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ABSTRACT

This paper describes findings from the Science Students in Primary School (SSIPS) project in which undergraduate science specialist student teachers were placed in primary schools where they "co-taught" investigative science and technology lessons with primary teachers. Students and teachers planned, taught and evaluated science lessons together. Almost six months after the student placement, a survey of children's attitudes to school science revealed that these children enjoyed science lessons more, and showed fewer gender or age differences in their attitudes to science than children who had not been involved in the project. Confidence audits completed by student teachers before and after the project indicated significant increases in confidence in many aspects of science teaching. The authors discuss how this model of collaborative planning, teaching and evaluation can both enhance initial teacher education and improve children's experience of science. (Author)

The Impact of Co-teaching between Science Student Teachers and Primary Classroom Teachers on Children's Enjoyment and Learning of Science and Student Teacher Confidence

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Abstract: This paper describes findings from the Science Students in Primary Schools (SSIPS) project in which undergraduate science specialist student teachers were placed in primary schools where they 'co-taught' investigative science and technology lessons with primary teachers. Students and teachers planned, taught and evaluated science lessons together. Almost six months after the student placement, a survey of children's attitudes to school science revealed that these children enjoyed science lessons more, and showed fewer gender or age differences in their attitudes to science than children who had not been involved in the project. Confidence audits completed by student teachers before and after the project indicated significant increases in confidence in many aspects of science teaching. The authors discuss how this model of collaborative planning, teaching and evaluation can both enhance initial teacher education and improve children's experience of science.

Introduction

The Science Students in Primary Schools (SSIPS) project was set up to evaluate the contribution of pre-service primary (elementary) science specialist student teachers towards the enhancement of science and technology classes for teachers and children. Third and fourth year undergraduate Bachelor of Education (BEd) science students worked alongside class teachers in the planning, teaching and evaluation of science and technology lessons as part of their' science methods' course. The methods course is designed to include preparation for taking on the role of 'science co-ordinator' in the primary school. The project team obtained funding to pilot the scheme, which provided schools with equipment, teacher cover and support workshops organised by science teacher educators and science advisers. Three initial teacher education institutions (ITEs) and a group of science advisers worked with the project schools.

The objectives of the study were to improve the pupils' experience and enjoyment of science, increase the confidence and expertise of the student teachers, improve teachers' knowledge of science, technology, and of science and technology pedagogy and to link the theory and practice of primary science teaching.

This study is the first systematic investigation of the effect of collaborative teaching by primary student teachers (science specialists) and classroom teachers on children's enjoyment of science. The authors strongly believe that the inclusion of a specialized school placement, in which students co-teach their main subject with the classroom teachers, is a development which could enhance all primary teacher education programmes.

The SSIPS project focused on developing both students' and teachers' skills in planning, teaching and evaluating practical, investigative science and technology lessons. There is an international push to make science lessons more practical. Atkin (1998) described the findings from the OECD study of innovations in science, mathematics and technology education and reported that the clearest trend which emerged from the 23 case studies (carried out in 13 countries) was that science and mathematics lessons were becoming more practical. In addition, there was a move to make the content of science lessons more relevant to the lives of the learners. Atkin (1998) stressed that the critical point determining the success or failure of innovations is the classroom interaction between teachers and pupils. The SSIPS project aimed to enhance such interaction by improving teacher confidence in all aspects of science and technology teaching. James et al (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. In the SSIPS project there was a deliberate attempt to embrace the professionalism of both student and classroom teachers. Both groups were involved in the design of research instruments, data collection, on-going critique and modification of different aspects of the project and dissemination of the findings.

