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## The beliefs and attitudes of primary school teachers in the Bunbury region toward the subject of science

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**THE BELIEFS AND ATTITUDES OF PRIMARY  
SCHOOL TEACHERS IN THE BUNBURY REGION  
TOWARD THE SUBJECT OF SCIENCE**

**BY**

**Michelle A. McKeon B.A. Ed. (Prim.)**

**A Thesis Submitted in Partial Fulfilment of the  
Requirements for the Award of**

**Bachelor of Education with Honours**

**at the Faculty of Education, Edith Cowan University**

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## USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

## ABSTRACT

The study investigated the beliefs and attitudes of primary school teachers in the Bunbury region toward the subject of science. Teachers' beliefs and attitudes were investigated in terms of the dependent variables of teachers' attitude toward science, preference for teaching science and confidence to teach science and how they related to the independent variables of qualifications, Year 11 and 12 science subjects, years of teaching experience, time of last science inservice and gender. Teachers' perceptions of the barriers toward more and better teaching of science in primary schools were also investigated. The sample included 89 teachers from nine schools, six Western Australian Department of Education schools, two Catholic Education schools and one Independent school, all situated in the Bunbury region. The sample consisted of 59 female primary school teachers and 30 male primary school teachers. The participants were required to complete a 28 item survey which included questions to determine the demographics of the sample, background information on the teachers, an idea of teachers' attitude, preference and confidence for teaching science and information about how teachers are teaching science. The study found teachers to generally have a high attitude and confidence toward teaching science and a moderate preference for the subject.

## DECLARATION

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed .

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## Chapter 1

### Introduction

#### Background to the Study

There is a recent focus on science in Western Australian schools, with science being established as a priority area by the Education Department of Western Australia for 1995 to 1997 and additional funding being allocated to science education to support curriculum and teacher development. A national curriculum for science education has also recently been developed, and *Primary Investigations*, a science teaching package, is being implemented in many Western Australian schools.

Science, although viewed as being important, is often taught very little and without much enthusiasm in the primary classroom, according to the literature. One of the possible blocks to the extensive teaching of science could be the beliefs and attitudes of teachers toward the subject. These beliefs and attitudes may be influenced by scientific background and knowledge; confidence to teach science; gender and amount of preparation time and materials required for science. These are the issues and ideas the study aims to investigate.

#### Purpose of the Study

The purpose of the study is to determine the beliefs and attitudes that primary school teachers in the Bunbury region have toward science. It is expected that this will achieve an insight into possible influences on teachers' beliefs and attitudes toward science; an idea of how background scientific knowledge and experience relates to beliefs and attitudes; an indication of the time and instructional style teachers give

to their science instruction and the barriers and problems toward teaching science.

### Definition of Terms

#### *Attitude*

"An attitude to a concept such as science is the person's collection of beliefs about it, and episodes that are associated with it, that are linked with emotional experiences" (White, cited in Skamp, 1992, p. 377).

#### *Child-centred learning*

A form of instruction where the teacher is a facilitator of knowledge and utilises the background of the pupils as the starting point for learning. The pupils largely control their own learning experiences and discover concepts for themselves.

#### *Elementary school*

The American term for primary school.

#### *Integrated programme*

A programme of learning experiences devised by a teacher involving instruction covering concepts of many subject areas at the one time.

#### *Likert Scale*

A type of survey item where the respondent is to "indicate their agreement or disagreement [to an attitude statement] along a five-point (or sometimes longer) scale ranging from 'strongly agree' to 'strongly disagree' " (Burns, 1994, p. 337).

### *Post secondary qualifications*

Any qualifications gained after the completion of secondary school.

### *Private Schools*

For the purposes of this study the term 'private schools' refers to the two Catholic Education schools and the one Independent school that participated in the study.

### *Science*

1. "Study and knowledge of natural phenomena" (Krebs, 1988, p. 478).
2. A subject of instruction in the primary school curriculum where children learn about various simple scientific topics and concepts.

### *Teacher-directed learning*

A form of instruction where the teacher directs all learning that takes place and is the major centre of knowledge in the classroom.

### *Western Australian (WA) Department of Education Schools*

Schools that are constructed and funded by the Western Australian state government.

### Significance of the Study

This study aims to provide working information about teachers' beliefs and attitudes that is both specific to the Bunbury region and able to be generalised to other regions. The value of this data will be in the development of science in-servicing programs; science teaching packages; and teacher preservice and inservice science courses.

### Limitations

The schools that participated in the study are all situated in the Bunbury region and, therefore, exist in similar communities and cultural settings. The teachers at each of the schools are quite similar with the majority of them holding permanent positions and having over ten years teaching experience. Most of the teachers also have a three or four year teaching qualification and have had no occupations other than teaching. These similarities between teachers indicate that the findings gained from the survey are probably specific to this region and not very generalisable. It is possible that the findings could be generalised to other large centres such as the metropolitan region, Kalgoorlie or Geraldton, but without similar studies in all these regions this is not known.

The return rate of the surveys was 58.6%, or 89 surveys returned out of the 152 distributed. Problems stem from this in that the attitudes of the 41.5% of teachers who did not complete the survey are not known. Are these teachers a relatively homogeneous group, all with similar attitudes? Does this group have the same range of attitudes as the responding group? Was there a reason for these teachers not completing the survey? Without the answers to these questions it cannot be certain that the results collected are not somewhat skewed.

