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ABSTRACT

This paper is a progress report on an ongoing, longitudinal study of the preparation of preservice elementary teachers in science. The study builds on previous work and explores the experiences of an intake of preservice students in 1994. These students were required to take a core course in science content in their foundation and subsequently a science education course in the third year of their four-year program of study for a bachelor of education. The courses were deigned and implemented using strategies influenced by constructivist principles. These included, among other features, attempts to establish a community of learners in which collaborative knowledge building, meaningful learning, and autonomy were emphasized. The experiences of the students were monitored by measures of changes in attitude towards science and personal science teaching self-efficacy, through interviews, and analysis of student writing. The study revealed complex relationships between content oriented and methods oriented courses indicating that students' attitudes and beliefs change in relation to their perceived needs. The methods course was particularly successful at improving attitudes towards teaching science but had minimal impact in this instance on self-efficacy. In contrast, the foundation course had no immediate impact on attitudes, but did enhance self-efficacy and was valued by students during curriculum design activities in the subsequent methods course. (Contains 54 references.) (Author/ND)

Impact of course and program design features on the preparation of preservice elementary science teachers

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Abstract

This paper is a progress report on an on-going, longitudinal study of the preparation of preservice elementary teachers in science. The study builds on previous work and explores the experiences of an intake of preservice students in 1994. These students were required to undertake a core course in science content in their foundation and subsequently a science education course in the third year of their four year program of study for a bachelor of education. The courses were designed and implemented using strategies influenced by constructivist principles. These included among other features, attempts to establish a community of learners in which collaborative knowledge building, meaningful learning and autonomy were emphasised. The experiences of the students were monitored by measures of changes in attitudes towards science and personal science teaching self-efficacy, through interviews, and analysis of student writing. The study reveals complex relationships between content oriented and methods oriented courses which indicate that student's attitudes and beliefs change in relation to their perceived needs. The methods course was particularly successful at improving attitudes towards teaching science but had minimal impact in this instance on self-efficacy. In contrast the foundation course had no immediate impact on attitudes, did enhance self-efficacy but was valued by students during curriculum design activities in the subsequent methods course.

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Background and significance

The state of science education in elementary schools and the competence of elementary science teachers have been under intense scrutiny, both nationally and internationally, for a number of years (Tilgner, 1990; Claxton, 1992, Department of Education Employment and Training — DEET, 1989). Concern has been expressed continually about the low level of science teaching activity, the science knowledge base of elementary school teachers (Ginns & Watters, 1995; Hurd, 1982), the quality of instruction in science in elementary schools, and the associated preservice preparation of teachers. Arguments supporting the need for science education have been based on the desire to develop in children the skills and knowledge required to empower them in a technological society (Fensham, 1994). But an additional concern is that as a society we are facing a "crisis" significantly more urgent than that perceived in the 1950s which gave such impetus to curriculum development in science. We are entering a new century when population, resources, economic and social concerns will reach a critical point. Our challenge is to make science education meaningful and useful for children of today in order that they can, as Rutherford and Ahlgren argue (1990):

> ...develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to face life head on. It should equip them also to participate thoughtfully with fellow citizens in building and protecting a society that is open, decent and vital (p. v).

To achieve this laudable situation we need confident, reflective and creative teachers who are committed to these goals. Teachers who graduate from preservice programs with a lack of interest in science and who are not confident in their ability in science are ultimately reticent to teach science in elementary schools. Hence, the teaching of science is spasmodic and prescriptive and is not building on children's interests and empowering them as scientifically literate contributors to society. One of the major outcomes of concerns about teaching science in elementary schools is the production of new science curricular, national standards and visionary statements (Curriculum Corporation, 1994; Department of Education and Science, 1991; National Research Council, 1996; National Science Teachers Association, 1995). The reform of teaching science embodied in these documents needs to be pre-empted by or occur concurrently with, reform in the teaching of science in preservice tertiary institutions (Shroyer, Wright, & Ramey-Gassert, 1996). It can hardly be expected that teachers of science will teach in any way other than they themselves were taught (Calderhead & Robson, 1991) and indeed it has been asserted that little professional growth occurs among preservice teachers (Kagan, 1992). Reports on the preparation of teachers advocate enhanced content courses, a strategy that may be problematic, if the focus in these courses is on the traditional view of science as a body of acquired knowledge. Such a belief is contrary to our current thoughts about how people come to an understanding of science that goes beyond rote memory. It is these issues that may play a more important role in the motivation of teachers to engage in worthwhile science teaching. Indeed, at the core of anxiety about teaching science by many preservice teachers is the perception that science is a body of irrelevant facts and has no personal relevance for most people (Kahle, Anderson & Damjanovic, 1991; Manning, Esler & Baird, 1982; Mechling, Stedman & Donnellan, 1982; Watters & Ginns, 1995). However, preservice science subjects implemented with a focus on science as a meaningful and relevant social endeavour, and which espouse constructivist principles, can impact positively on students' science teaching self-efficacy (Watters, Ginns, Enochs, & Asoko, 1995). However, Skamp (1995) has shown that preservice programs impact on different students in different ways and that practicum experiences play a relatively important role in student teachers' conceptualization of good science teaching. Clearly, personal histories are important factors that need to be accounted for in the design and implementation of preservice courses.

Most young children are naturally curious and interested in their surroundings and in making sense of the world they live in. However, many preservice teachers have, in their own education, experienced poor science teaching and have thus lost this drive and indeed have become suspicious, disinterested and reluctant to engage in science teaching. The range of theoretical perspectives that have developed in recent years and which should have major implications for the way science is taught and classroom interactions structured have yet to have any major impact. For example, constructivist philosophies and co-operative learning are influencing the curriculum resources being produced world wide but the implementation of these strategies is slow (Tobin, Tippins, & Hook, 1993). Many undergraduate students have experienced very different styles of science instruction in their own schooling which in most cases was didactic. Thus we see in undergraduate students negative attitudes towards science, a lack of experience in working scientifically, inadequate or limited substantive knowledge of science, and inappropriate epistemologies of science, and even overt resistance to new teaching strategies. Hence, there is a critical need to identify and establish the significance of factors, which will prepare and motivate preservice students to teach science in elementary schools.

