6.3 Teacher Development in Science Education

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Teacher development is seen in this chapter as development and learning by teachers as they seek to improve their teaching (Bell & Gilbert 1996). After completing the initial teacher education required by most societies, teachers continue to learn about teaching and learning throughout their professional lives. While an emphasis on inservice teacher education is implied in this discussion of teacher development, preservice teacher education is not excluded.

Teachers, as a group, are often frustrated that, after attending inservice courses or professional association meetings, or studying for university qualifications, they still feel unable to use the new teaching activities, curriculum materials or content knowledge to improve the learning of their students. Hence, the nature of teacher development and the factors that help or hinder it are of interest to all those wanting to introduce changes to science teaching to improve it.

The views of teacher development documented in this chapter were developed from the data and data analysis of the Learning in Science Project (Teacher Development). This three-year research project (1990–1992) was funded by the New Zealand Ministry of Education and investigated the development of some New Zealand primary and high school teachers of science as they learned new teaching activities that enabled them to take into account students’ thinking as researched by the previous Learning in Science Projects (e.g., Osborne & Freyberg 1985). The findings of the research are more fully documented in Bell (1993a) and Bell and Gilbert (1996). The research was mainly interpretive, descriptive and qualitative, and the three aspects of teacher development discussed in this chapter (see also Bell & Gilbert 1994, 1996) arose from a consideration of the data, the authors’ experiences in teacher development and the current literature.

The chapter describes teacher development as professional, social and personal development as well as learning. The next major section of the chapter considers these three aspects of professional, social and personal development using illustrations from the research project’s data. The second part of the chapter focuses on teacher development as learning.
TEACHER DEVELOPMENT AS PROFESSIONAL, SOCIAL AND PERSONAL DEVELOPMENT

The work of the Learning in Science Project (Teacher Development) has shown that teacher development is usefully seen as a form of human development involving professional, social and personal development (Bell 1993a; Bell & Gilbert 1994, 1996). Professional development, as an aspect of teacher development, involves the use of different teaching activities, the development of beliefs and conceptions underlying the activities, and the development of subject matter knowledge and skills. Social development involves the renegotiation and reconstruction of what it means to be a teacher (of science, for example). It also involves developing ways of working with others to foster the kinds of social interaction necessary for renegotiating and reconstructing what it means to be a teacher of science. Personal development, as an aspect of teacher development, involves each individual teacher constructing, evaluating and accepting or rejecting for herself or himself the new socially constructed knowledge about what it means to be a teacher of science, and managing the feelings associated with changing their activities and beliefs about science education, particularly when these go ‘against the grain’ (Cochran-Smith 1991) of socially constructed and accepted knowledge.

These three aspects of teacher development, described more fully below, are interactive and interdependent: development in one aspect cannot proceed unless the other aspects develop also. Hence, teacher development programs and activities must address and support all three aspects of development for change to occur. Moreover, social development is crucial if personal and professional development are to happen. Most importantly, because teachers bear the ultimate responsibility for teaching, their centrality in the social construction of knowledge about teaching must be recognised (Bell & Gilbert 1996).

Professional Development

Professional development typically includes teachers learning about new teaching or learning or assessment activities for use in the classroom, and tends to be offered in more formal situations, such as seminars, workshops and lectures. The emphasis of such teacher development activities is the presentation of new activities and related information to the teachers. The teacher development program may or may not include activities in which teachers discuss and reflect on the new teaching activities. Teacher development activities also may include curriculum development work, especially the rewriting of school curricula within the framework of new national or State curricula. Professional development also includes teachers learning some science. Most teachers are keen to update their scientific knowledge or extend it in areas required by the curriculum or new curricula.

Professional development also includes teachers trying out, evaluating and practising new teaching activities over an extended period, and in a collaborative
situation where they are able to receive support and feedback, critically reflect, and renegotiate and reconstruct what it means to be a teacher of science. This element of professional development tends to be underplayed in many inservice programs and to occur through more informal modes such as telephone conversations, conversations in the staffroom, sharing anecdotes and visiting other teachers’ classrooms.

Professional development also involves teachers developing their personally and socially constructed beliefs and ideas about science education, the teaching and learning process, and teacher development. That is, it involves conceptual development. Teachers bring to professional development programs different ideas, beliefs, experiences, concerns, interests and feelings. They have different starting points in the development process and might achieve different outcomes within the broad goals of the program, even though they have attended the same program. Therefore, teacher development programs have both anticipated and unanticipated outcomes, and facilitators need to be prepared for both. Also, teacher development activities need to acknowledge, incorporate and address (rather than ignore) teachers’ prior ideas, beliefs, experiences, concerns, interests and feelings about science and science education.

The research identified ‘better learning’ as a major factor that helps teachers change what they are doing in the classroom (Bell & Pearson 1992). When talking about the new teaching approaches that they were using, the teachers often talked about the better learning conditions (increased enjoyment, social cooperation, ownership, student confidence and student motivation) and outcomes (improved learning skills, development of students’ concepts and ideas, and attainment in school or national examinations) that were occurring. That better learning was occurring was perceived by the teachers as a reason to continue to change their teaching activities and beliefs, despite any difficulties or uncomfortableness with changing. In other words, the teachers sought and responded to feedback about student learning during the trialing of new teaching activities. The new classroom activities were evaluated with respect to whether the activities were successful in creating learning opportunities and learning outcomes. Therefore, teacher development activities need to provide opportunities for teachers to collect feedback on students’ learning.