During the data collection phase there was an industrial dispute occurring between the State School Teachers Union (SSTU) and the WA Department of Education. The dispute resulted in many teachers who had SSTU membership placing a ban on any extra duties or activities outside their teaching responsibilities. It is not known if



these events contributed to the return rate or affected the answers given on any of the surveys.

The wording of some of the questions may have skewed responses. For example, the use of the terms 'Very low' and 'Very negative' in questions 12 and 14 respectively (see Appendix A) may have resulted in teachers electing for an option slightly higher, as there are stigmas attached to having a 'very low confidence' or a 'very negative attitude'. As the findings show in Chapter 5, very few teachers selected these options. Question 13 may provide a more realistic view of the actual situation as terminology such as 'Very low' or 'Very negative' was not used and the question was posed in a less direct manner. Every subject needed to be numbered in terms of teaching preference, from a high of 'one' to a low of 'eight'. Therefore, putting a particular subject low on the list does not have a stigma attached as every position (or rank) had to be filled.

## Chapter 2

### Literature Review

#### Introduction

The literature surrounding teachers' attitudes and beliefs toward science is wide and varied. Many studies have examined this topic and its many facets. Only the studies, and sections of studies, that are relevant to the research discussed in this paper will be reported on.

#### Attitudes Toward Science

The majority of pre-service teachers "have negative attitudes to science and to its teaching and learning" (DEET, cited in Grindrod, Klindworth, Martin & Tytler, 1991, p. 151). A questionnaire administered by Grindrod et al. (1991) to 346 students prior to their commencement of a science unit found 51% of students had negative science feelings. A study by Young and Kellogg (1993) found a smaller percentage of teachers, 21%, to have a negative attitude rating. However, these ratings by Young and Kellogg (1993) were based on an assessment of teachers' essays, describing their science background and strengths and weaknesses in science, and the coding system, although explained clearly, could have been subjective.

J. Rowe (1992) conducted a study "into the state of science in Western Australian primary schools" (p. 47) in 1983 which was repeated in 1990 to identify any changes that had occurred. The information for the study was reported by 80 third year education students in 1983 and 250 third year education students in 1990 all of whom had completed an Assistant Teacher Programme in various schools and "were able to

base their generalisations of recent observations" (J. Rowe, 1992, p. 47). Teachers' attitudes toward science in 1983 were concluded as being not very positive with an improvement in teachers' attitudes by 1990.

Much of the literature and many of the studies located do not directly comment on teachers' attitude toward science. This is because most of the studies have examined attitude toward science teaching in relation to other factors such as scientific background, gender, confidence and time spent on science. The combination of these factors, and often others, are used to provide an insight into teachers' general attitude toward science. For example, a study by Coulson (1992) used four questionnaire scales, "confidence", 'enjoyment', 'usefulness' and 'appropriateness of science for young children' (p.101) as a general attitude scale when combined. This study is elaborated on in the following section.

### The Relationship Between Scientific Knowledge and Attitudes Toward Science

The relationship between background scientific knowledge and teachers' attitude toward teaching science is a common topic of discussion in the literature (Appleton, 1992; Beisel, 1991; Jane, Martin & Tytler, 1991; Pedersen & McCurdy, 1992; Watters & Ginns, 1994; Young & Kellogg, 1993; Zeitler, 1984). However, there are conflicting points-of-view on this topic. For example, Watters and Ginns (1994) state that "the attitude of primary teachers toward teaching science is implicitly related to their conceptual understanding of science" (p. 348) whereas Shrigley (cited in Pedersen & McCurdy, 1992) opposes this, finding "a low correlation between science knowledge and teachers'

attitudes toward science" (p. 142). It must be noted that no statistics were given to support either of these statements in the respective articles. Considering the above, at this point it would appear wise to take the view of Young and Kellogg (1993) who concluded that "the relationship between science study and preservice teachers' attitudes about science or teaching science is not clear from the literature" (p. 280). Other studies that have explored this relationship are elaborated on below.

Coulson (1992) explored the attitudes toward science of first year students enrolled in an early childhood education course through the use of an instrument comprising "four Likert-type scales, biographical items and two open-ended attitude items" (p. 101). The scales comprised four areas of statements that were labelled "'confidence', 'enjoyment', 'usefulness' and 'appropriateness of science for young children'" (p.101). The combined scales were used as a general 'attitude' scale. It was found that "students who had studied at least one science subject at Year 12 level had significantly higher scores on all scales than students who had not studied science at senior level" (Coulson, 1992, p. 101).

