

## Chapter 2

# A Five-Year Systematic Study of Coteaching Science in 120 Primary Schools

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### 2.1 Introduction

This chapter explores ways in which coteaching can be used to address theoretical and practical problems in contemporary pre-service teacher education. Many aspects of school education have changed over the last 50 years, particularly in relation to learner characteristics, increasing levels of government regulation and bureaucracy, globalisation and political uncertainty. Pre-service teacher education has not, in the main, embraced these changes, and consequently, new teachers lack the agency and confidence required for effective engagement with students. Coteaching provides a new way of ‘mentoring’ that assumes that the student teacher is not a blank slate, but someone who has different, yet valuable expertise, which can be shared with the classroom teacher to enhance the learning of the children. Coteaching science in primary schools, for example, enables the student teacher to bring scientific expertise to the classroom, which can be shared with the pedagogical expertise of the classroom teacher to improve children’s interest, enjoyment and learning of science. Coteaching, therefore, can expand the agency of student teachers in the classroom and improve the confidence of primary school teachers to teach science.

We describe our work in preparing for and implementing coteaching. In Northern Ireland, approximately 120 primary schools have been involved in coteaching since we started this work in 2002. We present and discuss data relating to the student teachers’, classroom teachers’, children’s and university teacher educators’ experiences of coteaching and the effect on primary science learning and teaching. We also show how we have used coteaching to enhance teachers’ and student teachers’ information and communication technology (ICT) skills, specifically their use of virtual learning environments (VLEs) and computer-mediated technologies. Finally, we have expanded our use of coteaching to improve the sustainability of teachers’ continuing professional development (CPD) work by their sharing both the learning programmes and their implementation in the classroom via coteaching with pre-service student teachers. This is described in Karen Kerr’s chapter later in the book.

## 2.2 Model of Coteaching

Coteaching explicitly brings two or more teachers together to improve what they can offer to the children they teach, while providing them opportunities to learn more about their own teaching. It involves the shared planning, teaching and evaluation of lessons. Each coteacher can learn from the other without even attempting to do so. In our model of coteaching, the student teachers and the classroom teachers act as *equals*, each bringing specific expertise to the lesson (Fig. 2.1).

We used coteaching as a way to expand the agency of student teachers in the classroom. Our concept of agency can be described as the power of the student teacher to access appropriate resources in the classroom. We felt that via coteaching, they could access the greatest resource available to them: an experienced classroom teacher. Lavoie and Roth (2001) observed that student teachers rarely (if ever) get to work alongside an experienced teacher – they normally observe someone teaching or teach alone. The student teachers are science specialists; science makes up one third of their bachelor of education degree. By the time they start coteaching (year 3 of a 4-year degree), they have a good knowledge of science and science pedagogy, but their experience of elementary teaching (all subjects) will have totalled only 16 weeks. The classroom teachers, on the other hand, are well experienced in elementary teaching, but many lack both the background science knowledge and the confidence to teach science. By coteaching with a student teacher who has a very good knowledge of science and science pedagogy, the classroom teachers might develop their own confidence in science teaching.

There is much research evidence highlighting the lack of confidence among elementary teachers to teach science. In the USA, there has been a lot of concern about the standard of preparation of science and mathematics teachers (Barufaldi and Reinhartz 2001). During the 1980s and 1990s, more than 500 national reports

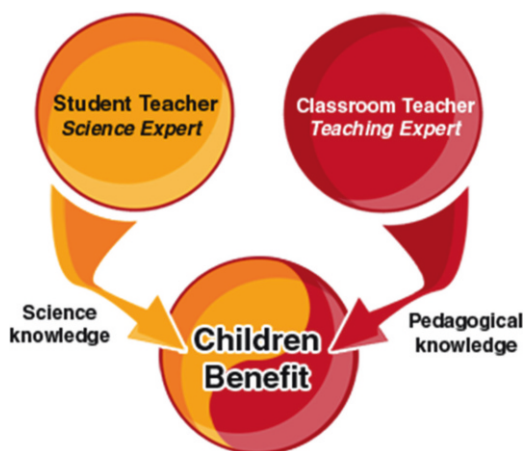


Fig. 2.1 Model of coteaching for primary science

addressed various inadequacies in science curricula and in the preparation of new teachers. Many of the resultant reforms centred on collaborative efforts to effect change. In the UK, Harlen, Holroyd, and Byrne (1995) found that many primary teachers lacked confidence in their ability to teach science and technology. A third of these teachers identified their own lack of background knowledge as a source of their problems. More recently, Murphy and Beggs (2005a, b) carried out a large-scale study to explore teachers' views and experiences of primary science education across the UK and to identify ways in which it could be improved. They reported that a high proportion of primary teachers felt they lacked the confidence, expertise and training to teach current science curricula effectively.

Our coteaching projects were set up to improve children's experience and learning of science by addressing the issues of primary teachers' lack of confidence in science teaching and student teachers' lack of agency in the classroom.

## 2.3 Implementation of a Coteaching Model

Implementation of coteaching is discussed in three sections: preparation, enactment and evaluation.

### Preparation for Coteaching

We developed the idea of student teachers working in the classroom with experienced teachers in a way that would ensure the sharing of expertise. The idea originated in discussions between university teacher educators and school principals.

The guiding principle in setting up coteaching was to avoid participants 'stepping on each other's toes'. From the outset the university teacher educators planned to actively include all participants in the coteaching research design and to ensure that each was willing to accept the responsibilities associated with working in new ways in the classroom. It was stressed that coteachers would concentrate on enhancing the children's learning experience of school science. We also promoted communication channels that enabled individuals to voice concerns about issues they felt uncomfortable discussing with their coteachers. In addition, and in response to advice from the school principals who were involved in the original research design, we organised workshops for classroom teachers to develop further their knowledge and skills in science teaching, so they would feel better equipped when working with the student teachers. These sessions ran before, during and after the coteaching placements and provided the university teacher educators with valuable feedback from the class teachers in relation to their experiences of coteaching. The student teachers provided similar feedback during science classes at the University College.

Initially, we (university teacher educators) set up a meeting with the principals of the first ten participating schools. The meeting was intentionally held on neutral ground, at a conference hotel, and explored issues relating to coteaching with the intention of refining the research and implementation design. The principals questioned us about the respective roles of student and classroom teachers in the classroom.