With the increased involvement of schools in initial teacher education, there has been some, though not substantial, research interest in the contribution that student teachers can make to developments within their placement schools. For example, the work of Lee and Wilkes (1999) in primary schools in England reveals that, in certain circumstances, students can make a positive impact in their placement schools. Lavoie and Roth (2001, p3) observed, however, that student teachers rarely (if ever) get to work side by side with an experienced teacher - they normally observe someone teaching or teach alone. Roth (2001, p15) described his concept of *co-teaching* between novice and experienced teachers in which the novices *'experience the classroom at the elbow of another practitioner and thereby develop a sense of the practice through the eyes of the other.'* Unlike the model described by Roth (2001), however, students in the SSIPS acted as *equal* partners in the process. There was no mentoring or assessment of the students' teaching by the teacher, nor by their college tutors.

There has been much interest in the observed decline in children's interest in science whilst they are still at primary school. Murphy and Beggs (2002) reported significant differences in the attitudes of younger (8-9 year old) and older (10-11 year old) children towards school science. Younger children were more positive about science in general and about almost all of the areas of the science curriculum. There were also differences between girls and boys. Girls were slightly more positive than boys about science lessons generally, and about some life science topics in particular. Boys were more positive than girls about some of the physical science topics.

The attitudes of the children involved in the SSIPS project towards school science were examined for this study in order to determine whether there was any noticeable difference as a result of the classroom innovations facilitated by the project.

Design and Procedures

The project involved three phases. Phase 1 was the school placements. It was hoped that the students' science expertise may be of benefit to the teachers and that the teachers' expertise in all aspects of teaching children would provide invaluable help and guidance to the students. The emphasis of the work done with the children was on science and technology investigations involving as much experimentation as was practicable. Students and teachers completed reflective journals during the placements in which they recorded the relative successes of different aspects of their experience.

Phase 2 involved focused workshops provided by the university science staff and the science advisers. Teachers selected areas to be covered in the workshops. The idea was to capitalise on the work teachers had carried out with the students and to provide specific support which could assist teachers in Phase 3. The third phase involved the schools reflecting on their science provision at a whole school level and, using the experience from the interventions, modifying and enhancing their science schemes.

Students completed a confidence audit (adapted from Harlen 1995) at the start and after the end of the placement. Data from the audit was supplemented with that from interviews and from comments in reflective journals which students completed during the school placements.

Approximately 250 children in Key Stage two classes (8 to 11 years old) who had taken part in the SSIPS project completed a short questionnaire six months after the student placements had ended. The findings were compared with those from a large group of children who completed the same questionnaire (apart from the free response area at the end) approximately nine months prior to the start of the SSIPS project (Murphy and Beggs 2003a). The first part of the questionnaire contained questions designed to collect data relating to factors which may have some influence on pupils' attitudes towards science, such as age, gender, the help pupils received with their science homework, and the extent to which they watched science and nature programmes on television.

The attitude items were largely adapted from a survey of attitudes towards ICT, which had been completed by primary schoolchildren (Murphy and Beggs 2003b). A pilot version with 119 ten to eleven year-olds in schools not included in either main survey was carried out. Exploratory factor analysis (using principal components analysis followed by a varimax rotation, deriving the number of factors from the scree plot and including only factor loadings higher then 0.3) of the attitude items from the pilot survey confirmed three factors that accounted for 35% of the total variance. These factors were named as *enjoyment of science, appreciation of the importance of science* and *perceived ability to do science.*

The children were asked to indicate their response to the attitude items on a simple 3-point scale ('yes', 'not sure' or 'no') and to each science topic by ticking 'like or 'don't like'. Pupils (at the discretion of the class teacher) then completed the free response area, in which the SSIPS-participant children were asked to write about something they remembered from the lessons in which the student was present.