The major focus of this study was to determine the personal and contextual elements that may influence change in students' beliefs during a preservice program and examine the outcomes for possible effects on students' motivation and commitment towards teaching science in elementary schools.

Context and Objectives of the study

This study follows the progression of a cohort of preservice elementary teachers during the early part of their preservice education program. During the period of the study the students studied two core science courses. The first course involved a science discipline-oriented course undertaken in Semester 1 of their program. The second course was a science methods course undertaken during Semester 5 of the four year program. Both courses were undertaken within the same faculty and both coordinated by the researchers. Details of the interventions will be described in the methods section of this paper.

The study was part of ongoing action research aimed at improving tertiary teaching methods that would enhance students attitudes, skills and knowledge in teaching science effectively in schools. The study occurred in a natural setting of preservice teacher education in an institution with an annual intake of approximately 150 students. Preceding the events reported in this study were explorations of a range of strategies that informed the understanding of the researchers as to the salient factors influencing student teachers attempting to understand their course program. Specifically the objectives of this phase of the study were: (1) to monitor changes in preservice elementary teachers' (a) beliefs about their ability to teach science and (b) science related attitudes during their preservice training; (2) to identify course and program design features that may be associated with changes in these beliefs and attitudes; and (3) to analyze the data for implications for teacher education programs.

Theoretical perspectives

The strategies adopted to achieve these objectives were informed by a number of theoretical perspectives. At a macro level individual instructors' practices were grounded in their own implicit theories of action. Five instructors (three male and two female) were involved in teaching this subject. Their theoretical perspectives, personalities and experience varied widely. Although regular team meetings were held, teaching strategies did vary from group to group. In the second intervention the structure of the course allowed a coherent strategy based on constructivist philosophies and processes of knowledge construction congruent with these philosophies. Given this constraint the documentation, tasks and philosophy of the program influenced the establishment of a common instructional design.

The instructional design adopted for the science content course and the science method course drew upon four areas of research: (a) the role of learning environments that are conducive to the development of autonomy (b) the establishment of community of learners (c), the development of a sense of confidence in teachers' abilities to teach science and (d) the effect of epistemological beliefs about the nature of science and teaching practice.

The learning environment

Research on learning environments is extensive. However, that conducted by Taylor, Fraser and White (1994) on the socio-cultural forces shaping the high school science classroom from a critical theory perspective provided the necessary guidance for us in establishing the teaching context. Factors identified by Taylor et al. as important elements of such an environment included: (a) making science seem personally relevant to the outside world; (b) engaging students in reflective negotiations with each other; (c) instructors inviting students to share control of the design, management, and evaluation of their learning; (d) students being empowered to express critical concern about the quality of teaching and learning activities; and (e) students experiencing the uncertain nature of scientific knowledge.

Community of learners

In effect, the teacher should foster the development of a community of learners (Bereiter, 1994) and employ strategies designed to facilitate knowledge construction (Collins, Brown, & Newman, 1989). A learning environment of this nature would thus be distinguished by certain recognisable features. The degree of discourse and collaboration in generating conditions for a community of learners would appear paramount. Thus group work adopted in workshops was designed to encourage genuine collaboration. The effectiveness of group work is supported by the research of Qin, Johnson, & Johnson (1995), Slavin, (1991) and Roth and Roychoudhury (1993) when students engage genuinely in co-operative activities. Such activities should encourage deep learning where students take an active approach to learning and seek personal relevance or meaning in the material, and a questioning and challenging attitude to learning (Marton & Saljo, 1976). That is, discourse is limited to technical assistance such as organising the equipment or being prepared to report on individually completed work. The effectiveness of group work has been highlighted by Linn and Burbules (1993) who identified key issues mitigating against successful group work that included the social structure of the groups, the goals of individual learners, and the diverse nature of knowledge construction.

Development of attitudes

Attitudes towards and beliefs about teaching science were concerns in this study. The importance of attitudes has been highlighted in other studies; attitudes are relatively stable, attitudes are learned and; attitudes are related to behaviour (Koballa, 1988; Shrigley, Koballa, & Simpson, 1988). Attitudes are influenced by beliefs, hence research into personal and teaching efficacy will be important for developing an understanding of the relationship between attitude to science and the teaching of science. The construct of self-efficacy provides a framework for interpreting the complementary relationships between attitudes, beliefs and behaviour (Bandura, 1977, 1986). According to this theory behaviour is based on two factors, firstly, people develop a generalized expectancy about action-outcome contingencies through life experiences, or outcome expectancy and, secondly they develop a more personal belief about their own ability to cope, or self-efficacy. In cases where both self-efficacy and outcome expectancies vary, behaviour can be predicted by considering both factors. For example, Bandura hypothesized that a person rating high on both factors would behave in an assured, confident manner.

Bandura's self-efficacy model has provided many significant insights into the general behaviour of teachers (Ashton & Webb, 1986; Dembo & Gibson, 1985; Greenwood, Olejnik & Parkay, 1990). In the domain specific area of science, Enochs and Riggs (1990) have developed and validated the Science Teaching Efficacy Belief Instrument (STEBI-B) for preservice elementary teachers in the United States. The two scales that emerged in STEBI-B were labeled Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). STEBI-B has also been validated on a population of Australian preservice elementary school teachers (Ginns, Watters, Tulip, & Lucas, 1993). In addition, Lucas et al. found that personal science teaching efficacy was correlated with a student's stated preference to, or not to teach science. Watters and Ginns (1994, 1995) have generated tentative assertions linking preservice teachers' science teaching self-efficacy to prior school experiences, their perceptions of excitement and joy in learning science, and engagement in a constructivist learning environment. It is apparent from these previous studies that potentially poor science teaching behaviors may be already established at an early stage in students' preservice careers, however, self-efficacy may not fully explain preservice teachers' motivation to teach science.