Teachers themselves often feel that they do not have enough background knowledge to teach science adequately (Appleton, 1992; Zeitler, 1984). Pedersen and McCurdy (1992) found 45.83% of teachers felt science was the subject they knew the least content knowledge about. Yates and Goodrum (1990) found 27% of teachers responding to their questionnaire felt that they needed further development of their background science knowledge. Jane et al. (1990) found an even larger

percentage among student teachers who had not majored in science. Forty-six percent of the student teachers felt "that a more extensive background of science studies would have given them a better understanding of the topics presented" (Jane et al., 1990, p. 191) and helped them feel more prepared and positive in a compulsory third year Competence and Methodology in Science (Science Education) unit they had completed. In addition to this 72% of the student teachers participating in this study who were majoring in science "felt that their major studies in science had helped them to better understand the topics presented" (Jane et al., 1990, p. 191) in the compulsory third year Competence and Methodology in Science unit. Teachers who have negative feelings toward science that stem from their lack of science background knowledge may also experience feelings of lower confidence in teaching science. This is discussed in a following section focusing on confidence to teach science.

#### The Relationship Between Attitudes Toward Science and Teaching Behaviour

According to Ajzen and Shrigley (cited in Coulson, 1992) there is a relationship between teachers' attitudes toward science and their science teaching behaviour. Given this relationship, "teachers' attitudes toward science can be expected to influence their practice in teaching science" (Coulson, 1992, p. 101). Shrigley (1983) supports this with the statement:

I believe our success has been dulled by ignoring the force of teacher attitude which, in general, is less than positive, and how this attitude has resulted in teaching behaviour that has not supported science adequately. (p. 205).

No evidence was cited to support the claims of the 'less than positive teacher attitude' and the 'teaching behaviour that does not support science'. Shrigley (1983) goes on to describe a model that proposes to change the attitudes and behaviours of teachers, a description of which is not relevant here. However, an assumption the model is based on is relevant:

the model suggests that science will be taught to [sic] more elementary school classrooms when teacher attitude and teacher behaviour becomes more positive toward science. (p. 214).

Shrigley (1983) also presents a simple cyclic diagram that is based on the assumption that a science attitude change can aid a science behaviour change and also the reverse; a science behaviour change can aid a science attitude change.

Stefanich and Kelsey (1989) also discussed a relationship between the attitudes of teachers toward science and their science teaching behaviour and came to the following conclusions. Teachers with positive attitudes toward science have an increase in their "commitment to and intensity of science teaching" (Stefanich & Kelsey, 1989, p. 187) whereas, teachers with negative attitudes toward science "are more traditional in their teaching styles, more closed-minded and generally more resistant to curriculum change" (Symington & Fensham, cited in Stefanich & Kelsey, 1989, p. 188).

#### Confidence to Teach Science

The national inquiry into mathematics and science education (Department of Employment & Training, cited in Goodrum, Cousins &

Kinnear, 1992) "concluded that science was not a priority for many teachers and that many lacked confidence in teaching the subject" (p. 163). The literature strongly supports this conclusion, with many studies also commenting on the relationship between confidence and science knowledge, teachers' confidence for the various topic areas of science, how teachers' confidence affects their teaching behaviour and the reasons for this general lack of confidence.

"Many teachers feel that they lack confidence and expertise in the science and technology areas" (Jane et al., 1991, p. 188). This lack of confidence is a concern as it is often viewed as being a major reason for the small quantity of science taught in primary schools (Grindrod et al., 1991). The lack of expertise teachers feel in science and technology could also be a factor in the quantity, as well as the quality, of science being taught.

A questionnaire issued to 191 teachers in Central Florida (Manning, Esler & Baird, 1982) contained an item where teachers were required to rate their confidence level on a five point scale from 'High' to 'Very low'. It was found that only 19% of the teachers rate their confidence to teach elementary science as 'Moderately high' or 'High' while nearly one third (32%) of teachers rate their confidence as 'Low' or 'Very low'. The obvious conclusion was that there was "a lack of self-confidence among [these] teachers in their ability to teach science competently" (Manning et al., 1982, p. 41).

Appleton (1992) conducted a study to address the question "of whether discipline knowledge is necessary for teacher education students to feel

more confident about teaching science" (p. 12). This study stemmed from the findings and recommendations of the review conducted by the Australian government into science teacher education programs (Department of Employment, Education and Training, cited in Appleton, 1992) in 1989. "The committee conducting the review felt that teachers' confidence would be improved if they had a stronger science discipline knowledge base, and recommended that minimum periods of science discipline units be included in preservice programs" (DEET, cited in Appleton, 1992, p. 11).

The study involved "139 students in their first year of a three-year preservice primary and preschool teacher education course" (Appleton, 1992, p. 12) who were about to study a compulsory science education unit. The students completed identical surveys before and after the science education unit which "explored the students' self-perceptions of their teaching of science and technology" (Appleton, 1992, p. 12) through Likert scale type items. For example, their level of interest in teaching science, the extent of background knowledge they have for teaching science and their competency in teaching science and technology. The study revealed the following findings:

- Students' ratings showed a positive change in all but two of the items after the completion of the science education unit (Appleton, 1992).
- "The two items for which there was no significant change were the students' expressed level of interest in teaching life and earth topics" (Appleton, 1992, p. 14) which both had low means (indicating positive ratings) before the completion of the science education unit.



- The areas that showed the greatest positive change in mean before the science education unit and mean after the science education unit were "the students' perceptions of their background knowledge to teach science, particularly matter, space and energy, and to teach technology" (Appleton, 1992, p. 14).

The study concluded that "it can reasonably be assumed that the unit on science education was largely successful in effecting change in the students' perceptions of themselves as teachers of science and technology" (Appleton, 1992, p. 14).