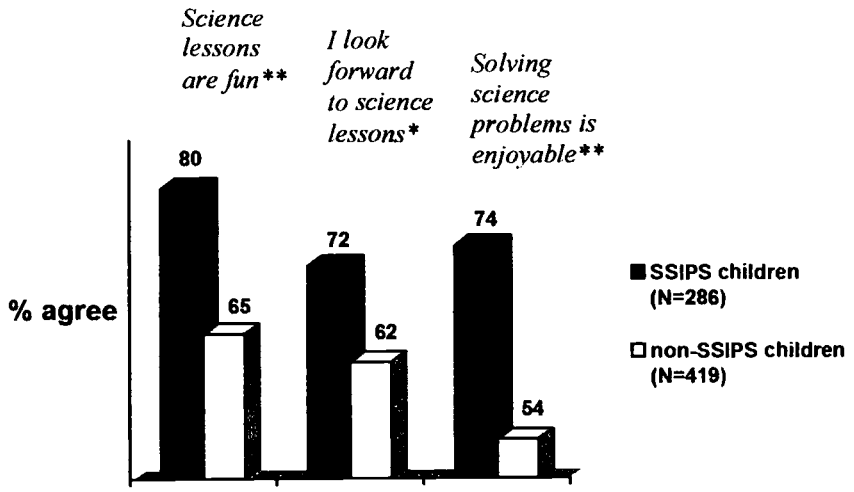
The response to the attitude items and science topics was tested for reliability using an internal consistency method (Cronbach's alpha coefficient, [Cronbach, 1990]), which yielded a reliability coefficient of 0.7999. This was considered equal to the 0.8 criterion which is regarded as internally reliable.

Estimates of concurrent validity were measured using Pearson's product moment correlation coefficient. Highly significant positive correlations were observed between positive science attitudes, enjoyment of science, and appreciation of the importance of science.

Findings

Children who were involved in the SSIPS project were significantly more positive about their science lessons. The chart in Figure 1 represents the percentage of children in each group who agreed with the statements indicated. The significance of the difference between the mean response of all children in each group was calculated using t-tests (assuming unequal variance) and is indicated by the asterisks. The difference could have resulted from the work carried out while students were in the classroom. However, since the survey was carried out almost six months after the placement, it is more likely that there has been a longer-term effect. This could be explained by the teacher's increased level of confidence in investigative science and technology teaching as a result of a combination of the student placement and the other interventions.

Figure 1 Relative enjoyment of science lessons



* denotes that the difference between the mean responses was significant at $p < 0.05$

** denotes that the difference between the mean responses was significant at $p < 0.01$

Comments from the teacher and student journals and interviews also reflected children's enjoyment of the experience. Most students linked the children's enjoyment with their progress in science, for example:

'... *they loved the practicals, it added to their enjoyment ... they listen more and take more in. We tested them through questioning at the end - they all seemed to take it in a lot better than previous classes I have taught who haven't had as much practical work.* '

There was much evidence from the children's free responses in the questionnaires that six months after the students had been in school, many children were able to recall specific aspects of their learning in both content and experimental areas.

These findings imply that the work carried out by children in science lessons that focused clearly on investigative science was more enjoyable and enhanced their science knowledge and skills. Both the student and class teacher gained in confidence as a result of this experience, leading to a higher level of enjoyment of science by primary children.

There were fewer differences between girls' and boys' preferences for different science topics in the classes who had been involved in the SSIPS project. There was a positive shift in girls' enjoyment of physical science topics as a result of the interventions (Table 1). 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 teacher (mostly female) teaching science as investigations appears to have significantly increased girls' liking for the physical science topics.

Table 1 Gender preferences for different science topics

Topic	Non-SSIPS project children (mean response)			SSIPS project children (mean response)		
	Girls (N=480)	Boys (N=481)	p	Girls (N=172)	Boys (N=114)	p
			'biology-related' topics			
Ourselves	2.79	2.67	**g	2.80	2.54	*g
Health education	2.76	2.58	**g	2.72	2.54	-
Animals	2.79	2.76	-	2.82	2.70	-
Plants	2.51	2.37	*g	2.56	2.44	-
Life – cycles	2.48	2.49	-	2.56	2.19	**g
			'chemistry-related' topics			
Materials	2.50	2.35	*g	2.52	2.44	-
Solids, liquids and gases	2.42	2.49	-	2.55	2.54	-
Water cycle	2.39	2.35	-	2.37	2.46	-
Rusting	2.04	2.09	-	2.14	2.10	-
Environment	2.65	2.58	-	2.56	2.46	-
Recycling	2.61	2.52	-	2.67	2.58	-
			'physics-related' topics			
Forces	2.30	2.53	**b	2.36	2.41	-
Electricity	2.60	2.73	*b	2.72	2.74	-
Energy	2.63	2.67	-	2.68	2.67	-
Sound	2.62	2.62	-	2.68	2.46	-
Light	2.67	2.67	-	2.60	2.54	-