A collective decision was reached that project participants would develop codes of practice for classroom teachers, student teachers and university teacher educators. Principals were also concerned that some teachers might be anxious about how to coteach. We were unable to provide a how-to guide; instead, a second collective decision was made that coteaching teams would discuss a range of possible coteaching scenarios. The value of this preparatory work with school principals was immense. School principals were much more aware than we were of possible constraints. They appreciated the need for great care in our approach during all steps of implementation. They accepted responsibility for their role in the project which, we felt, was crucial. In retrospect, their advice and intimate knowledge of the work was key to the reported successes (Murphy et al. 2004b).

The next stage was a 1-day launch seminar, attended by school principals and all coteachers: classroom teachers, student teachers and university teacher educators. The seminar aimed at enabling coteachers to get to know each other and to work together in ways which would lead to developing successful working relationships. Coteaching teams developed codes of practice by adapting codes previously created for teachers and student teachers during 'non-coteaching' school placements. They also discussed the strategies they may adopt in hypothetical coteaching situations, such as the following:

For each scenario, consider your strategies for (a) that day and (b) future planning:

1. The class teacher and student teacher have planned a science investigation to take place during week 2 of the placement. The class teacher is absent on that day – the student teacher arrives and a substitute teacher is in class.
2. The class teacher and student teacher have planned a science investigation to take place during week 2 of the placement. The student teacher phones in sick on that day.
3. After a week or 2 you feel that all is not well in your relationship with the class teacher/student teacher.

Other group activities included adapting a reflective diary for use by coteachers, discussions relating to anxieties surrounding coteaching and suggestions for improving the research design. This day was intensive and intentionally provocative so that participants appreciated their responsibilities in the project. Participants were asked to consider seriously their involvement in the project and those who were still willing signed a code of practice. There was to be no penalty for those who felt unable to sign; alternative arrangements for non-coteaching placements would be made. All participants signed up. Their evaluations of the day recognised the importance of their role in the design and implementation of coteaching. Most were really looking forward to the project and a few were also still anxious about their role. This anxiety partly arose as a result of our inability to inform coteachers about how to coteach. We had never tried this before. The project was innovative and we were hoping that the participants would apprise us as to how coteaching could be successfully enacted in the classroom.

Typical comments from the student teachers, recorded in the reflective diaries indicated a mixture of their enthusiasm for science teaching, the value of learning

from working together with experienced teachers, and some anxiety about their role as coteachers, for instance:

I like the format that the project offers. I feel that it will give a certain degree of freedom to try new ideas and experiment with ways of teaching that will allow me to inject a more practical element back into science.

I am to use my knowledge to provide investigative and practical ideas to create a fun, discovery-learning, science environment in which children are stimulated to learning. To gain an understanding of children's thoughts, opinions, ideas of what science is and their understanding of scientific concepts.

I expect this experience to be very beneficial for me as it will enable me to spend more time in the classroom working with children from varying backgrounds teaching a subject I enjoy and hopefully passing my enthusiasm onto the children

I will gain an insight into the teaching of science in the primary classroom. I hope to learn different skills from the teacher and become more confident in the teaching of science.

I will learn about children's and teacher's views of science. Learn how a teacher goes about teaching science in the primary school, experience the management of a science lesson and experience the many safety aspects considered in a science lesson.

I'm a bit confused about my role in the classroom during this project. I understand the concept of team teaching but I'm not exactly sure how I will fit into this role. I feel I might be stepping on the teacher's toes if I interrupt her lesson questioning. On the other hand I don't want to feel like a spare part in this role of team teaching. I want to participate fully.

I hope it develops well and I'm very interested in how the team teaching will progress. I am also keen to teach science from an alternative perspective that I have been used to.

In the first year of our work, we referred to the innovation as team teaching, until we read about *coteaching* which more accurately reflected what we were trying to do.

The classroom teachers' comments about what they expected from coteaching were different in that they reflected the teachers' intention to support the student teachers in the classroom and the hope that they would learn more about their own science teaching, for example:

To give the student teacher the opportunity to grow in experience and help me to plan and deliver a science topic.

To give students valuable opportunities to develop teaching skills in the class situation.

To see science being taught by a specialist who can bring a different light into experiment and practical work for the children.

To gain further understanding of the subject area and confidence in tackling activities previously not taught by using student's expertise.

We were keen to address issues of social capital and agency in this work. According to Putnam (1993) social capital refers to features of social organisation such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit. We tried to ensure that our implementation of coteaching facilitated social capital and focused many of our efforts on building trust and openness. We also discussed changing power relationships with the coteachers: they were going to work in a non-traditional way in the classroom.

The student teachers would have more agency in the classroom and would expand the opportunities now open to them. Classroom teachers would develop more agency in regard to science teaching: they would have improved access to scientific resources and their use with children by working alongside the science specialist student teachers. However, the classroom teacher would have less power in that they would be sharing access to children and the classroom. Children in the classroom would have much more agency in that they would have improved access to their teachers and would be given more time and resources to develop scientific thought and processes. University teacher educators would get more opportunity to work with children, student teachers and classroom teachers, thus giving them more agency, both in the classroom and in practicing what they preach. However, they would also lose power over the student teachers and, to some extent, the classroom teachers. In the coteaching situation they would be expected to work alongside their new peers and, potentially, expose some of their inadequacy in the classroom situation.

We promoted discussion of these issues during the launch seminar. The following quote from a school principal reiterated the importance of sharing ownership of the research design with the classroom teachers:

I thought the launch day was very good in the [hotel name] and I thought the working in small groups was very good, people discussing their priorities and groups of teachers putting in what they saw – because sometimes it can be very management directed. But the input of the teachers was very good because when they have input then they will want to follow it through...

### Enactment of Coteaching

It is difficult to enact *equal* responsibility in coteaching. Having equal responsibility does *not* mean that coteachers are doing the same thing at the same time; it does not even require that coteachers are teaching together. Our working definition was that coteachers shared responsibility for the children's enjoyment and learning of science. After the first year, we identified the most common enactments of coteaching. In some classes, all were evident. These were: equal teaching roles for student and classroom teachers; one leading under the guidance of another; one leading and the other acting as 'assistant' and one leading as the other observes, all coteachers working with small groups of children and children themselves acting as coteachers. These models are all illustrated by video clips and can be viewed online in a continuing professional development unit on coteaching (Murphy and Beggs 2006).