Appleton (1992) also states that "teacher education students with little science discipline knowledge ... express lower confidence in teaching science, particularly the areas of science which they know least about" (p. 11). From the results of studies reported on in the literature it appears that the areas student teachers and practicing teachers know least about are the physical sciences (Butler Kahle, Anderson & Damnjanovic, 1991; Grindrod et al., 1991; Mechling & Oliver, 1983; Yates & Goodrum, 1990).

Yates and Goodrum (1990) carried out a study in a Perth district to explore teacher attitudes toward science. It was found that "only a small percentage of teachers lacked confidence in teaching Plants (7%) and Animals (8%)... [while] the lack of confidence was much higher for the physical sciences" (Yates & Goodrum, 1990, p. 301). Butler Kahle et al. (1991) also found a distinction between biological and physical science topics. United States teachers were significantly more

interested, had more background knowledge and felt they were more skilled in teaching biological science topics than physical science topics.

Grindrod et al. (1991) found that first, second and third year student teachers at Victoria College mainly teach biological science topics during their teaching practicums. It was also found that "in third year, more physical science was done [or taught, than in first and second year] but at the expense of other non-biological topics" (Grindrod et al., 1991, p. 156). This study concluded "that students and teachers are more comfortable teaching biological science" (Grindrod et al., 1991, p. 156) than physical science but their confidence with physical science does increase over the course of their studies.

Skamp (1991) conducted a study which, in part, reported on preservice and practicing teachers reasons for confidence, or lack of confidence, in teaching science. The reasons given for confidence in teaching science included that many preservice and practicing teachers "were more confident about their knowledge of particular topic areas because they had more [personal] knowledge of that area" (Skamp, 1991, p. 297), often in the form of Year 11 and 12 science subjects. Other common reasons for confidence were "interest in the area; [the topic had been] used in practicum/taught a lot; and preservice courses" (Skamp, 1991, p. 297). "Of the reasons given for lack of confidence 'lack of knowledge/unfamiliarity with content' is the most cited" (Skamp, 1991, p. 297). Other reasons that were given included "lack of interest in the topic area; lack of resources; and deficiencies in preservice courses" (Skamp, 1991, p. 297).

### Preference for Teaching Science

Manning et al. (1982) found, in their study of 191 teachers, that out of five subject areas (language arts, math, reading, science and social studies) 4.2% of teachers rank their preference for science first while 51.9% of teachers rank their preference for science fourth or fifth. Mechling et al. and Westerback (cited in Pedersen and McCurdy, 1992) also found in their respective studies on teachers' attitude toward science that over half of teachers surveyed "ranked science fourth or fifth out of five subject areas on terms of teaching preference" (p. 142).

A similar study to that conducted by Manning et al. (1982) was carried out at the University of Nebraska (Pedersen & McCurdy, 1992). "When ranking seven curricular areas in order of preference, 37.50% of the preservice teachers [surveyed] ranked science as fourth or fifth" (p. 142).

### Gender Differences in Science Confidence and Scientific Background

Conveners of preservice and inservice courses for teachers were surveyed in a study carried out by Bearlin (1990). One of the findings was that the majority of female teachers were viewed by the conveners as having a lack of confidence prior to their completion of the preservice or inservice course. How the conveners came to this conclusion, however, is not made clear.

Jane et al. (1991) conducted a questionnaire study "of primary teacher trainees' perceptions and attitudes to science" (p. 188). The results reported state the most common Year 12 science subject studied by the trainees, both male and female, was Biology (also found by Skamp, 1991) but that males had generally studied more physical science than

females. In addition to this, male teachers also appear to have more confidence in teaching the area of physical science. Bearlin (1990) found that female primary and early childhood teachers tend "to have more negative perceptions of their teaching skills in the physical sciences than males" (p. 21). This is supported by Skamp (1991) who found that the only significant difference between male and female student teachers on entry into preservice teacher education was that males were "more confident than females about the Natural Phenomena [or physical science] topic area" (p. 294).

Butler Kahle et al. (1991) conducted a study that examined the differences in attitudes and skills in teaching science between Australian and United States teachers. Due to the low number of male teachers in the United States sample gender comparisons were only made with the sample of Australian teachers. The following conclusions were drawn about the sample of Australian teachers:

- "Significant differences were not found in the interest expressed for biological or physical topics by male or female Australian teachers" (Butler Kahle et al., 1991, p. 210).
- "Although both male and female Australian teachers indicated that they had adequate knowledge to teach lessons about animals and plants, significantly more male teachers thought that they were adequately prepared to teach the topics of matter and energy" (Butler Kahle et al., 1991, p. 211).
- "Both male and female Australian teachers ranked themselves as skilled in teaching topics about animals, plants, and matter, but significantly more male Australian teachers ranked themselves

skilled in teaching the topic of energy" (Butler Kahle et al., 1991, p. 211).

Differences in preference for teaching various science areas were found between 34 male and 26 female teachers in a questionnaire administered by Hutchinson (1983). Table 2.1 summarises these findings.