* denotes that the difference between the mean responses was significant at $p < 0.05$

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When children from the SSIPS project classes were compared with those who had not been involved in the project, the older (10-11 year old) 'SSIPS' children showed much less of a decline in enjoyment of science. For example, younger children in the non-SSIPS group showed a significantly more positive response than older ones to 12 out of the 16 topics listed, whereas younger children in the SSIPS group only gave significantly more positive responses than older children to 4 out of the 16 topics (Table 2).

Table 2 Popularity of different science topics by younger and older children

Topic	Non-SSIPS project children (mean response)			SSIPS project children (mean response)		
	8-9 years (N=556)	10-11 years (N=419)	p	8-9 years (N=86)	10-11 years (N=200)	p
	'biology-related' topics					
Ourselves	2.76	2.70	-	2.84	2.63	*y
Health education	2.75	2.57	**y	2.84	2.56	*y
Animals	2.83	2.71	**y	2.72	2.80	-
Plants	2.56	2.27	**y	2.47	2.53	-
Life – cycles	2.62	2.30	**y	2.47	2.39	-
	'chemistry-related' topics					
Materials	2.52	2.29	**y	2.74	2.39	*y
Solids, liquids and gases	2.46	2.45	-	2.54	2.55	-
Water cycle	2.60	2.10	**y	2.51	2.36	-
Rusting	2.12	2.00	-	2.14	2.12	-
Environment	2.71	2.48	**y	2.55	2.51	-
Recycling	2.69	2.39	**y	2.74	2.59	-
	'physics-related' topics					
Forces	2.50	2.30	**y	2.36	2.40	-
Electricity	2.66	2.68	-	2.74	2.72	-
Energy	2.72	2.55	**y	2.71	2.66	-
Sound	2.69	2.41	**y	2.72	2.54	-
Light	2.74	2.55	**y	2.62	2.56	-

* denotes that the difference between the mean responses was significant at $p < 0.05$

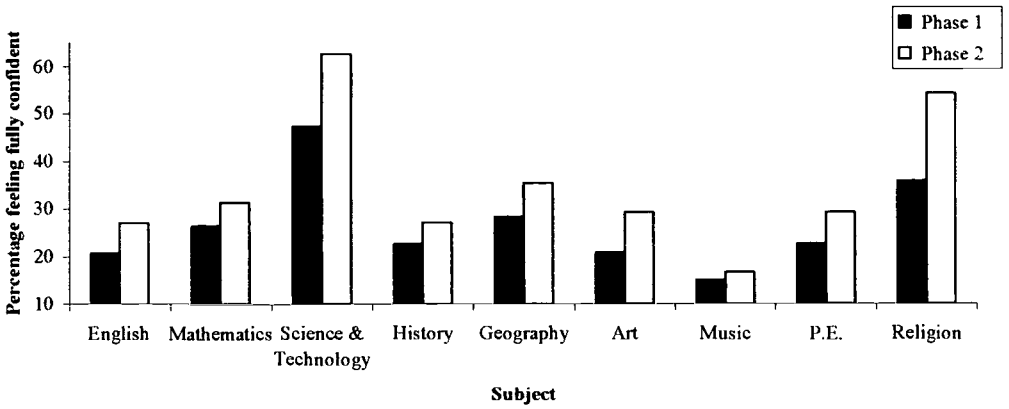
** denotes that the difference between the mean responses was significant at $p < 0.01$

The results imply that the older children in the SSIPS project may be experiencing less of a decline in interest in school science than children who were not involved. Murphy and Beggs (2003a) suggested three reasons which explained why children in the more senior years of primary school may' go off science, namely lack of experimental work, the content-driven curriculum and the way children prepare for national tests. Since the SSIPS project emphasized

the teaching of practical and investigative science and technology, it would appear that increasing the amount and quality of experimental science could lead to a reduction in the decline in children's interest in science in their more senior years in the primary school.