Epistemology and beliefs about the nature of science

Knowledge about science is just as important in developing scientific literacy as is knowledge of science. It is claimed that teachers have poor understandings of the inter-relationships between science, society and technological development (Rubba, & Harkness, 1993). This is of concern as the research literature indicates that there is a possible link between teachers' views of scientific knowledge and their classroom practice (Duschl & Wright, 1989; Brickhouse, 1990). For example, Duschl and Wright (1989) found that high school science teachers gave little thought to the nature of the discipline from which teaching tasks were taken and gave little consideration to the nature and place of theories in making teaching and learning decisions. Brickhouse (1990), in a study of three middle school teachers, observed that their beliefs about the nature of science were represented in the way they planned and taught science. Brickhouse and Bodner (1992) noted a conflict between a beginning teacher's view of science as an informal, often anarchistic endeavour and his or her views that children in the classroom need to be presented knowledge in a structured format. A primary school teacher's beliefs about science, reflected in her desire that children should get the "right answer," inhibited her acceptance of change from a content-oriented, textbook based science program to a hands-on problem solving approach (Martens, 1992).

Methods and procedures

Design

The study reported here is part of on-going research on the preservice preparation of teachers and their subsequent induction into practice. This research program is envisaged as action research. Carr and Kemmis (1986) believe that three conditions are necessary to identify a project as action research. Firstly, the subject matter must be a social practice susceptible to improvement; secondly, the project must proceed through a spiral of cycles of planning, action, observing and reflecting; and thirdly, the project should involve the practitioners and widen its audience so others may benefit from their experience. This study can be conceptualized as a cycle of action, observation and reflection.

Methods

The research project is multi-method involving the use of quantitative and qualitative data in a longitudinal study. Quantitative data were obtained through a pretest posttest design, while rich descriptions of selected subjects have been acquired through interviews, field notes, analysis of student reflective writing and observations. The phase of the study reported here commenced in 1994.

Subjects

The subjects were 164 students enrolled in a four year elementary teacher education program. Individual quantitative measures are reported for smaller samples where complete data were collected. Over the duration of the study a number of students left the course while some joined from other institutions.

Procedures

Quantitative data. The following psychometric instruments have been used in the study:

- a measure of students' sense of self-efficacy - Science Teaching Efficacy Belief Instrument (STEBI-B) (Enochs & Riggs, 1990);
- a measure of the students' desired learning environment - modified Constructivist Learning Environment Survey (CLES),
- a measure of science related attitudes - Test of Science Related Attitudes (TOSRA).

CLES is an instrument developed in a high school context which measures students perceptions of the classroom environment through six scales (Taylor, Fraser, & White, 1994). TOSRA measures attitudes to science in seven conceptually different areas (Table 1) and has been validated using high school children (Fraser, 1981). The points at which the three instruments were administered are shown in Table 1.

Qualitative data. The quantitative measures were complemented by a series of interviews of selected subjects and by an on-going analysis of the student journals. Interviews were semi-structured and designed to encourage each subject to focus on critical incidents that related to his or her learning of science in school. Subsequent interviews provided opportunities for subjects to reflect on their experiences in both science courses and other university courses completed so far and analyze the impact on their beliefs about their ability to teach science in the elementary school. Two members of the research team analyzed the interviews and alternative interpretations were reconciled by discussion. Field notes and data from course evaluation questionnaires were also collected.

Intervention

The intervention in this study can be described at two levels. All students undertook a science-discipline-oriented core course in the first semester of their preservice teacher education program and a science methods or curriculum course in the fifth semester. They also were engaged in a range of courses that exposed them to other discipline areas, to history and philosophy of education and to learning and development as well as practice teaching. Practice teaching for this cohort was not a major factor as the primary practicum experience did not occur until towards the end of semester 5 concurrent with the science methods course. The structure of each of the core science courses will be outlined.

Science content course — Semester 1

A science discipline-oriented or content course was implemented in the first semester of the program. The course comprised a series of lectures and practical workshops spread over a 14 week semester and was designed to address deficiencies in subjects' knowledge particularly in physical science. The one hour whole group lecture each week addressed a series of topics in science. The workshops of two hours duration provided students with opportunities to engage in practical exploration of ideas and phenomena discussed in lectures. Students were assigned to one of six different workshops each workshop being led by a different instructor. The teaching strategies adopted by each instructor reflected his or her own theories in action which were quite distinct. Despite the regular occurrence of teaching team meetings and student liaison committee meetings that provided ongoing feedback to the teaching staff, instructors approached the teaching from a range of perspectives. At one extreme, one instructor adopted a traditional didactic and Socratic model of teaching whereas another instructor espoused more humanitarian and critically constructivist perspectives. The choice of instructors and groups were pragmatic and determined by bureaucratic constraints of time tabling and staffing.

The communicated objectives of the science content course included an introduction to a range of content and processes:

1. describe the nature of scientific endeavour and apply these principles to scientific investigation;
2. demonstrate knowledge and understanding of significant scientific concepts;
3. demonstrate high level thinking and problem solving skills in significant science concept areas;
4. critically discuss the nature of science, the historical development of science and the relationship of science to society;
5. use and understand appropriate scientific language and understand its relationship to general literacy.

The content was organised in the form of key ideas, or themes, which were considered throughout the semester. The key ideas are described below:

a. Principles of scientific investigation.

b. Atomic theory, properties of matter; energy forms and energy transformations.

c. What is Science?

d. Science and Society.

e. Communication and writing in science.