*Table 2.1*

Teacher preferences for areas of science (Hutchinson, 1983, p. 45).

|                 | Prefer to teach |        | Prefer NOT to teach |        |
|-----------------|-----------------|--------|---------------------|--------|
|                 | Male            | Female | Male                | Female |
| animals, plants | 28%             | 62%    | 12%                 | 12%    |
| matter, energy  | 34%             | 15%    | 26%                 | 54%    |
| no preference   | 38%             | 24%    | 62%                 | 35%    |

Table 2.1 shows that most female teachers have a strong preference for the topics of animals and plants and few female teachers prefer to teach matter and energy. Only slightly more male teachers prefer matter and energy over animals and plants. In addition to this more male than female teachers do not have preferences for particular areas of science.

#### Time Spent on Science Instruction

Yates and Goodrum (1990), in their Perth study on teachers' attitudes toward science, found that teachers have a lack of interest and

confidence in teaching science but despite this "almost all teachers (94%) indicated they taught science each week with the average time being one hour per week" (Yates & Goodrum, 1990, p. 301). A similar timetable for science was found by Goodrum et al. (1992) who conducted a case study that investigated teachers' lack of confidence in teaching science. It was found during the study that "most [Year 6 teachers] timetabled science for an hour per week but suggested this was the first subject to disappear in the week's schedule when other demands were made" (Goodrum et al., 1992, p. 164). The Year 5 and Year 2 teachers participating in the study also taught science weekly, but no actual times were reported.

J. Rowe (1992) reported similar amounts of time spent on science to that stated above. The third year education students participating in the study reported the average amount of time spent on science weekly in 1983 was 55 minutes, whereas in 1990 the average amount of time spent on science weekly had increased to 61 minutes.

Literature from the United States of America suggests that there is little time spent on science instruction and that this is due to the 'back-to-basics' movement (Manning et al., 1982; Mechling & Oliver, 1983; Pedersen & McCurdy, 1992). "The back-to-basics movement demands instructional time to teach reading, mathematics, and language arts. This emphasis inevitably reduced the time available for other subjects, including science" (Manning et al., 1982, p. 40).

Rutherford (cited in Mechling & Oliver, 1983) commented in an interview on the amounts of science instruction occurring in

elementary schools. He stated: "At the elementary school level, instruction in science has almost ceased, being no more in most classrooms than a few minutes each week of reading from textbooks" (p. 16). Manning et al. (1982) and M. Rowe (cited in Stefanich & Kelsey, 1989) came to very different conclusions, as elaborated below.

M. Rowe (cited in Stefanich & Kelsey, 1989) reported on the national (USA) averages for science instruction in elementary schools, which were 17 minutes per day in Years K-3 and 28 minutes per day in Years 4-6. To put these statistics into perspective with the other studies they calculate to 85 minutes per week in Years K-3 and 140 minutes per week in Years 4-6.

The results of a survey administered by Manning et al. (1983) to 191 elementary teachers revealed 24.1% of teachers teach no science each week while the same percentage teach science for one hour each week. Although nearly a quarter of teachers teaching no science is a great concern it must be noted that this study also found that more than half of the teachers surveyed (51.8%) teach science for two hours or more each week. Manning et al. (1982) stated that "These data paint a bleak picture for elementary science instruction in Central Florida" (p. 41). From the lower amounts of science instruction reported on in studies previously mentioned (Goodrum et al., 1992; Mechling & Oliver, 1983; J. Rowe, 1992; Yates & Goodrum, 1990;) it is likely that many researchers of this topic would disagree.

### Barriers Toward the Teaching of Science

The reasons for the reluctance of primary school teachers to teach science are often stated as being poor attitudes, lack of confidence or lack of scientific knowledge (Appleton, 1992; Grindrod et al., 1991; Hone; Victor; Blosser & Howe, cited in Pedersen & McCurdy, 1992; Victor, cited in Stefanich & Kelsey, 1989). These barriers toward effective science instruction have already been discussed. There are other barriers, however, many of which have little to do with teachers' attitude and confidence toward or knowledge of science. These are discussed in the following paragraphs.

Aubusson and Webb (1992) conducted a study involving 40 teachers, on their beliefs about learning and teaching in primary science and technology. One part of the study focused on the reasons teachers "suggested for not teaching [science and technology] in the way they said they should [be teaching]" (p. 27). These reasons are outlined in Table 2.2.

The Year 6 teachers participating in the study by Goodrum et al. (1992) felt "that they themselves did not lack confidence but rather factors within the school system contributed to their reluctance to teach science" (p. 165). For example, the teachers felt that science instruction required an amount of effort in terms of preparing the topic, gathering ideas from various texts and organising materials. As science was not viewed as a priority by many teachers few were willing to commit this time and effort to organising it. The Year 5 and Year 2 teachers also expressed concerns about science such as "the lack of structured science curriculum from which to plan weekly lessons, background knowledge



in science, and readily available materials and equipment with which to teach science" (p. 167).