Students reported in the interviews that they felt much more confident going into their full-time placement as a result of their school-based work for the SSIPS project. The data in Figure 2 indicates that the increase in confidence was felt across all subject areas (phase 1 relates to the first audit at the start of the project and phase 2 refers to data from the second audit after the end of the project placement). These results indicate that although the students were concentrating on developing science they 'grew' in overall teaching confidence as a consequence of planning, teaching and evaluating lessons as a 'team' with the classroom teacher.

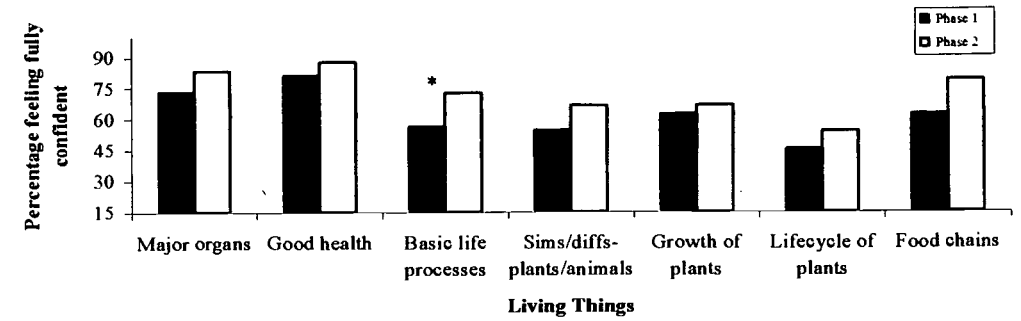
Figure 2: Science student teacher confidence in teaching subjects of the primary curriculum