#### 2.3.1 *Equal Teaching Roles*

Figure 2.2 illustrates equal teaching roles in the lesson. The student teacher (on the left) and the classroom teacher are teaching together to maximise the learning opportunities for the children. In this lesson, the coteachers were discussing the senses and then asking the children to sort toys into groups using their senses of sight and touch.



**Fig. 2.2** Equal coteaching roles

### ***2.3.2 Student Teacher Leads; Classroom Teacher Guides***

One of the main benefits of coteaching for student teachers is to develop more confidence in their teaching whilst working side by side with a more experienced classroom teacher. This was evident from video footage of some of the cotaught lessons; the student teacher frequently turned around and checked whether what she/he was saying was appropriate whilst leading a lesson. In one specific instance the student teacher was leading the introductory discussion to a ‘dissolving’ activity. She was asking children for their ideas of different common substances which dissolve. One of the children answered ‘Disprol’ – the brand name of a pain reliever. The student teacher said ‘yes’ and then quietly asked the teacher about whether this type of answer was acceptable. The classroom teacher assented and the children then came up with lots of good examples of substances which dissolved, often using brand names.

### ***2.3.3 Classroom Teacher Leads: Student Teacher Guides***

In respect of running science investigations, the student teachers, being science specialists, offered advice during the lesson when the classroom teacher was leading. This can be illustrated in the following lesson transcript. The lesson is the same one described in the previous paragraph. The classroom teacher is leading an investigation into dissolving; the student teacher helps the teacher to promote the development of children’s scientific skills.

Classroom teacher: Pour it [sand] in very carefully and don’t put the water in until you are told.



Student teacher: Should we get them to predict what is going to happen?

Classroom teacher: Girls, will you think about what might happen, what do you think is going to happen?

### ***2.3.4 Student Teacher Leads: Teacher Assists***

In some lessons or parts of lessons, the coteaching model comprised the student teacher leading the lesson whilst the classroom teacher acted as an ‘assistant’, supporting the work of the student. For instance, I observed a student teacher using a pupil-assisted demonstration to help illustrate the concepts of transparency and opacity. During the demonstration the classroom teacher assisted by passing particular materials to children or to the student teacher.

### ***2.3.5 Classroom Teacher Leads; Student Assists***

In this model the classroom teacher might be leading a science investigation in which the student teacher’s role is ‘another pair of hands’. The classroom teacher would direct the work of the student teacher. We observed this situation in a lesson in which the children were designing air-propelled ‘cars’. The classroom teacher was taking the children through the different elements of design; the student teacher’s role in this case was to ensure each child had access to the different materials they required.

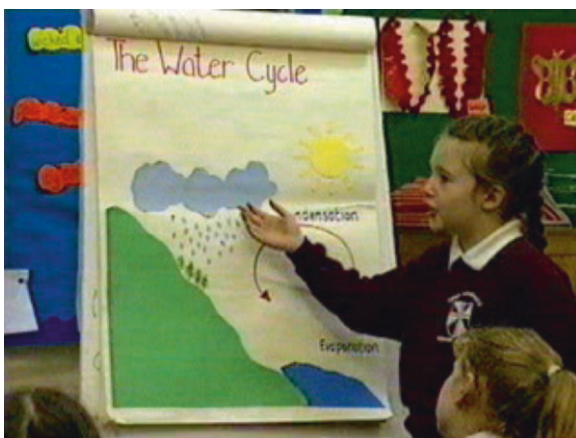
### ***2.3.6 Student Teacher and Classroom Teacher Each Work with Small Groups***

This coteaching model was evident at certain stages in almost all observed classes. Each coteacher assisted small groups of children during the practical activity. It was during this stage of the lesson that visiting university teacher educators and/or researchers would most commonly act as coteachers unless asked to play a different role by the other coteachers in the room. The opportunity to interact with children during the science lessons was highly valued by the university teacher educators; many had not ‘taught’ young children for years.

### ***2.3.7 Student Teacher Leads: Classroom Teacher Observes and Vice Versa***

On occasions during coteaching, one coteacher might be interested in receiving feedback on their teaching. In this case, one coteacher might be observing a lesson. Our experience of this model showed that the opportunity to observe as an equal





**Fig. 2.3** Child as coteacher

promoted much self-reflection. In the following extract from an interview, a classroom teacher is reflecting on her own practice as she observes the student teacher.

One of the main things that I gained was that you could sit back and watch your children responding to somebody teaching them. ... You could see that there was sometimes children in the classroom continually getting the attention from the student teacher because they were the loudest who were always coming up with answers, always being funny. They were getting the attention and there were other children who were being completely ignored ... because they were quiet and sitting not making a sound but not showing any interest. It made me aware that I'm probably doing that in my teaching. (Classroom teacher)

### **2.3.8 *Child Acts as a Coteacher***

When children experience more than one person teaching, it is possible that they might feel more comfortable acting as a coteacher themselves. We strongly encouraged teachers to include this role for children as much as possible. Figure 2.3 illustrates a child leading part of the lesson on the water cycle. The child is guided by the student teacher to explain the water cycle in her own words to the rest of the class.

## **2.4 Implementation Issues**

### **2.4.1 *Should Student Teachers Be Assessed During Coteaching?***

Coteaching is a new way of working and can lead to feelings of anxiety in regard to enacting the role as coteacher. We intentionally promoted the idea that coteaching in the classroom would not be assessed. When university teacher educators

visited classrooms, their role was to support the children's learning by adding their expertise and not to supervise the student teachers. There was no debriefing about the teaching performance. Instead, the university tutors were included in the lesson evaluation discussion and invited to share their experiences. These discussions were similar to cogenerative dialogues (Roth and Tobin 2002). They could not be presented as true cogenerative dialogues, however, since they did not include representatives of all groups participating in the lesson; there were no children present.

We were also concerned that obvious mentoring by the classroom teachers might serve to diminish the agency of the student teachers and make the latter feel as though they were being judged, as opposed to acting as an equal participant in the promotion of better science learning and teaching in the classroom. Coteachers were encouraged to share expertise.