*Table 2.2.*

Reasons science and technology is not taught as it should (Aubusson and Webb, 1992).

| Internal Constraints  | External Constraints   |
|---|--|
| <ul style="list-style-type: none"> <li>• Fear of a lack of control, noise</li> <li>• A lack of pedagogical knowledge</li> <li>• Fear of lack of knowledge in science and technology</li> <li>• Fear of change and the temptation of the known</li> <li>• It is perceived as too hard</li> </ul> | <ul style="list-style-type: none"> <li>• A lack of time</li> <li>• Pressure from supervisors</li> <li>• The need to follow school policies</li> <li>• Resources</li> <li>• Children lack necessary skills</li> <li>• Community expectations</li> <li>• Formal testing</li> </ul> |

Third year primary trainee teachers participating in the study by Grindrod et al. (1991) identified three main factors that they felt were acting against science instruction in schools. These factors were a "lack of content knowledge, a crowded curriculum, and lack of resources and problems with management of equipment" (p. 157).

J. Rowe (1992) found that in 1990, 23% of third year education students reported that equipment for science teaching in the school they had observed was 'Very little or none'. Forty percent of students reported

that there was 'Some' equipment while 36% reported the equipment was 'Good'. In terms of science materials at the school 23% of students reported 'Very little or none', 36% reported 'Some' and 40% reported 'Good'. It is not known if the low amount of equipment and materials reported by the students at some schools was viewed as a barrier toward science teaching by the teachers at the schools.

### Summary

The literature comments on student teachers' and teachers' poor attitudes toward science, lack of scientific knowledge (especially in the physical sciences), lack of confidence in teaching science, low preference for teaching science, lesser science confidence and experiences of female teachers, the often unsatisfactory amount of time spent on science instruction and reasons for teachers' reluctance to teach science. There are exceptions to these findings but, in general, the literature gives a sombre picture of teachers' attitudes toward science education in primary school classrooms.

## Chapter 3

### Research Questions

#### Introduction

The literature reports teachers as lacking in confidence to teach science, having a low preference for science and generally demonstrating a poor attitude toward the subject. The major factors contributing toward or relating to this situation, according to the literature, are teachers' gender, teachers' background scientific knowledge and problems associated with teaching science. The study questions aim to examine some of these relationships, in addition to others.

The study questions address the relationship between science attitude, confidence and preference and independent variables such as qualifications, high school science subjects, years teaching, inservicing and gender. The barriers toward the teaching of science, as perceived by the participating teachers, are also examined through the study questions.

#### General Research Question

The general research question which the study investigates is:

What are the beliefs and attitudes of primary school teachers in the Bunbury region toward the subject of science?

Five specific study questions were developed to explore the general research question and are presented in the following section.

### Specific Study Questions

1. Is there a difference in the attitude toward science for teachers with different:
  - a. qualifications?
  - b. year 11 and 12 science subjects?
  - c. years of teaching experience?
  - d. time of last science inservice?
  - e. gender?
  
2. Is there a difference in preference for teaching science for teachers with different:
  - a. qualifications?
  - b. year 11 and 12 science subjects?
  - c. years of teaching experience?
  - d. time of last science inservice?
  - e. gender?
  
3. Are teachers' preference to teach science related to their use of science journals or magazines, science radio programs and science television programs?
  
4. Is there a difference in confidence to teach science for teachers with different:
  - a. qualifications?
  - b. year 11 and 12 science subjects?
  - c. years of teaching experience?
  - d. time of last science inservice?
  - e. gender?

5. According to teachers, what are the barriers toward more and better teaching of science in primary schools?

## Chapter 4

### The Experimental Design

#### The Design of the Study

The study is in the form of a survey design (see Appendix A for the survey in full). All teachers were presented with a letter of introduction including a consent form (see Appendix B) and the same survey. All teachers were to complete Part A of the survey while Part B was to be completed only by those teachers who were teaching science as part of their weekly timetable. The majority of responding teachers (82.0%) fell into this latter group. The data collected were analysed for trends and generalisations as relating to the research questions presented in Chapter 3.

#### Sample

The sample consisted of primary school teachers from nine schools in the Bunbury region. The schools consisted of six WA Department of Education schools and three private schools. The number of teachers at the schools ranged from the smallest school with eight teachers to the two largest schools with 24 teachers each. Out of the 152 teachers at these nine schools 89 responded to the survey, resulting in a return rate of 58.6%. The individual return rates from the schools spanned a large range, with a low of 34.8% at one school and a high of 90% at two schools. The return rate from the private schools (71.4%) was higher than the return rate from the WA Department of Education schools (54.7%).

### Target Population

The target population was originally intended to be all teachers in the state of Western Australia. However, it became apparent (as discussed in Chapter 1) that the teachers in the Bunbury region are not representative of the whole state and the target population was, therefore, narrowed to the teachers in the South West of Western Australia, including the metropolitan area.

### Instrument

The instrument utilised was a 28 item survey, divided into two parts, as shown in Appendix A. The items contained in the survey were of various types (Likert scale, multiple response, tick-a-box, make a comment) and, therefore, required a variety of response types.

### Data Collection

The data collection was carried out over a period of seven weeks. Before the Bunbury schools were contacted a similar school situated in the surrounding district participated in a pilot study. The teachers at this school completed the survey and gave suggestions for improvement on the design of the instrument. The data collected from the pilot study was used to trial the statistical calculations that were to be carried out on the data from the Bunbury schools.