Social Development

One aspect of social development is reconstructing our collective knowledge of what it means to be a teacher of science. The main reason why many teachers become engaged in teacher development is their wish to be able to do a better job – to be a better teacher and to have better learning by their students. At times, the new teaching activities that promote better learning could be out of keeping with the current collective view of science teachers of what it means to be a teacher of science. This view of what it means to be a teacher of science may or may not be explicit. For example, a shared view amongst teachers of science could be that a
quiet, orderly classroom is an indication of good classroom control by the teacher and good learning opportunities. Using new learning activities based on open-ended inquiry by students could feel uncomfortable for a teacher because the noise level in the classroom increases, as does the movement around the room and the asking of questions by the students. For some teachers, this may not be a problem as they feel better about themselves as teachers and are receiving feedback that better learning is occurring. They have reconstructed their view of what it means to be a teacher of science. However, other teachers may wish to retain their current view of what it means to be a teacher of science and cease to use the new activity. For major teacher development to occur, the collective view of what it means to be a teacher of science needs to be reconstructed by the group and each teacher has to reconstruct his or her own view for himself or herself as to what it means to be a teacher of science. It is extremely difficult (and uncomfortable) for teachers to teach in a way that 'goes against the grain' (Cochran-Smith 1991). For innovation to occur in science teaching, the socially-constructed view of what it means to be a teacher of science must be reconstructed as a part of the associated teacher development. And, given that teachers are ultimately responsible for their teaching, their centrality in the social construction of knowledge about teaching must be recognised.

Another aspect of social development as a part of teacher development is the working with other teachers to reconstruct what it means to be a teacher of science. The teacher development activities required for this task may be different to those typically used in teacher education. Lectures, seminars and workshops may not provide opportunities for teachers to talk with each other about what they are doing in the classroom and how they see themselves as teachers. Using anecdoting as a way of sharing experiences and beliefs is a way of facilitating the reconstruction of what it means to be a teacher of science and is seen by teachers as an important factor in their professional development (Bell 1994). Telling anecdotes is a way in which teachers can share their experiences and ideas with other teachers, ask for and receive feedback and support, reflect on their classroom teaching experiences, and consider new teaching activities and new theoretical ideas about science education. Telling anecdotes also enables the teachers (rather than a facilitator) to focus the discussion on teaching and what they were doing in the classroom, and to renegotiate and reconstruct what it means to be a teacher of science. In the Learning in Science Project (Teacher development), the teacher development was helped when the teachers were able to talk with each other about what they are doing in the classroom, as an integral and key part of the program. It was not something to be left to chance before or after meetings or over lunch or morning tea time. For example, two teachers commented on the ways in which they valued the sharing sessions:

I didn’t have another teacher in my school that was on the course which was perhaps a disadvantage, looking back on it and so, I tended to use other people at our weekly sessions in that respect to give me confidence because I found it was really quite scary to leave your textbooks behind, to leave your
dictatorship from the front behind, to risk having chaos in your classroom, to try something new. So, I found the weekly sessions really quite good and the discussions. (High School teacher)

Certainly the big group situation, listening to other teachers, other practising teachers – that was a big plus, to hear how other teachers coped with certain circumstances, to hear that other teachers had the same sorts of difficulties and what they had tried and what successes and failures they have had. But they certainly had more credibility for me than reading it in a book. (High School teacher)

Social development can be facilitated to a certain extent by facilitating a contrived collegiality (Hargreaves 1992), but true collaborative ways of working originate from teachers valuing them as ways of fostering their own and others development. The classroom can also be a source of teacher development (Thiessen 1992) and the social development involves the changing of the relationships between teachers and students. Here, it is the students who are providing the source of feedback and support for the teacher. When a school culture does not encourage collegial relationships between teachers, a teacher may prefer to work with the students rather than a group of teachers. But, in this situation, the teacher is not isolated in her or his development, just isolated from other teachers.

**Personal Development**

*Personal development* is an essential aspect of teacher development (Bell & Gilbert 1994, 1996). Personal development involves being aware and accepting of the need for professional growth; attending to the feelings and concerns of behaving differently in the classroom and changing their ideas about what it means to be a teacher of science; and managing the feelings associated with changing. It also involves each individual teacher constructing and evaluating *for herself or himself* an understanding of the collective, socially-reconstructed knowledge of what it means to be a teacher of science. Another aspect of personal development is teachers taking more control of their learning and being reflective (Schön 1983, 1987, 1991).

Many of the teachers in the research project were aware and accepting of the need for change when they become dissatisfied with an aspect of the classroom (e.g., the learning by students, student behaviour, lack of student interest in the lessons or classroom resources). For example, a teacher commented on some of the reasons for her attending the program:

Because I wasn’t happy with how I was presenting things. The kids were getting good marks. But I wasn’t happy. I just didn’t like it. I wasn’t getting to every kid in the class, you could see their eyes glazing over . . . So I was looking for something new and I didn’t really know what I was looking for. I wanted a new approach to the same stuff but I wanted to be able to present
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