#### ***2.4.2 Should Coteachers Be 'Matched'?***

It was clear from the start that in coteaching we are asking classroom teachers to share that which they were used to doing alone. There are many ethical issues that arise. The preparatory work described above was carried out to raise awareness and anticipate the particular types of issues pertaining to each classroom. After the first year of coteaching it was evident that, in some cases, random pairing of student and classroom teachers was not always ideal. We discussed the possibility of introducing an element of matching for future projects. The participants felt this may be a useful step. The University College co-director of the coteaching projects visited each school principal and they discussed potential coteaching teams which would work best to promote children's enjoyment and learning of science. This careful and sensitive process did lead to more harmonious coteaching and was adopted in all future work.

#### ***2.4.3 Promoting Harmonious Coteaching***

We investigated ways of promoting harmony between coteachers by analysing their reflections in the coteaching diaries they kept and from interview transcripts. The data from the student teachers revealed that there was most harmony in the relationship between student teachers and teachers when the respective roles were perceived as equal, less harmony when the role of the student teacher was perceived to be dominant, and least harmonious of all when the role of the teacher was perceived to be dominant. This trend is illustrated in Fig. 2.4, which summarises comments from student teacher diaries and interviews.

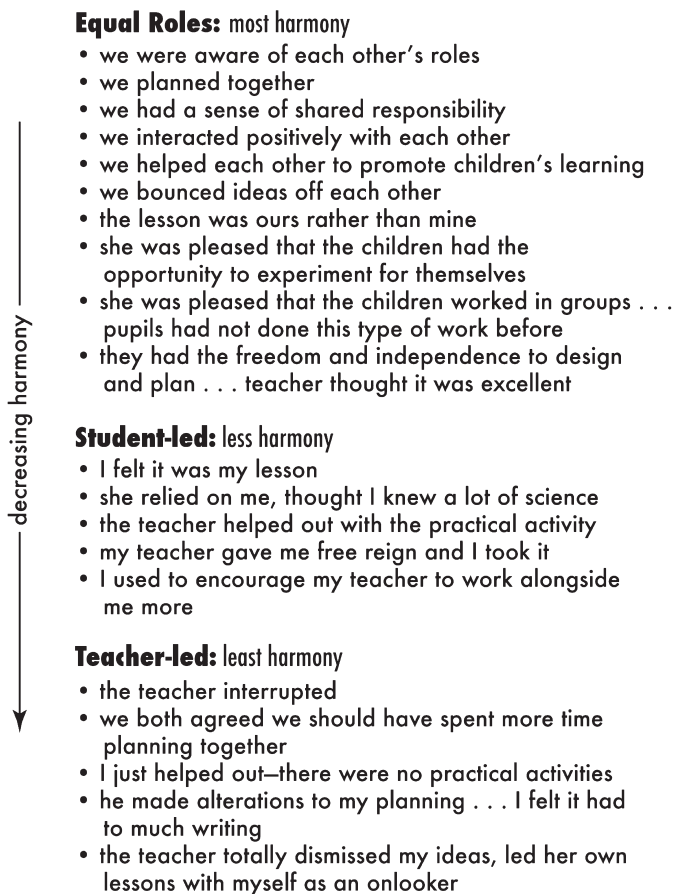


Fig. 2.4 Harmony in coteaching

### 2.4.4 Anxiety About Coteaching Role

Anxiety about how to coteach is the most challenging aspect for all concerned. The research team acknowledge this and initially invited participants to share their different ways of enacting coteaching for subsequent cohorts. We videoed several cotaught sessions and provided concrete information about ways to coteach. The following extract from a discussion between Jim, project co-director, and Loretta, a school principal, provides some insight to some of the issues surrounding role anxiety:

Jim: Had you any concerns that affected your decision to take part?

Loretta: I was very interested from the very start. The concerns I had would have been to do with any project. First of all I was concerned about the quality of the student teachers,

how well they would be able to support our teachers and to work alongside them. I was also concerned about the consistency of the program: would people turn up regularly or would there be reasons why the program couldn't run on certain days? That could create a problem in schools in that teachers and children are waiting for someone to come in and if they don't arrive they get very disappointed. That, in turn, affects the whole program. The other concerns I had really were that it was a different relationship to teaching practice and I was wondering how both the teachers and the students would cope with that.

Jim: How were these issues addressed for you before the project started?

Loretta: We had talked about the quality of students and obviously not every student is at exactly the same level and we knew there was going to be a slight variation. Having said that, we were very happy with the quality of support that was provided and in some cases there were students who weren't brilliant at the beginning but with confidence did become much better and contributed a lot to the program. The student teachers were very consistent. They had been here for the whole 10 weeks and I felt that contributed a lot to what the teachers got out of it. They expected it to happen each week and it did happen and they were happy with that. The relationship issue just really wasn't one in the end. They both got on and worked well together and no concerns were brought to me by teachers about that.

Jim: Why did you become involved?

Loretta: First of all, I'm really interested in primary science I think it's a brilliant subject for primary school. It's a cross curricular subject in which children can learn skills in all sorts of areas but also it teaches them a particular way of thinking about things which they don't get in other subjects. That's the main reason why I would be interested in any project of this type. Secondly, I was very interested in a professional development point of view for my teachers and interested in anything that can enhance their skills in the classroom. Thirdly, I'm also interested in research and getting teachers involved in research.

Jim: Did you feel you got enough information about how the project was being organised?

Loretta: Yes I felt I was kept fully informed. You contacted me regularly to let me know what was happening. Karen [research assistant] was very good about keeping in touch with us about when she was coming and yes I'd no problem with communication.

Jim: How would you describe the purpose of the project?

Loretta: The purpose I felt was that it was further development of the partnership of the College and the students and the school for the good of all working in the area of science. That it was something that would give extra support to teachers in the area that they had identified where some were lacking in confidence or expertise. It would also give students more experience in working in classrooms.

Jim: What do you feel the outcomes were for your school from involvement in the workshop held in the college?

Loretta: For the teachers there was enhanced professionalism. They were very aware of what was going on in school and they responded very well to that. It also raised their self-esteem. They were happy to be involved in the project and telling other staff about it. It helped their classroom skills in working in the area of practical, investigative science and it stimulated interest among other staff about what was going on. In the hard area of science it was useful to us, especially the outcomes of the workshops where we got specific feedback on our own schemes. The content of the workshops really came from teacher's identification of the issues and I see that in the long term being very useful to us as we further develop our schemes.

Jim: Would you continue to be involved in a similar project of this type? What changes might you suggest?