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Assessment included a written assignment on the nature of science submitted mid semester, a written examination that was structured to test recall, understanding and problem solving and an on-going diary or journal covering workshop activities.

In the science content course our objective was to establish a learning environment that focused on providing opportunities for students to develop content knowledge that was perceived to be of relevance to the teaching of science at elementary level and which focused on areas that the students had least prior experience, namely the physical sciences. Strategies were also adopted that attempted to enhance student's level of self-efficacy. These strategies were influenced by the theories of constructivism and conceptual change and hence the key elements were built around collaborative group work, social learning, cognitive apprenticeship, and discourse. To support the development of self-efficacy students were provided with opportunities to experience success in authentic situations and to be persuaded that such behaviours were indicators of competent teacher practices. A deliberate strategy of co-operative group work was implemented. The students were encouraged to keep a journal and to analyse and reflect on their own learning and incidents of conceptual change that occurred.

Science methods intervention —Semester 5

The methods course was implemented through a lecture and workshop program similar in structure to the above course. A component of this course required students to apply their content and pedagogical knowledge with children. However, in this course workshops groups were larger and led by two instructors, one of whom was common to all workshops.

The objectives of the course included the following skills in students

1. an ability to analyse the theoretical bases of science curriculum development;

2. to be able to demonstrate an understanding of the development of children's science concepts, reasoning abilities, manipulative skills, and attitudes;

3. to be able to articulate the components of and provide a rationale for any worthwhile science program;

4. justify and apply or demonstrate how to apply appropriate instructional strategies including the management of the learning environment and selection of resources for the teaching of science.

Content

a. Bases of science curriculum design.
b. The essential elements of a science program.
c. Comparison of existing approaches to teaching science..
d. Conceptual development in Science and relationships with mathematics and language development.
e. Policies, resources and support for science education.

The assessment in this course included a child study in which the student explored the child's understanding of a concept in science and then developed a teaching program based on that concept. Other assessment included a final examination that covered major issues in science education and a reflective journal.

In implementing group work students were, as far as possible within the constraints of the workshop, provided with experiences that encouraged friendly, open discussion of concepts. For example, sufficient background knowledge was provided for various scientific concepts in the form of notes within a workshop manual. A preliminary short discussion was held in each workshop about the global aims of the workshop which involved both a content and a pedagogical focus. That is, the students in any particular workshop would revise, explore or attempt to understand a scientific concept as well as develop an understanding of the role of, say questioning, in teaching science. In all activities students were encouraged to maintain their diary or journal and to implement narrative reporting of their experiences with specific instructions to reflect on changes in their own views about teaching and learning during and after each the workshop. Within groups the students were encouraged to express their understandings of the concept and pool these understandings through the construction of, for example, group concept maps.

The processes adopted in the first phase of the assignment were to interview the child and to elicit the child's understanding of a concept. The students were expected to adopt a teaching strategy that then extended or revised the child's understanding of the concept. The assignment provided a meaningful and realistic task in which the students could demonstrate their own understanding of the pedagogical content of the course through an assessment process that was authentic but also they were able to identify conceptual understanding of scientific topics in children which often mirrored their own prior understandings or even current understandings but through discussion in groupwork and with the tutors came to realise were naïve.

Findings

Mean scores on STEBI-B, TOSRA and CLES for the group, at the respective administration points, are shown in Table 1. The outcomes of t-tests of significance between means for paired samples are also included in Table 1. The most statistically significant finding was the decrease in scores on the CLES instrument over the duration of the science content course. This finding is interpreted as a failure of the perceived learning environment to meet expectations of the students. In contrast, there were significant gains across all scales of CLES at the conclusion of the science methods course. The introduction of learning strategies that emphasised collaborative learning, the perceived relevance of the content of this course, and the engagement in meaningful tasks are clear differences between the two courses.

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Table 1

Mean Scores on STEBI-B, TOSRA and CLES at the administrative points indicated

TEST	SCALE	*n*	Semester 1 Start PRET (SD)	Semester 1 End POST1 (SD)	Semester 5 Start POST2 (SD)	Semester 5 End POST3 (SD)
STEBI-B	PSTE	45	46.0 (6.5)	48.0 (6.3)**	45.5 (5.5)$^{\#\#}$	46.4 (7.0)
	STOE	44	35.2 (4.2)	34.6 (4.7)	34.7 (5.0)	34.0 (5.0)
TOSRA	SIS - Social Implications	45	36.0 (4.3)	35.5 (5.5)		
	of Science	44		35.5 (5.6)	30.4 (1.6)$^{\#\#}$	
		21			30.7 (1.7)	37.2 (7.3)$^{@@}$
	NS - Normality of	45	34.6 (3.6)	36.2 (4.6)*		
	Scientists	43		36.4 (4.7)	31.6 (2.5)$^{\#\#}$	
		20			31.7 (2.0)	38.0 (5.5)$^{@@}$
	ASI - Attitude to	45	37.6 (4.8)	36.4 (6.1)		
	Scientific Inquiry	44		36.3 (6.2)	30.7 (2.5)$^{\#\#}$	
		21			30.8 (2.2)	38.0 (4.8)$^{@@}$
	ASA - Adoption of	45	37.9 (3.1)	37.1 (3.8)		
	Scientific Attitudes	44		37.1 (3.8)	29.9 (2.3)$^{\#\#}$	37.8 (4.4)$^{@@}$
		21			29.8 (2.2)	
	ESL - Enjoyment of	45	31.6 (6.1)	32.0 (6.5)		
	Science	44		31.9 (6.5)	27.9 (2.2)$^{\#\#}$	35.2 (5.4)$^{@@}$
		21			27.5 (2.4)	
	LIS - Leisure Interest in	45	27.0 (6.5)	26.0 (6.8)		
	Science	43		25.7 (6.8)	28.4 (2.4)$^{\#}$	
		21			28.5 (1.7)	28.8 (6.0)
	CIS - Career Interest in	45	28.3 (5.7)	27.0 (6.2)		
	Science	44		26.9 (6.2)	28.8 (2.6)$^{\#}$	
		21			28.8 (2.4)	30.0 (5.9)
CLES	PRS - Personal Relevance	45	23.69 (3.0)	20.9 (2.3)***		
	of Science	27		21.0 (2.1)		26.1 (2.7)$^{@@}$
	SUS - Scientific	45	22.0 (2.3)	20.8 (2.0) ***		
	Uncertainty Scale	27		20.1 (2.0)		23.7 (2.4)$^{@@}$
	CVS - Critical Voice	45	22.7 (3.4)	21.1 (3.3) ***		
	Scale	27		20.9 (2.9)		25.6 (2.4)$^{@@}$
	SCS - Shared Control	45	18.0 (4.1)	14.0 (3.2) ***		
	Scale	27		14.4 (3.5)		16.1 (4.1)$^{@}$
	SNS - Student	45	23.55 (2.7)	21.6 (2.6) ***		
	Negotiation Scale	27		21.0 (2.7)		26.2 (1.8)$^{@@}$
	AS - Attitude Scale	45	22.6 (2.6)	20.2 (3.5) ***		22.0 (4.2)
		25		20.2 (3.6)		

