreements between individuals in the group, there were also some very strong friendships forged, and the retrained teachers continued to support each other during their year of 'survival' in schools.

Once the retrainees were placed in schools, the course convenor became the university tutor, and his method of "giving the students something to talk to him about" was to set them a portfolio assessment task that he labelled a "patchwork narrative". The retrainees were asked to reflect on an issue of significance to them, and to prepare an activity and an assessment task to share with the group. The intention of the tutor was that these pieces of writing would be emailed to other members of the group and feedback would be exchanged before the presentation of a final portfolio document. However, technical difficulties and time constraints inhibited the exchanges. Only one retrainee took full advantage of the combination of the portfolio and the university tutor to reflect on his learning throughout the year. For this teacher (Don) his prior relationship with the university tutor enabled him to openly discuss the problems he was having with managing difficult classes and in managing a difficult workplace environment.

During their first year in schools the retrainees were able to take advantage of a mentor appointed by the employer. Three days were allocated for meeting with this mentor, and most used this time to go through the equipment in the storeroom, and discuss ideas for activities and assessments. For the majority the

mentor was an experienced teacher in the same school who was available and happy to answer questions at any time. In some cases this mentor could not provide all the answers, and the retrainee sought help from another teacher or from a district consultant. For five retrainees this mentor was outside the school, and the amount of help they could provide was limited by time and availability. As Don said: *Jerry (Don's mentor) didn't feel it was satisfactory and I didn't feel it was satisfactory ... I rang Jerry, it would have been less than five times during the year and said I am not really sure about this and asked him a question. When it came to the crunch I felt very self-conscious ringing him because I was aware I was taking up his time.*

Possibly owing to their years of experience as teachers, the retrainees who did not have a mentor located in their school were effective in identifying when they needed help, and active in finding friends, workshops or NSW Department of Education and Training personnel who would help them. The extended network of assistance that was accessed by the retrainees consisted of the:

- Mentor appointed by the employer,
- University tutor,
- Other retrainees,
- Wider education system (workshops, district science consultants),
- Fellow teachers and
- Portfolio (with online exchanges).

The graduates of the retraining program were fortunate because their need for support was anticipated, and both the university and the employer (NSW Department of Education and Training) offered mentoring. Graduates of teacher education programs are often left to manage on their own, despite research that shows the value of teacher induction programs (Tickle, 2000). We suggest that a combination of sources of advice and support, like the network available to the retrained teachers, could be of advantage to other novice teachers.

The importance of the school culture
Studies of novice teachers have shown that the first year of teaching is a struggle for survival, and the school culture is a significant factor in whether the teacher returns for a second year (Hebert & Worthy, 2001; Schemp, Sparkes & Templin, 1993). All of the

retrained teachers found the transition to science teaching to be a struggle, but some found the task much more enjoyable than others. The participants in our study fell into three broad categories with regard to enjoyment and satisfaction with the experience of being a retrained teacher. These were:

1. Those in a supportive school environment.
2. Those with one experienced teacher in the school who acted as a mentor.
3. Those in a hostile school environment.

The majority of our graduates reported an experience like that of Linda who commented:

I think the reasons I did well were the school, the staff room, the kids themselves, and the opportunity to be better, and that's pretty much all it takes really... And I know from what my mentor and head teacher have said, that if they had got someone different to me who wasn't as good with behaviour management, even if they didn't know the content that much, then it might have all fallen down. So along with what was happening in the school, it all worked well.

Our research suggests that there was a complex interaction between the school and the retrained teacher and this interaction had great impact on the retrainees feeling of satisfaction with their change of career. For those like Linda the school offered support in the form of a discipline policy, well-resourced programs and teachers who were willing to share their expertise. In these circumstances the retrainees could spend the extra time they needed to learn the science content and feel comfortable that they had the resources to help them deliver effective science lessons.

Some staff (3) were not as lucky as Linda in having a whole faculty or school providing support, but were able to rely on one teacher. Sue was in a faculty where the retiring head teacher had left much of the management in disarray. She relied on the new head teacher for support:

My head teacher, even though he wasn't my mentor, really became my mentor in some respects because I was constantly asking "what do you think about these ideas, what sort of resources do you have?" and he would come up with, off the top of his head, all these brilliant things about what to do, and it was great in that respect.