Loretta: Yes I felt it was very beneficial for the staff and the school and I would be interested in being involved. Basically I thought it went very well but no matter what you do time is always the biggest issue. Time for planning and review is as important as actual teaching. The change I would suggest is that there should be the same amount of time spent planning and reviewing of all the outcomes for the students and teachers as the time spent in the classroom.

### **2.4.5 School-Level Decisions**

Issues are bound to arise during coteaching in schools which are beyond intervention from outside the school. For instance, in one school a student teacher was re-assigned to a different classroom teacher due to school-related demands on the former. The new classroom teacher had not been involved in any of the coteaching preparatory work and her attitude to coteaching was quite negative. Clearly, such a new way of working requires much preparation and all coteachers must be fully aware of the principles involved. We would not advocate the introduction of coteaching to participants who are not fully aware of its nature, goals and challenges. Further, we would strongly recommend that all participants sign a code of practice.

#### **Evaluation of Coteaching**

Coteaching science took place during school placements with the aim that the science expertise of the student teachers' and the classroom teachers' expertise in all aspects of teaching children were shared. The emphasis of the work done with the children was on science and technology investigations involving as much experimentation as was practicable. Several methods were used to evaluate the impact of coteaching.

All coteachers (i.e. student teachers and classroom teachers) carried out confidence audits relating to many aspects of their teaching development at the start and end of coteaching placements. Student and classroom teachers also kept reflective journals in which they recorded different aspects of their experience. They participated in the design of the respective journals at an early stage in the projects. The journal was semi-structured and asked participants to respond to specific questions relating to their experiences and reflections throughout the placement. There was a 'diary' section at the back of the journal in which participants were encouraged to record additional comments.

All coteachers were interviewed at different stages during the coteaching projects. The interviews carried out during the school placements served mainly to monitor their experiences. More formal interviews were carried out with the student teachers 6 months after the school placement to coincide with the survey of children's attitudes. The student teachers had, by the time these interviews took place, completed

their 'main', assessed 7-week full-time teaching practice in which they taught all areas of the primary curriculum. One classroom teacher from each of the participating schools was also interviewed at this time. The teachers were asked to comment on their experiences of the coteaching placement. Student teachers' practical teaching grades (which had been assessed by non-coteaching colleagues in solo taught classes, as was the case for all other student teachers who had not been involved in coteaching) were compared between student teachers who had and had not participated in coteaching.

To determine the impact of coteaching on children's attitudes to school science, approximately 250 children (8–11 years old) who had taken part in cotaught classes completed a short attitude questionnaire 6 months after the student placements had ended. The findings were compared with those from a large group of children who completed the same questionnaire approximately 9 months prior to the start of the coteaching. Both survey samples comprised similar proportions of girls and boys. For more details of this questionnaire, see Murphy et al. (2004b). To supplement the data from the questionnaires, interviews were carried out with children after both surveys. In addition, data from teachers and students involved in coteaching were compiled from reflective journals kept during the placements and from interviews that were carried out during and after the placements. We also carried out focus group interviews with small groups of children and an entire cohort of the student teachers to explore feelings and experiences of coteaching.

When the coteaching involved online learning communities (OLCs) (Murphy et al. 2004a), student and classroom teachers were trained together in the use of the virtual learning environment, '*Blackboard*'. The joint training sessions took place in the University College, and provided face-to-face contact between those student teachers and teachers who would be coteaching during the students' block school placement. Participants were introduced to a panel of subject matter experts (SMEs) who provided online support in curricular matters and with the use of multimedia in the classroom. Student teachers completed two block placements in schools in which they cotaught science and shared data and documents between schools.

## **2.5 Impact of Coteaching Science in Primary Schools: Student Teachers, Classroom Teachers, Children and Teacher Educators**

This section presents and discusses the findings relating to the student teachers', classroom teachers', children's and university teacher educators' experiences of coteaching and their effect on primary science learning and teaching. As mentioned in the chapter introduction, we implemented coteaching primarily to address two of the main current problem areas in primary science: lack of teacher confidence in primary science and technology teaching and the decline in children's interest in school science in the more senior primary years. The coteaching projects concentrated on developing both student teachers' and classroom teachers' skills in planning,

teaching and evaluating practical, investigative science and technology lessons, including the successful integration of multimedia, to enhance children's interest, enjoyment and learning of science. As a further development of coteaching, we set up an online learning community of coteachers in schools across Northern Ireland.

We summarise some recent research into lack of teacher confidence in primary science and technology teaching and primary children's attitudes to school science. We consider how coteaching may be enhanced via the creation of an online community enabling collaboration between coteaching teams in geographically distant schools. We provide a summary of methods by which coteaching was evaluated and present the findings. The impact of coteaching on student teachers, classroom teachers and children is discussed. Findings relating to the added value that can be gained from the online collaboration of coteachers are also illustrated. Finally, the overall impact of coteaching is discussed.

In 1995, Wynne Harlen published a seminal report on primary teacher confidence in science teaching in Scotland. She reported that when teachers were asked to rate their confidence in teaching 11 subjects, science was eighth (music, information technology and technology were below science). They were less confident teaching the technological and physical aspects of the primary science curriculum than the biological topics. Teachers also reported having more difficulty with assessment of processes and of concepts than with other teaching skills (Harlen et al. 1995). These findings have been reproduced worldwide, and many initiatives have been put in place to improve the primary teachers' confidence in science. More recently, a major research study of primary teachers across the UK (Murphy et al. 2007) showed that there has been some progress in developing teacher confidence in primary science over the last 10 years. However, the situation is still critical. One half of teachers surveyed in the UK for the study identified lack of teacher confidence and ability to teach science as the major issue of concern in primary science. The report also showed that professional development in science works, in that teachers who have experienced science CPD are much more confident to teach science than those who have not.

Many reasons are suggested for teachers' lack of confidence in science and technology teaching, including insufficient subject knowledge, lack of experience in science practical investigation, lack of resources, and problems of classroom management such as overcrowding, lack of space and safety considerations. Abell and Smith (1994) studied US student elementary teachers and reported that these students were not scientifically literate and yet would be teaching science in US elementary schools. Murphy et al. (2001) showed that third-level students, including those who experienced compulsory school science from the ages of 11–16 and some with post-16 science qualifications, could not correctly answer questions in some primary science topics in tests which had been written for 11-year olds. These problems, when taken together with the emphasis of national tests on content knowledge, may have contributed to science frequently being taught as facts or as a 'body of knowledge' in the final 2 years of primary school. Teachers felt the need to prepare children for the tests by ensuring that they can recall the required content knowledge.