Note * or ** indicates significant differences between POST1 and PRET at .05 and .01 levels respectively
$^{\#}$ or $^{\#\#}$ indicates significant differences between POST2 and POST1 at .05 and .01 levels respectively
$^{@}$ or $^{@@}$ indicates significant differences between POST3 and POST2 at .05 and .01 levels respectively for TOSRA
$^{@}$ or $^{@@}$ indicate significant differences between POST3 and POST1 at .05 and .01 levels respectively for CLES
*** indicates significant differences between PRET and POST1 at 0.001 levels respectively.

Also evident in the quantitative data are interesting changes in attitudes as measured by TOSRA. During the science content course, attitudes were relatively stable but decreases in attitudes towards science between the conclusion of the science content course and the science methods course were large. The engagement in the methods course reversed this trend. Science teaching self efficacy increased in the science content course.

The qualitative data obtained during the science content course highlighted the difficulties students experience in coming to terms with a discipline area that they are unfamiliar with and anxious about. Delays in changes in attitudes may reflect more favorable experiences with other courses experienced in the intervening period or that the relevance and applicability of the subject matter of the science content course was not capitalized upon within a useful time frame. The latter scenario is the more likely as previous studies in which the courses were presented end on more positive changes are observed in self-efficacy (Watters, Ginns, Enochs & Asoko, 1995).

Implications of this research are that content and pedagogy need to be addressed in an inclusive or integrated strategy. This research is being extended to explore such a hypothesis

Whilst these quantitative measures provided a normative assessment of the developing attitudes, self-efficacy and perceptions of the learning environment, the qualitative data provided revealing insights into individual students' experiences.

An analysis of the interviews of the students in the science content course has been published, in part previously (Watters & Ginns, 1995). The reactions and experiences of the students during this phase of their program were frequently related to the particular group in which they were placed a factor acknowledged by one student, Michelle, when she responded:

> At university I found initially that lectures were boring but my views changed when I went into C's group. There you could say what you wanted to. Her group was not so formal and she encouraged us to present our own opinions. Laboratory was great fun but I did not always enjoy every experiment. It was the opportunity to discuss that was of benefit. As I said before, if you are not interested in the subject you won't listen. Also the structure of university lectures is not conducive to learning. People, like me, are too embarrassed to talk in front of 150 students. Nevertheless, lectures were still relevant. But I believe that it is hard to make things interesting especially with science.

Students were highly positive of the experiences of learning in the science education course and more forthcoming in their acknowledgment of their individual experiences and feelings about science. One student, writing in her journal, expressed an honest assessment of her position towards science. Her approach had changed significantly during the course. This student is unusual among preservice students as few have undertaken science in high school and been recognized achievers.

> I never cared for science much throughout my schooling years because of the language used and the experiments that were based around definitions and equations. I always succeeded to produce really good grades because our examinations were based on facts, so I just learnt all my text books in a rote-like fashion. Hence coming away from school with VHA's (very high achievement-highest grade) in biology and multistrand (general science) but nevertheless I was none the wiser. ... I regarded science as useless and definitely for boring geniuses.

However, the completion of a science content course, albeit rote learned, was apparently useful as we see from the comments below how a second student valued her previous study in this program. Furthermore, the acknowledgment of rote learning by is consistent with the CLES data that indicated the lack of success in establishing an appropriate environment that students perceived to be useful for them. The patterns of learning that had been adopted in school would appear to have been a dominating influence in maintaining a "rote learning" approach.

> These questions really got my brain working. I started to wish I had done more work in Science Foundations. Most of the theory underpinning these question was from science foundations. After discussing the questions in my group with guidance from our teacher (sic) the knowledge that I learnt from the earlier subject began coming back. I believe if I didn't have that knowledge foundation I would have found these questions a lot harder! I pulled out my science foundations workbook and it all seems to make more sense not, not like a foreign language as it once was.

The science education course relied heavily on activities that were posed as problems. For example, an activity in which students were asked to predict the effect of boiling potatoes rapidly or slowly on the cooker and then to do the activity created extensive interest and discussion. A number of students reported that they repeated the task several times at home to convince themselves of the outcomes. The role of group discussion and experience was seen to be of particular value, albeit the role of argumentation was not recognised:

> These types of questions would be good with higher primary students. I believe a discussion in groups should occur, first like we did in the tutorial. Then the students could test out their hypothesis (the potato question would be a good one). Being in a co-operative group is important where all students may have a say without being intimidated. Group discussion is useful as students can listen to other students' ideas and compare them with their own.