This group of retrainees often made use of the extended network described above. Sue had to experiment with strategies for classroom management that suited her new school, and there were some successes and some failures. By the end of the first year she was able to report:

I put in... and I was accepted for the year advisor for 2004... I also belong to the computer committee, because at my school everyone has to join the committee, and I'm also an environmental officer. And I also tutor people one hour in physics before school starts...because a lot of them were struggling and I said "if you've really got a problem I would be happy to coach you for an hour". I found I got a good response to that so that was a good experience as well.

The school community, or the school combined with the network of assistance provided by the university and employer, was enough to support most (9) retrainees and enable them to overcome the limitations of the brief period of retraining. Had the time been available to provide these recruits with a year of learning of science content they would have been better prepared for the classroom, and the pressure on them and their faculty would have been reduced, but the lack of this learning could be compensated for by the assistance provided to these people when they went into the school. However, when this assistance was not provided the retraining program alone was not enough to facilitate an effective transition to science teaching.

Two retrainees were allocated to schools where they met with a lack of acceptance based on a failure to respect their qualifications as science teachers. For these teachers the first year in schools was a very difficult and ultimately unrewarding experience. One retrainee described the problems of managing in an unsupportive environment:

I have not done the main subject I was trained in (physics) and that made a problem. At first arrival I am doing a subject that has agriculture. In Senior Science there is something like water, the knowledge for that was not in the old textbook. There was a syllabus I got off the net. Another teacher had a text, so I said can I borrow that? And he said no, I've got year 12 tomorrow. Can I have it the next day? No. I left it home, sorry. I did find one weeks later It was

about six weeks before the new textbooks arrived so the student's attitude to me was pretty shocked because I couldn't teach them much.

This retrainee was not given a physics class even though he was regarded by the employer as competent to teach physics and the school had requested a physics teacher. Those retrained teachers who taught physics reported that they felt confident of their ability to teach this subject, and found those senior classes rewarding. When the retrainees were not allocated a physics class they found it difficult to justify the effort they had put into their retraining and difficult to gain satisfaction from their work. A retrainee who had changed to a new school after a year of being told "What would you know, you are just a primary teacher", found that she was still struggling:

I suppose I am just suspicious because I've been badly burnt by the school that I was at last year. It turned me right off teaching high school, and the stress of going through the course, I needed to be in a totally cozy environment for me to recover from the stress, teething problems and such... You needed to be thrown into a bed, it broke my spirit, there are times when I just don't care.

The two retrainees who reported that the retraining course combined with a network of assistance was insufficient for their survival as science teachers were dealing with other disadvantages. One was in a country school, where he was unable to get the resources he needed and online communication was expensive. The other had many family commitments that increased the pressures on her time and made it difficult for her to access the help she needed. As one of their more fortunate fellow graduates commented:

You think what it might have been like, being stuck out on a limb with no-one to help you and that would have been extremely difficult. I still find it difficult you know, I'm staying back longer than anyone else, I have to plan my lessons and work out exactly what I am going to do, then I can feel comfortable and say okay now I can relax.

Concluding remarks

In summary, we can inform my friend that there is value in using retraining as a way of overcoming a shortfall in numbers of science teachers. With the help of the school community, and ongoing support from university and

employer, a carefully selected group of teachers can successfully transfer their pedagogical knowledge to a new subject specialisation. However, we have to add that we have also become aware of limitations to the use of retraining. The success of this course depended on the nature of the recruits, and we suspect that the pool of dedicated and enthusiastic teachers who wish to retrain as science teachers is quite small. We also found that the time, effort and money invested in this program was very high. The retraining course was designed specifically for these eleven people and many hours of staff time had to be devoted to curriculum development. While we learned a great deal about teacher education and mentoring along the way, we would have to suggest that in general, retraining is an effective but not a cost effective approach to teacher education.

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Addresses for Correspondence:

Frances Steele, University of Western Sydney, Locked Bag 1797, Penrith South DC, NSW 1797, Ph (02) 96304255.

Kevin Watson, Social Ecology and Lifelong Learning, University of Western Sydney, Locked Bag 1797, Penrith South DC, NSW 1797, Ph (02) 4736 0785, k.watson@uws.edu.au

Les Vozzo, University of Western Sydney, Locked Bag 1797, Penrith South DC, NSW 1797, Ph (02) 9772 6590, l.vozzo@uws.edu.au

Peter Aubusson, University of Technology Sydney, P.O. Box 222, Lindfield, 2070, Ph (02) 9514 5264, peter.aubusson@uts.edu.au