In the USA there has also been major concern about the standard of preparation of science and mathematics teachers (Barufaldi and Reinhartz 2001). During the 1980s and 1990s, more than 500 national reports addressed various inadequacies in both science curricula and in the preparation of teachers. Many of the resultant reforms centred on collaborative efforts to effect change. Atkin (1998) in his overview of the OECD study of innovations in science, mathematics and technology education stressed that the critical point determining the success or failure of innovations is the classroom interaction between teachers and children. James, Eijkelhof, Gaskell, Olson, Raizen and Saez (1997), also commenting on the case studies carried out in the OECD study, concluded that the teacher is at the heart of curriculum innovation, and that innovation depends on a '*more thorough-going and comprehensive view of teacher professionalism*'. Indeed many researchers, including Wilson (2000) have called for more direct involvement of teachers in research programmes. Coteaching primary science aims to enhance such interactions by improving teacher confidence in all aspects of science and technology teaching.

In relation to the promotion of children's positive attitudes to science, most researchers agree that the erosion in children's interest in school science occurs between the ages of 9 and 14 (e.g. Hadden and Johnstone 1983; Schibeci 1984; Murphy and Beggs 2003), even though they retain positive attitudes towards science generally and acknowledge its importance in everyday life. The problem of declining interest in school science is international and many reasons have been put forward to explain it, including the transition between primary and post-primary schooling, the content-driven nature of the science curriculum, the perceived difficulty of school science and ineffective science teaching, as well as home-related and social-related factors. Murphy and Beggs (2003) carried out an extensive survey of primary children's attitudes to science and found that most of the older children (10–11 years) had significantly *less* positive attitudes than younger ones (8–9 years) towards science enjoyment, even though the older children were more confident about their ability to do science. The effect of age on children's attitudes was far more significant than that of gender. Girls were, however, more positive about their enjoyment of science and were a lot more enthusiastic about how their science lessons impacted upon their environmental awareness and their health. There were also a few significant differences in the topics liked by girls and boys – generally girls favoured topics in the life sciences and boys preferred some of the physical science topics. The attitudes of the children involved in cotaught classes towards school science were examined in order to determine whether there was any noticeable difference as a result of the science coteaching.

The basis of coteaching is collaboration between teachers to expand the learning opportunities available to the children. In order to increase the level of collaboration between coteachers, we set up an online learning community (OLC), by way of computer-conferencing using a virtual learning environment (VLE) between student teachers, classroom teachers, university teacher educators and subject matter experts (Brown 2001; Wegerif 1998). The OLC encouraged critical reflection and knowledge construction through social interaction with others (McConnell 2000; Palloff and Pratt 1999). This facilitated collaboration between coteachers in

geographically distant schools (some of which were more than 160 km apart). Research shows that a strong sense of community not only increases the persistence of participants in online programmes, but also enhances information flow, learning support, group commitment, collaboration, and learning satisfaction (Dede 1996; Wellman 1999). One of the important factors related to sense of community is social presence (Rovai 2002). According to Garrison and Anderson (2003), the formation of community requires a sense of social presence among participants. In coteaching, this community proved extremely valuable in the development of shared planning, resource production and evaluation by teams of classroom and student teachers.

2.5.1 Student Teachers

Coteaching had a significant impact on the teaching confidence of student teachers. We found that their confidence increased in all subject areas, despite the fact that they were only coteaching science, suggesting that coteaching may have improved student teachers overall confidence in classroom teaching. The chart in Fig. 2.5 shows that a higher percentage of student teachers reported that after coteaching science (for half a day per week over 10 weeks) they felt fully confident to teach all subjects of the primary curriculum.

Interviews with student teachers carried out after the coteaching placements also indicated that most felt that their confidence had considerably improved as a result of coteaching.

In one post-coteaching interview, a female student teacher talked about coteaching and her overall teaching confidence:

I had a real opportunity to build confidence in teaching science and this helped me prepare for my teaching practice (internship). I feel this was a totally worthwhile experience. I built good relationships with all children and enjoyed teaching the lessons. I definitely feel much more confident in teaching practical science and have a clearer understanding of how children

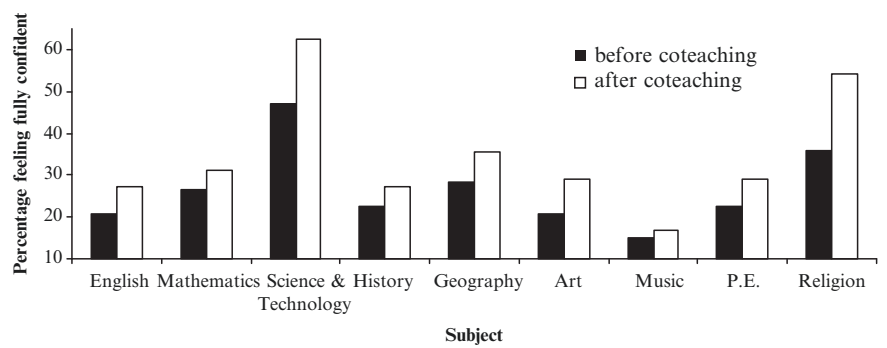


Fig. 2.5 Improved confidence of student teachers after coteaching

learn science. I think the children enjoyed it. They loved getting involved and I could tell they were excited every Tuesday morning. The teacher enjoyed it as well. She let me know this when I was leaving.