The importance of meaningful learning was seen to be a powerful contributor to attitude change. The practical nature of the science education course was highlighted in this student's comments:

> The rainforest activity was brilliant! Taking science out of the traditional classroom setting also took away many of the negative feelings I had about science. I really enjoyed the opportunity to learn about science without the pressures of "performing." Children will have the opportunity to discover for themselves as I have done. The activity was motivation and interesting — two significant factors that determine the success of a particular lesson. This is what science should be about. What I learnt today had meaning. All of a sudden, all of my ideas about science teaching came together as a whole.

That students were beginning to reflect on their own learning experiences and the meaningfulness of the material they were to learn is evident in the two following excerpts. In the first case the student has adopted a strong advocacy role for science and concluded that it would be irresponsible not to teach science.

> I thought all teachers had to teach science! How do teachers get away with not doing their job? Can't they see how they're disadvantaging their students. ...

> This unit has been based on discovering your feelings about science. I have learnt that I'm not as afraid of science as I thought and that I'm actually looking forward to teaching and planning exciting and challenging programs for my students.

A second student acknowledged her difficulties but at the same time recognised that her view of science was changing. This comment was written in the fourth week of the semester. It was later followed by more reassuring reflections in which her confidence was clearly more evident. The changing perspective of science was a clear objective of the course.

> The activities this week were really difficult. I was totally confused, because what I thought was correct was not, and what I thought was not correct was!! How am I going to cope in the future —when teaching science. I though that my knowledge was expanding and that I was beginning to think in science terms; boy was I wrong!!!

> I know why I am so uncertain about teaching science — I don't know enough about it. If I have a choice later in life, I don't think I would like to teach science, but I will be teaching it soon. But, if science is about process, argument and discussion maybe there is still some hope?

> I am really trying to get all the ideas concepts and understanding clear in my head, but it will take a long time. If somebody asked me today what science was about, I would still answer — life, plants, animals, energy ... etc., matter. I guess that I am still really confused, and will be for sometime yet. I must not lose faith in myself — please not yet!

Conclusions

Internationally teachers are facing tremendous pressures for curriculum change. With mandated national curricula in the UK (Department of Education and Science, 1991), national curricula statements in Australia (Curriculum Corporation, 1994) and standards being foreshadowed in the USA (Project 2061), teachers have had to cope with multiple pressures for change. For example, in Queensland the introduction of mathematics performance standards has substantially challenged teachers' classroom practices. Attitudes to change are shaped by many factors but important among them are teachers' beliefs about the subject area, beliefs in their ability to teach effectively in that area and beliefs about the effectiveness of teaching having any impact on children's learning. Given Fullan's (1993) contention that the engine of change is the individual teacher, research on attitudes and beliefs are crucial to ensuring that effective and useful change can occur. The research that we have conducted in this series of studies, and associated studies, not only highlights the importance of attitudes and explores some of the antecedent factors but also the reliability of STEBI-B as a instrument which can be used to monitor changes and to identify significant individuals requiring support or who can fulfil leadership roles.

The preservice preparation of teachers of science has long been recognised as problematic. When engaged in the learning of subject matter in which students lack confidence, experience or a sense of self-efficacy, high levels of anxiety are generated leading to an expressed desire to avoid the teaching of these subjects in their future career. Effective interventions need to address the source of low self-efficacy by providing opportunities for students to experience meaningful success. Concomitantly, it is desirable that all preservice teachers develop sufficient understanding of science to become effective teachers. Content knowledge and pedagogical knowledge are crucial elements of a competent teacher's repertoire. Understanding and knowledge is effectively accommodated when the learning experiences are personally relevant, build on prior knowledge and experiences, and occur in an environment in which the learner feels empowered to be in control of, or be able to impact on, the learning process. That is, in theoretical terms, a constructivist inspired learning environment. The interventions that have occurred in these studies have explored how such environments can be generated given the size of classes, university teaching policies, multiplicity of teachers, national policies and a professional belief in what competencies preservice teachers need in order to be effective teachers. Our ultimate goal is to establish learner centred programs in which students become actively engaged in the process of learning relevant and useful knowledge and skills to make them exemplary teachers of science, and also engage in experiences that are challenging, intrinsically motivating and perceived by them to be successful.

To achieve this goal requires reflective teaching practices on the part of the instructors (Uprichard & Englehardt, 1986). Thus the intervention in the foundation subject in the Australian University was designed with several features in mind. Firstly, content focused on comprehensiveness to extend students' experiences and understanding beyond biological science which most had studied in school and for the most part students have a reasonable tacit knowledge. Secondly, activities were designed to model typical classroom activities that effective teachers of science would engage in with children. However, these activities were explored in more conceptual depth and implemented around common conceptual organisers. For example, students were introduced to the kinetic theory of matter (particle theory) over several weeks and a range of activities participated in that exemplified this concept—diffusion, capillary action, atmospheric pressure, change in state. The core strategies explored by instructors include group work, reflection on students' prior or initial understandings and extensive practical involvement with concrete examples. Many of these strategies have been tried, reflected upon and modified in an on-going action research process. The results reported here have shown small positive changes in self-efficacy for students in this course. Indeed a fine grained analysis of the results has shown statistically significant increases in self-efficacy in some workshop groups compared to others (Hanrahan, 1994). Given that we know many of these students have had extremely negative experiences with science prior to university (Watters & Ginns, 1995), the strategies adopted clearly are beginning a long term process of initiating positive changes. For some students the changes are exceedingly dramatic. For others, used to more didactic approaches in which the examination material is presented and worked through, changes in strategies are less manageable. Many students are still locked into the culture of "tell me what I need to know to pass."