When the pilot study was complete each school selected for the major study was contacted and the research explained briefly to the principal. An appointment was made to speak to the Principal or the science co-ordinator (as preferred by two Principals) in person and deliver the surveys. A labelled folder was left with the school for completed

surveys to be placed in which decreased the problem of surveys going missing and made the process of survey collection more smooth. Any completed surveys were collected from the schools after one week. From that point on each school was contacted in person or by phone at weekly intervals to check if any further surveys had been completed. This process continued until the end of the third term, at which time data collection was deemed complete.

A number of problems occurred during the data collection phase. One school that agreed to participate had an extremely low return rate of two surveys completed out of 22 teachers, or 9.1%. It was decided that this school be struck from the study due to the adverse effect of this low return rate on the total return rate. A comparable school, in terms of size and community situation, also from the Bunbury region was then approached and agreed to participate. This school gave a healthier return rate of 61%.

Despite constant personal contact with each school very few surveys were completed after the first week of circulation and collection. The reason for this is not known. It is possible that after one week the non-responding teachers had forgotten about the survey, misplaced it or discarded it. Considering the number of surveys and questionnaires (from other research) that were circulating in schools at the time this seems quite likely.

During the weeks of data collection there was an escalation in the industrial dispute between the State School Teachers Union (SSTU) and the WA Department of Education. On Thursday 21 September



1995 many teachers participated in a full day strike and during the weeks surrounding this date many teachers, by SSTU instruction, had placed a ban on any extra duties outside teaching. This industrial action did not affect the three private schools participating in the study and, hence, may explain the difference in return rates of these schools compared to the WA Department of Education schools. The private schools had a return rate of 71.4% while the return rate of the WA Department of Education schools was 54.7%. It was suggested during the study by most WA Department of Education Principals and some teachers that the current industrial action may affect the return rate and it appears that this was so.

#### Analysis of the Data

The computer package SPSS (Statistical Packages for the Social Sciences) was used to carry out the data analysis as the package is capable of performing many different statistical tests and calculations to a high level of accuracy. The statistical tests that were carried out in the analysis of the data were t-tests and one-way analyses of variance.

A few of the questions created particular problems when analysing the data. Question six, whether or not the teachers had previous occupations that were science related, was originally intended to be one of the major responses that would contribute to a score for 'teachers' scientific background' along with Year 11 and 12 science studied, post secondary science studied and inservicing completed. However, most of the teachers who responded to the survey had had no occupations other than teaching (60.7%) and only six of the teachers had had occupations that were science related (6.7%). This low percentage of

science related occupations made the use of this question in the data analysis very impractical and it was therefore only useful for background information.

Questions nine and ten, which were posed to gain an understanding of the science units teachers had completed in their preservice and inservice instruction, caused a large amount of confusion for the teachers participating in the study. The problems the teachers found with these questions were:

- Seven percent of the teachers didn't understand what the question was asking.
- Thirteen percent of the teachers couldn't remember how many science units they had completed.
- Six percent of the teachers gave a very unlikely answer according to the amount of qualifications completed.
- Eleven percent of the teachers stated they had completed no science units at all, which was also quite unlikely.
- Fifteen percent of the teachers did not answer the question.

All other teachers (48%) gave what could be called reasonable or likely answers, according to their qualifications, but even these must be taken with caution. It appears that some of these teachers confused the terminology, that is, interchanged the answers to the two questions. Due to the large number of problems these two questions created it was decided that it would be best to omit them from the data analysis. Any findings that involved this data would be skewed and an unrealistic representation of the population surveyed.

## Chapter 5

### Findings

#### Introduction

This chapter is organised into four sections, the first reporting the background information on the responding teachers, including demographics and information about the teachers' qualifications and scientific background. The second section reports on science related behaviours of teachers, such as their use of science journals or magazines, radio and television programs, the time they spend on science instruction, the placement of science in their class timetable, strategies and equipment utilised for science and extra science activities that they involve their class(es) in. The third section focuses on teachers' attitude, preference and confidence and addresses the first four study questions while the fourth section examines study question five, the barriers toward science teaching.

#### Background Information on the Responding Teachers

The questions at the beginning of the survey (Questions 1-8 and Question 11) were posed for the purpose of gaining demographic and background information from the teachers who participated. The findings relevant to these questions are reported in this section.

Two thirds of the responding teachers were female (66.3%) and one third were male (33.7%). Of the responding teachers 64 (71.9%) were teaching in WA Department of Education schools and 25 (28.1%) were teaching in private schools. The overwhelmingly common teaching status was 'permanent' with 87.6% of teachers holding this status.

Temporary teachers totalled 6.7% while 'permanent-on-probation' teachers and relief teachers totalled 4.5% and 1.1% respectively. The only relief teacher who participated in the study was relieving at a particular school for the period of one term. Teachers who were on short-term relief at the participating schools were not requested to participate in the study. Table 5.1 outlines the teaching status of the teachers at the nine participating schools, as well as the totals according to public or private schools.