Student teacher confidence in teaching younger children is frequently quite low. We were therefore interested in the experience of this teacher who was coteaching a class of 6–7-year olds (P3):

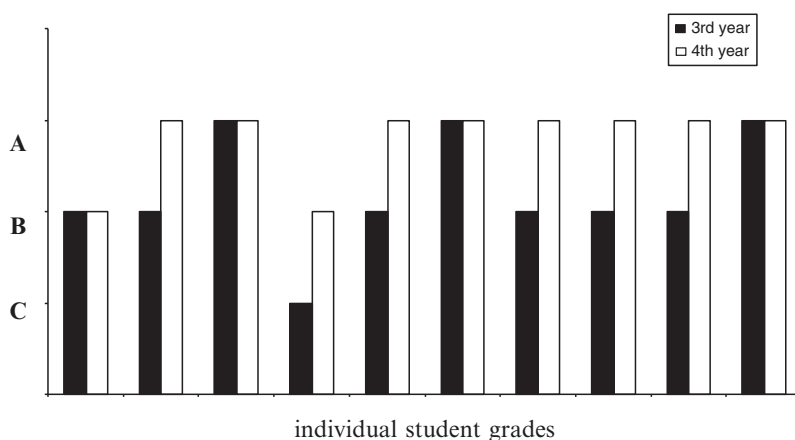
It gave me a bit of confidence. We seemed to focus on technology itself and physical activities, not just the theory of the thing. It was important for P3's that when you introduce a concept to them you have to have it backed up with something concrete that they could get involved in so it would reinforce the learning. It kept me on the ball for my approach to the lesson the following week and the week after, not just adopting my approach to the lesson but adapting to the other teacher's method of introducing and progressing. We did work in partnership and it worked out well, it gave me the confidence to contribute and to listen and it also was useful, because I was listening to a teacher that was in the situation and I was picking up on her cues all the time. I was learning from her approaches.

In a few instances the student teacher experience was not as positive. Two groups of factors seemed to obstruct the potential of coteaching for both student teachers and classroom teachers. First, factors external to coteaching, such as school politics and prolonged teacher absence, and second, when there were relationship problems between student teachers and classroom teachers. In subsequent planning for coteaching we tried to match student teachers and teachers, which worked very well. We teamed student teachers who were confident with classroom teachers who expressed fears about teaching investigative science. We placed less confident student teachers with experienced teachers who volunteered to support them.

We were very interested to see whether this increased confidence translated into improved performance in the assessed placement (coteaching was never assessed). The chart in Fig. 2.6 shows the improvement in practical teaching grades of the 2005 final year cohort of individual student teachers who had participated in two coteaching projects. All student teachers maintained a high (A/B grade) or improved their grade.

### **2.5.2 *Classroom Teachers***

The main teacher learning about science seemed to come from their observation of and participation in simple, classroom-based science investigations. They commented on how easy this was in practice – as opposed to reading about doing it – and how well student teachers used the resources that had been provided for science. The following extract from an interview with a classroom teacher a few months after the student teacher had been in the school illustrates the teacher's appreciation of her coteacher's confidence with investigative science and how she was able to take forward the work they had carried out together. She was asked whether she had picked up any new ideas:



**Fig. 2.6** Practical teaching grades of student teachers in coteaching projects

Yes I got a lot of new ideas— practical ideas of the use of the resources. I just felt she had great ideas and things that I'd never used before. I think you're inclined whenever you are doing the same class or classes every year to get into the same mould of teaching things and I just felt she introduced ideas that I hadn't thought of. I probably gave her a few ideas as well, so when we put the whole lot together she learnt from me and I learnt from her.

It would have been the practical ideas that I enjoyed the most because it was a fresh new approach that just gave me a totally different idea. One of the things coming up to Christmas we did was which material would be best for Santa's coat to keep him warm. So we did an experiment using all sorts of materials to see which one would keep him the warmest and that was great for fair testing. Afterwards I was able to follow it up with lots of artwork and the children were able to bring it into their writing, how they did [the investigation], which [coat] would be best, and why. It had that fun aspect to it as well.

Many of the classroom teachers also commented on the development of their science knowledge as a result of coteaching with the student teachers, particularly the physical science areas, as the following interview extract reveals. The classroom teacher was asked what she thought she might gain from her work with her coteacher:

I thought I was going to have an experienced student teacher in my room who had more knowledge in practical science than I had in regards to P6 [9–10 year old children] which, as it turned out, she did. Katie was very good. It was so new to me, the whole [pause] and the reason why I chose electricity was because I wasn't confident in that area at all. ... I really didn't know where to begin. I didn't know how to set up a circuit or how to teach it methodically and start at the beginning, which she was great at. She knew exactly where to start and had it all progressed from that. I have it all and all the worksheets and will use it again next year.

Another very important area for teacher learning was expressed by the following teacher as she reflected on how she observed critically some aspects of the student teacher's teaching whilst pondering that she probably did the same things and how she had now been made more aware and would be able to avoid such slips in the

future. She was responding to the question of what she thought she might have gained from coteaching:

One of the main things that I gained was that you could sit back and watch your children responding to somebody teaching them. Obviously you're normally the one who's in there doing the teaching and I thought the benefit was that, okay, you are involved in the lessons, but a lot of the times you were secondary. You weren't up there totally organising and in charge of everything. So it gave you an opportunity to watch how children responded. You could see there was sometimes children in the classroom continually getting the attention from the student teachers because they were the loudest, who were always coming up with answers, always being funny. They were getting the attention and there were children who were being completely ignored throughout some of the lessons because they were quiet and sitting not making a sound but not showing any interest. It made me aware that I'm probably doing that in my teaching but I would be aware even with the younger children that there are the ones that do get all the attention, sometimes it's for the right reasons, sometimes they deserve it but at other times you're so busy disciplining children that the other ones get left out. It's good to be able to see someone else teaching because you don't normally get the chance you are doing all the teaching. Also just with ideas and things some of the practical things they came up with I'd never done before, like making the lungs and things so that was good to see and getting new ideas.

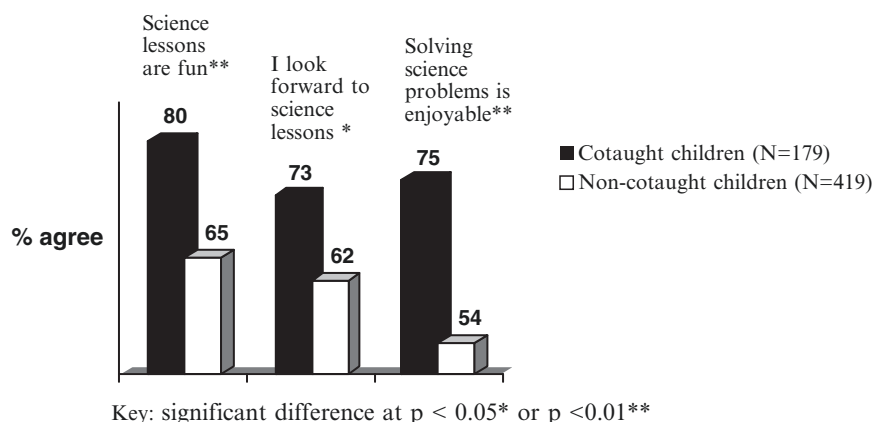
We also asked teachers to comment on whether coteaching contributed towards their own professional development. One male teacher, who was working in a class with two student teachers reflected:

... just having to encourage, support and talk them [student coteachers] through that aspect of the counselling side ... Discussing lesson plans, discussing at the end ... what had been good and what had not been good and trying to support them through times when they felt that it didn't go just quite as they expected. They needed a lot of that and I'm not good at that so it was nice to make me do that positive reinforcement. ... The nicest thing about the whole thing was that the children were totally engaged in what they were doing, every Thursday afternoon.