The interventions in the science education course were accompanied by small positive changes in PSTE, and several scales of TOSRA indicating a more favourable attitude towards science teaching and a change in views about science. These enhanced beliefs would be consistent with the change acknowledged in the CLES scale that described a perceived learning environment more aligned with the model espoused by Taylor et al. (1994). The course focused on pedagogical knowledge development and gave students opportunities to explore, with individual children, issues and strategies concerning the teaching of science. Students were involved in small group projects in which they chose their own topic, set their own agenda in terms of achievement of objectives and produced a product of future utility, thus developing a sense of professional autonomy. The tasks were intrinsically motivating in that they required the students to work with children and to model practices that exemplified good science teaching and also provided opportunities for sharing worthwhile information gained by other students. This type of instruction, seen as an intervention in this study, was one step towards establishing an effective community of learners within the constraints of university teaching practices.

Implications and further research

At this stage in the action research program we have become more aware and sensitive to a number of factors that contribute to student learning and beliefs. Opportunities for students to reflect on prior learning and for instructors to be aware of the status of many of the beliefs of preservice teachers is essential. An environment that allows risk free, meaningful learning to take place is also essential. Overcoming anxiety, providing real opportunities to engage in problems that have personal relevance are key strategies that need to be adopted. Steps towards establishing a community of learners requires the development of an environment in which the university teacher adopts the role of facilitator, listening, coaching, encouraging the student, and actively supporting the student to make connections with prior knowledge through the use of analogs, models, and divergent questioning. This needs to be a common commitment and enactment by the staff in courses that are multi-staffed.

A sensitivity towards the previous experiences of students who typically enroll in elementary education programs is crucial. The development of confidence expressed as a sense of self-efficacy depends on students having successful and reassuring experiences. These can be a feature of preservice programs if the teaching staff consciously and deliberately provide opportunities, and realistically evaluate performance. Performance in course related assessment may not be as important in changing self-efficacy compared to developing a sense of achievement through direct experience with children or pedagogy. This raises the question of what and how one can implement authentic assessment practices in preservice courses. Perhaps related to the feelings of low self-efficacy is the traditional view of science held by most students and hence a concerted effort should be made to encourage students to reflect on the nature of science throughout their program.

The concerns that emerged during this study were instrumental in reorganizing the sequence of courses within the program to enable a closer alignment of the science content and science education units, which now occur in Semesters 3 and 5 respectively. This study links with others we have been undertaking that suggest that consecutive and or integrated content and methods courses play an important role in assisting students to link content and pedagogy (Watters, et al., 1995).

The logistics of providing worthwhile programs at tertiary level given constraints of funding, time and diverse populations of students become for us the next challenge to confront. To extend on what we have learnt we are pursing two lines of research. The extent to which preservice training impacts on practice in the workplace is being monitored by maintaining a research agenda with the participants in this study as they are inducted into teaching. This extended study involves recruiting the beginning teachers as co-researchers, not only reflecting on inservice practice, but also providing feedback and input to the preservice program. Furthermore, the enthusiasm, skills and knowledge gained by these students is being employed by the instigation of peer-teaching practices and programs in which they mentor beginning students (Watters & Ginns, 1997).

The organization logistics of the university has precluded integration of practice teaching and the science education courses. Further research is needed to define the ways that theory and practice can be usefully implemented.

A limitation in the teaching of the content course was the size and diversity of he teaching team. An important area that needs further exploration is the professional development of the tertiary instructors, many of whom are graduate students or fossilized in past practices.

References

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement.* New York: Longmans.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs NJ: Prentice Hall.

Bereiter, C. (1994). Constructivism, socioculturalism and Popper's world 3. *Educational Researcher, 23*(7), 21-23.

Brickhouse, N. W. (1990). Teachers' beliefs about the nature of science and their relationship to classroom practice. *Journal of Teacher Education, 41*(3), 53-62.

Brickhouse, N. W., Bodner, G. M. (1992). The beginning science teacher: classroom narratives of convictions and constraints. *Journal of Research in Science Teaching 29*(5), 471-485

Calderhead, J., & Robson, M. (1991). Images of teaching: Student teachers' early conceptions of classroom practice. *Teaching and Teacher Education, 7*(1), 1-8.

Carr, W., & Kemmis, S. (1986). *Becoming critical: Education, knowledge and action research.* , (pp. 165-166). Lewes: Falmer Press.

Claxton, G. (1992). Why science education is failing? *New Scientist, 133*(1804), 45-46.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser*, (pp. 453-494). Hillsdale, NJ: Lawrence Erlbaum.

Curriculum Corporation. (1994). *A statement on science for Australian Schools.* Vic: Curriculum Corporation.

Dembo, M. H., & Gibson, S. (1985). Teachers' sense of efficacy: An important factor in school improvement. *The Elementary School Journal, 86*(2), 173-184.

Department Employment Education and Training. (1989). *The discipline review of teacher education in mathematics and science. Volume 1 Report and Recommendations.* Canberra: AGPS.

Department of Education and Science, (1991). *Science in the National Curriculum.* London: HMSO.

Duschl, R. A., & Wright, E. (1989). A case study of high school teachers' decision making models for planning and teaching science. *Journal of Research in Science Teaching, 26*(6), 467-501.

Enochs, L. G., & Riggs, I. M. (1990). Further development of an elementary science teaching efficacy belief instrument: A preservice elementary scale. *School Science and Mathematics, 90*(8), 694-706.

Fensham, P. J. (1994). Progression in school science curriculum: A rational prospect or a chimera? *Research in Science Education, 24,* 76-82.

Fraser, B. (1981). TOSRA: *Test of science-related attitudes.* Hawthorn, Victoria: Australian Council for Educational Research.

Fullan, M. (1993). The complexity of the change process. In *Change Forces: Probing the Depths of Educational Reform* (pp. 19-41). London: The Falmer Press.