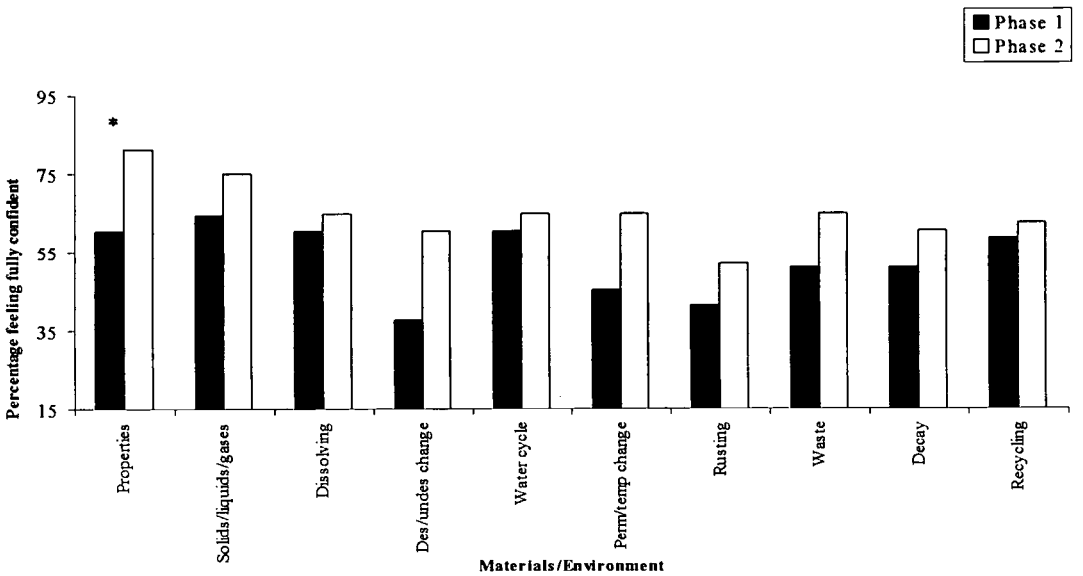


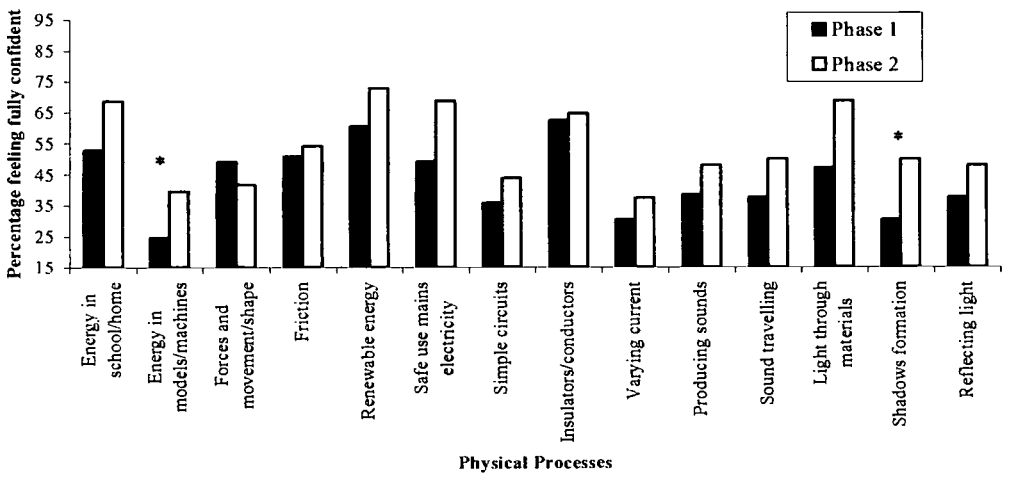
Key: Phase I = start of project; Phase 2 = after project school placement

The change in students' confidence in their knowledge to develop children's understanding in various areas of science in phases 1 and 2 is illustrated in Figure 3. In most areas there is an increase in the proportion of students feeling 'fully confident'. In some cases, the difference in confidence between phases 1 and 2 (as measured by t-tests of the mean confidence levels) is statistically significant. These areas were: basic life processes, properties of materials, energy in models and machine~ .and shadow formation. It is interesting to note that the percentage of students feeling fully confident to teach the area of forces in relation to movement and shape of objects actually decreased. The decrease could be explained in terms of the necessity for students to teach *investigative* science and the consequent challenge to familiarise themselves more fully with some quite difficult concepts in order to facilitate children's learning in this area.

Figure 3: Science student teacher confidence in their knowledge to develop children's understanding in different areas of science