The impact of coteaching on classroom teachers was highly positive in many ways. First, they had an opportunity to carry out science investigation together with student teachers who were science specialists. In all of their reflections, teachers talked and wrote about what they could 'take away' from the experience. In other words, each teacher had expanded her/his repertoire of science activities and investigations which s/he could carry out unaided in the future. The opportunity for this level of in-class support was highly valued; research has shown that in-class professional development for teachers is most effective. Teachers also improved their reflection and professional development skills by observing and supporting the work of student teachers.

### **2.5.3 Children**

Children who were involved in the coteaching were significantly more positive about their science lessons. The chart in Fig. 2.7 represents the percentage of children in each group who agreed with the statements indicated. The significance of



**Fig. 2.7** Relative enjoyment of science lessons

the difference between the mean responses of all children in each group was calculated using t-tests (assuming unequal variance) and is indicated by the asterisks.

The improvement in attitudes could be explained by the classroom teacher's increased level of confidence in investigative science and technology teaching as a result of the student teacher coteaching placement, since the survey was carried out almost 6 months after this placement.

There were also fewer differences between girls' and boys' preferences for different science topics in the classes which had been involved in coteaching (Murphy et al. 2004b). There was a positive shift in girls' enjoyment of physical science topics. The results indicate that the differences between girls and boys in their preference for particular science topics can be influenced by the way they are taught. The effect of more than one coteacher (mostly female) teaching science as investigations could have significantly increased girls' liking for the physical science topics.

In addition, the enjoyment of science was shown to be greater in older children who had been cotaught (Murphy et al. 2004b). Coteaching, therefore, seems to have a very positive effect on children's interest and enjoyment of science, and could be used to combat the reported decline in children's interest in science as they reach the more senior primary classes (9–11 years).

In summary, we found that coteaching impacted positively on student teacher confidence [to teach] and on their overall performance in teaching practice placements. Classroom teachers reported a lot of benefits of coteaching in terms of their confidence to teach science and in aspects of their professional development. Evaluation of children's attitudes to school science took place many months after the coteaching placement because we were looking for evidence of lasting impact on the teaching of science following coteaching with science specialists. We found evidence of significant improvement. The findings imply that since both the student and class teacher gained in confidence as a result of their coteaching experience; this could have led to a higher level of enjoyment of science by primary children.

## 2.6 Promoting Coteaching in Schools

Teachers in schools sometimes view research and development in teacher education with scepticism. Wilson and Easton (2003) described the results of a research project aimed at identifying the ways in which local education authorities can facilitate the use of research for school improvement (Wilson et al. 2003). Wilson summarised aspects of the debate surrounding the contribution of research for school improvement for policy makers and practitioners, citing the work of Hargreaves (1996), who reported that research has limited use and usefulness for practitioners as the findings are often viewed as complex, contradictory and of little direct relevance to classroom practice. She also cited the seminal work of Shkedi (1998) that explored the attitudes of teachers towards research literature, and found that very few teachers turned to research literature to expand their professional knowledge, solve problems or meet the requirements of their job. However, Wilson and Easton's (2003) research found that despite its negative image, teachers are using research to inform their knowledge and practice.

Our experience was that four elements are crucial for schools to engage seriously with coteaching research and development. Firstly, university teacher educators intending to work in schools must engage with school personnel *from the start* of their research design. It is at this stage that they get the most valuable insights into the workability of coteaching in the particular schools. Secondly, university and school personnel need to share ownership and responsibility for coteaching: there must be equal weight given to all participant voices (using, for example, cogenerative dialogue – a conversation with stakeholders about a shared experience) (Roth and Tobin 2005). Thirdly, university teacher educators must plan for sustainability of work that has benefits for school participants. There is a serious ethical issue regarding short-term, beneficial projects in schools which are discontinued when the funding runs out, leaving the situation to revert back and a loss of any benefits to students and teachers. Fourthly, the results should be disseminated in a form that is accessible to all participants and to those interested in accessing the work. Advocating new approaches to teaching and teacher education such as coteaching can be a deeply sensitive process, fraught with potential ethical issues. Care in this regard will lead to more successful integration of new approaches and speed up the necessary changes in teacher education required for twenty-first-century teaching.

## 2.7 Conclusion

The overall impact of coteaching was highly positive for all participants. There were instances (especially during the first year) which militated against successful coteaching caused by school-level decisions, lack of communication and unproductive coteaching relationships. Such instances provided the background for case



studies that were discussed as problem-based learning activities as part of the preparation for future coteaching teams. It was also mentioned earlier that ‘matching’ of coteachers (carried out by school and university personnel) was a highly successful innovation. Thus, student teachers who may have been less confident were placed with teachers who wished to support them. Similarly, teachers who were most anxious about their science cotaught with student teachers who were best able to communicate their science pedagogy and practice.

One of the most striking features of coteaching that is the most difficult to support with evidence, is the increasing democratisation of teaching observed in the classroom. Coteaching student teachers have much more agency – one described herself as a ‘much more legitimate participant’ in the classroom than when she was ‘taking the teacher’s classes’. Classroom teachers became learners as well as teachers. The children were also encouraged to participate more in the lessons and many opportunities were given for them to act as coteachers. Finally, from the perspective of a university teacher educator, developing more equal relationships with student teachers is one of the most rewarding experiences. When we went into classrooms, we were invited to assist with the teaching (usually working with groups or individuals), as opposed to sitting, observing and writing about the student teacher’s performance. We were also given the opportunity to teach, which is another bonus of coteaching.

Coteaching promotes a more democratic approach to teacher education and classroom teaching which, we feel, is the way forward for the successful preparation of teachers in the twenty-first century.

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