Ginns, I. S., & Watters, J. J. (1994, April). *A longitudinal study of preservice teachers' personal and science teaching efficacy.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Ginns, I. S., & Watters, J .J. (1995). An analysis of scientific understandings of preservice elementary teacher education students. *Journal of Research in Science Teaching, 32*(2), 205-222.

Ginns, I., Watters, J. J., Tulip, D. F., & Lucas K. B. (1995). Changes in preservice elementary teachers' sense of efficacy in teaching science. *School Science and Mathematics, 95*(8), 394-400.

Greenwood, G. E., Olejnik, S. F. & Parkay, F. W. (1990). Relationships between four teacher efficacy belief patterns and selected teacher characteristics. *Journal of Research and Development in Education*, *23*(2), 102-106

Hanrahan, M. (1994). Student beliefs and learning environments: Developing a survey of factors related to conceptual change. *Research in Science Education, 24,* 156-165.Hurd, P. D. (1982, September). State of pre-college education in mathematics and science. Paper presented at the national convention on precollege education in mathematics and science, Washington, DC: National Academy of Engineering.

Kagan, D. M. (1992). Professional growth among preservice and beginning teachers. *Review of Educational Research, 62*(2), 129-169.

Kahle, J., Anderson, A., & Damjanovic, A. (1991). A comparison of elementary teacher attitudes and skills in teaching science in Australia and the United States. *Research in Science Education, 21*, 208-216.

Koballa, T.R. (1988). Attitude and related concepts in science education. *Science Education, 72*(2), 115-126.

Linn, M. C., & Burbules, N. C. (1993). Construction of knowledge and group learning. In K. Tobin (Ed.), *The practice of constructivism in science education.* (pp. 91-119). Washington, DC: American Association for the Advancement of Science.

Manning, P., Esler, W., & Baird, J. (1982). What research says: How much elementary science is really being taught? *Science and Children, 19*(8), 40-41.

Martens, L. M. (1992). Inhibitors to implementing a problem solving approach to teaching elementary science: Case study of a teacher in change. *School Science and Mathematics, 92*(3), 150-156.

Marton, F., Saljo, R. (1976). On qualitative differences in learning. I-Outcome and process. *British Journal of Educational Psychology, 46,* 12-25.

Mechling, K., Stedman, C., & Donnellan, K. (1982). Preparing and certifying science teachers. *Science and Children, 20*(2), 9-14.

National Research Council, (1996). *National science education standards.* Washington, DC: National Academy Press.

National Science Teachers Association. (1995). *Scope, sequence, and coordination of secondary school science.* Washington, DC: NSTA.

Project 2061. (Draft, January 1993). Benchmarks for science literacy (part I: achieving science literacy. Washington, DC: American Association for the Advancement of Science.

Qin, Z., Johnson, D., & Johnson, R. T. (1995). Cooperative verses competitive efforts and problem solving. *Review of Educational Research, 65,* 129-143.

Riggs, I. M., & Enochs, L. G. (1990). Toward the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education, 74*(6), 625-637.

Roth, W.-M., Roychoudhury, A. (1993). The concept map as a tool for the collaborative construction of knowledge: a microanalysis of high school physics students. *Journal of Research in Science Teaching 30*(5), 503-534

Rubba, P. A., & Harkness, W. L. (1993). Examination of preservice and in-service secondary science teachers beliefs about science-technology-society interactions. *Science Education, 77*(4), 407-431.

Rutherford, F. J., Ahlgren, A. (1990). *Science for all Americans.* Oxford: Oxford University Press.

Shrigley, R. L., Koballa, T. R. & Simpson, R. D. (1988). Defining attitude for science educators. *Journal of Research in Science Teaching, 25*, 659-678.

Shroyer, M. G., Wright, E. L., & Ramey-Gassert, L. (1996). An innovative model for collaborative reform in elementary school teaching. *Journal of Science Teacher Education, 7*(3), 151-168.

Skamp, K. (1995). Student teachers' conceptions of how to recognise a "good" primary science teacher: Does two years in a teacher education program make a difference? *Research in Science Education, 25*(4), 395-429.

Slavin, R. E. (1991). Synthesis of research on cooperative learning. *Educational Leadership, 48*(5), 71-82.

Taylor, P. C. S., Fraser, B. J., & White, L. R. (1994). *CLES: An instrument for monitoring the development of constructivist learning environments.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, April.

Tilgner, P. J. (1990). Avoiding science in the elementary school. *Science Education, 74*(4), 421-431.

Tobin, K. G., Tippins, D. J., & Hook, K. (1993). Referents for changing a science curriculum: A case study of one teacher's change in beliefs. *Science and Education, 3*(3), 245-264.

Uprichard, A. E., & Englehardt, J. (1986). A research context for diagnostic for prescriptive mathematics. *Focus on Learning Problems in Mathematics, 8*(1), 19-38.

Watters, J. J., & Ginns, I. S. (1994). Science anxiety and self-efficacy among preservice primary teachers: origins and remedies. *Research in Science Education, 24*, 348-357.

Watters, J. J., & Ginns, I. S. (1995, April). *Origins of and changes in preservice teachers' science teaching self efficacy.* Paper presented at the annual conference of the National Association of Research in Science Teaching conference, San Francisco, 1995.

Watters, J. J., & Ginns, I. S. (1995, April). *Origins of, and changes in preservice teachers' science teaching self efficacy.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, CA.

Watters, J. J., & Ginns, I. S. (1997, March). *Peer assisted learning: Impact on self-efficacy and achievement.* Presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Watters, J. J., Ginns, I. S., Enochs, L. & Asoko H., (1995, November). *Science teaching self-efficacy of preservice primary teachers: A review of research in three countries.* Paper presented at the annual meeting of the Australian Association for Research in Education, Hobart, Tasmania.

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