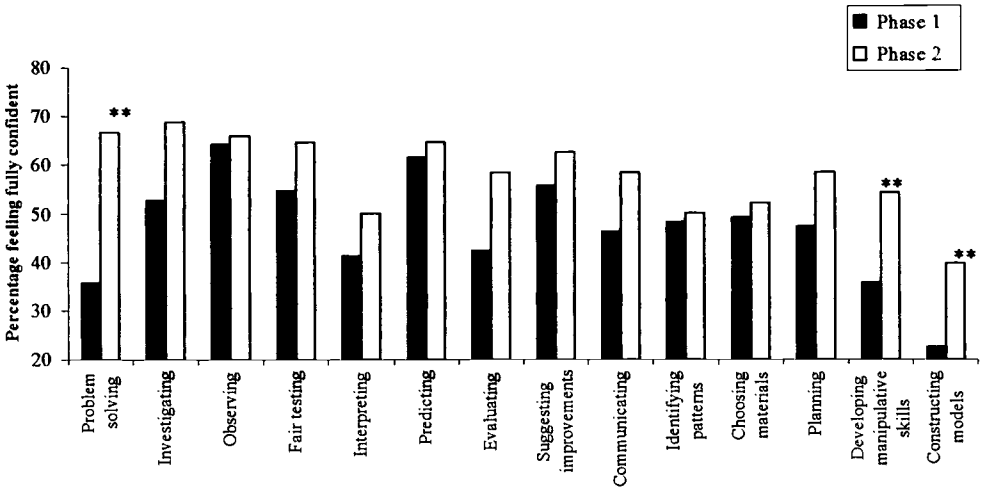


*denotes that the difference between the mean responses was significant at $p < 0.05$

The data in Figure 4 presents the difference in student confidence in developing children's science skills. There is a trend showing a higher proportion of students who are fully confident in all areas following the placement.

Three of the areas also showed a highly significant difference in the mean response, namely: problem-solving, developing manipulative skills and constructing models. This was a highly gratifying finding inasmuch as developing children's problem-solving skills and ensuring that students integrated the teaching of technology into their programmes were areas they strongly encouraged to address!

Figure 4: Science student teacher confidence in aspects of developing children's science skills



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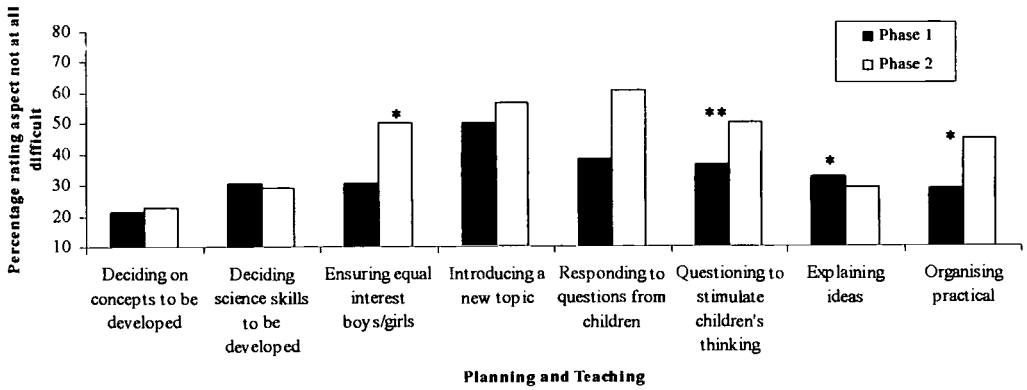
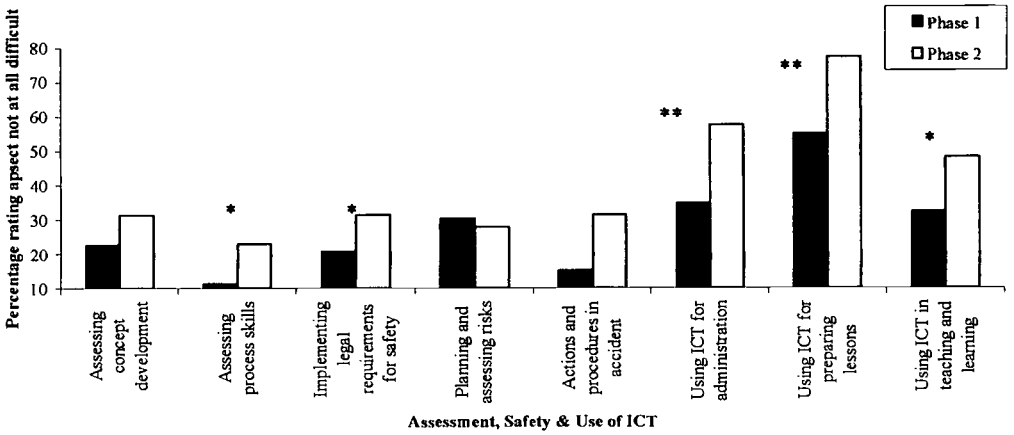
Students' confidence levels in other pedagogical areas are recorded in Figure 5. The data for planning and teaching indicates that there is significant improvement I in the students' confidence to ensure equal interest of girls and boys. This is also reflected in the results from the children's survey (Table 1) which shows that there are fewer gender preferences for different science topics among children who took part in the SSIPS project than amongst non-project children. Other areas that showed significant differences in the mean responses between phases 1 and 2 were: questioning to stimulate children's thinking, explaining ideas and organising practical classes. The chart which presents the findings for assessment, safety and use of ICT shows some improvement in student confidence in all aspects, and significant improvement in assessing process skills and using ICT. It is important, however, to note that although there was a significant increase (at $p<0.05$) in student confidence to use ICT in the classroom, the confidence to use ICT for teaching and learning is not as high as in using ICT for administration and preparation. Much research carried out with students and teachers indicates that use of ICT in the classroom lags way behind its use for administration and preparation (for example, see Murphy and Greenwood 1998).

Figure 5: Science student teacher perceptions of pedagogical issues





*denotes that the difference between the mean responses was significant at $p < 0.05$

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Conclusion

The overall findings from this study imply that the work carried out by children in science lessons which involved a science student teacher co-teaching with the classroom teacher, both focusing clearly on investigative science, was more enjoyable for pupils and enhanced their science knowledge and skills. In addition, the qualitative evidence from students demonstrates significant confidence development as a result of working as equal partners with teachers in the classroom. Data collection and initial analysis of the first cohort of teachers also evidences improvement in teachers' confidence (unpublished).

We suggest that the increased enjoyment and learning in science evidenced by children who participated in the SSIPS project is the result of a combination of two elements. Firstly, the co-teaching of science and technology by science specialist students and classroom teachers and secondly, the focus

on investigative science teaching. These two elements are interdependent since many teachers have great difficulty with the teaching of investigative science. The students in this model appear to have acted as "catalysts" in the classroom, providing a lasting positive influence on the teaching and learning of science, although unlike catalysts in many chemical reactions, the students did not remain unchanged by the experience - their own confidence levels indicated measurable increases in many aspects of science teaching.

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References

Atkin, J.M. (1998) The OECD study of innovations in science, mathematics and technology education. *Journal of Curriculum Studies,* 30 (6), 647-660

Cronbach, L. J. (1990) *Essentials of Psychological Testing.* New York: Harper & Row.

Harlen, W., Holroyd, C and Byrne, M (1995) *Confidence and Understanding in Teaching Science and Technology.* Edinburgh: Scottish Council for Research in Education

James, E., Eijkelhof, H., Gaskell, J., Olson, J., Raizen, S. and Saez, M. (1997) *Journal of Curriculum Studies* **29** (4), 471-483

Lavoie, D.R., and Roth, W.-M. (2001) *Models of Science Teacher Preparation: Theory into Practice*, London, Kluwer Academic Publications

Lee, S and Wilkes, J (1999) In what ways do student teachers contribute to teaching and learning in the classroom? Views from some schools in England. *Teacher Development* **3** (2) 249-261

Murphy, C and Greenwood, L (1998) Effective Integration of Communication and Information Technology in Teacher Education. *Journal of Information Technology in Teacher Education*, 7 (3) 413-429

Murphy, C. and Beggs, J. (2003a) Children's perceptions of school science. *School Science Review, in press*

Murphy, C. and Beggs, J (2003b) Primary pupils' and teachers' use of computers at home and school. *British Journal of Educational Technology*, **34,** 1,79-83

Roth, W.-M. (2001) Becoming-in-the-Classroom: Learning to teach in/as praxis, in: Lavoie, D.R., and Roth, W.-M. (2001) *Models of Science Teacher Preparation: Theory into Practice,* London, Kluwer Academic Publications

Wilson, E. (2000) Learning Concepts, in: Warwick, P and Linfield, R.S. *Science 3- 13: The past, the present and possible futures*, London, Falmer

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