*Table 5.1*

The teaching status of teachers at both WA Department of Education schools and Private schools.

| Teaching Status      | Permanent   | Permanent on probation | Temporary | Relief    | Totals       |
|----------------------|-------------|------------------------|-----------|-----------|--------------|
| WA Dept of Education | 56<br>62.9% | 1<br>1.1%              | 6<br>6.7% | 1<br>1.1% | 64<br>71.9%  |
| Private Schools      | 22<br>24.7% | 3<br>3.4%              | -         | -         | 25<br>28.1%  |
| Totals               | 78<br>87.6% | 4<br>4.5%              | 6<br>6.7% | 1<br>1.1% | 89<br>100.0% |

As expected, the most common type of teaching position held was 'full time teacher of one class' (73%). This was followed by teachers holding

a combined teaching/administration position (14.6%), with all other types of teaching positions having very low percentages.

The frequencies gained from question four: "What year level(s) are you currently teaching?" gives some insight into the teachers who did not respond to the survey. Table 5.2 summarises the teachers' responses to this question.

*Table 5.2*

Year levels taught by the responding teachers.

| Year level(s) | Frequency | Percentage |
|---------------|-----------|------------|
| K             | 5         | 5.6%       |
| K/1           | 1         | 1.1%       |
| K-2           | 7         | 7.9%       |
| 1             | 3         | 3.4%       |
| 1/2           | 5         | 5.6%       |
| 2             | 5         | 5.6%       |
| 2/3           | 1         | 1.1%       |
| 3             | 6         | 6.7%       |
| 3/4           | 3         | 3.4%       |
| 4             | 9         | 10.1%      |
| 4/5           | 0         | 0.0%       |
| 5             | 10        | 11.2%      |
| 5/6           | 3         | 3.4%       |
| 6             | 8         | 9.0%       |
| 6/7           | 3         | 3.4%       |
| 7             | 13        | 14.6%      |
| Mixture       | 6         | 6.7%       |
| None          | 1         | 1.1%       |
| Total         | 89        | 100.0%     |

The frequencies in Table 5.2 show a prevalence of some year levels, generally the higher grades. It appears that more teachers who teach the higher primary grades responded to the survey. The data also show that there are more teachers teaching straight classes (70.8%) than split levels (21.3%) and that all year levels were represented in the survey response.

The qualifications held by the teachers were coded according to the highest qualification held. For example, if a teacher has completed a Teaching Certificate and a Bachelor of Education they will fall into the 'Bachelor of Education' category. Table 5.3 shows the qualifications of the teachers surveyed.

As reported in Table 5.3 nearly one third of teachers (32.6%) had completed a Diploma of Teaching, while one quarter (25.8%) had added to their original teaching qualification with a Bachelor of Education. Only three teachers (3.4%) had qualifications with a science background, in the form of teaching qualifications majoring in science or a Bachelor of Science degree. Due to the low number of teachers in some of these qualification categories the categories were collapsed into five for the purposes of applying a valid one-way analysis of variance. The resulting five categories were; 1) Teaching Certificate with or without Higher Certificate (n= 12); 2) Diploma of Teaching (n = 29); 3) Bachelor of Arts in Education (n=19); 4) Bachelor of Education (n = 29); 5) Non-teaching degree plus a Diploma of Education (n = 3).

*Table 5.3*

Qualifications held by the responding teachers.

| Qualifications                        | Frequency | Percentage |
|---------------------------------------|-----------|------------|
| Teachers Certificate                  | 10        | 11.2%      |
| Higher Certificate                    | 2         | 2.2%       |
| Diploma of Teaching                   | 29        | 32.6%      |
| Bachelor of Arts - Education          | 19        | 21.3%      |
| Bachelor of Education - Science Major | 2         | 2.2%       |
| Bachelor of Education - Other Major   | 21        | 23.6%      |
| Bachelor of Science with a Dip. Ed.   | 1         | 1.1%       |
| Other degree with a Dip. Ed.          | 2         | 2.2%       |
| No response                           | 3         | 3.4%       |
| Total                                 | 89        | 100.0%     |

Question six, which asked teachers to list their prior occupations, produced the following findings: 61.4% of teachers have had no occupations other than teaching and of those teachers who have had occupations other than teaching only 17.6% have had science related occupations. In addition to this, male teachers (55.2%) are more likely to have held some other occupation than female teachers (30.5%), but similar amounts of male (6.9%) and female (6.8%) teachers have previously held a science related occupation.

The number of years each teacher has been teaching spans a range from less than one year to 40 years. The average number of years teaching is 14.5 years. Fourteen years is also the mode and median of the data.

The Year 11 and 12 science subjects studied by the teachers show a definite prominence of the Biological sciences, that is, Biology and Human Biology or Physiology. Table 5.4 shows the combinations of subjects studied in Years 11 and 12 by the male and female teachers surveyed as well as the total of all teachers who studied each combination.

Some interesting trends can be drawn from the data in Table 5.4. The majority of the teachers surveyed (72.9%) studied at least one biological science subject in Years 11 and 12, while only 26.8% of teachers studied at least one physical science subject. Teachers who did not study any science in Years 11 and 12 totalled 10.1% (some had completed their secondary schooling prior to Years 11 and 12), 42.6% of teachers studied only one science subject and 47.0% of teachers studied two or more science subjects.

Female teachers show a strong trend toward biological science with 81.3% studying at least one biological subject and 74.5% studying only biological science. A considerably smaller percentage of male teachers have studied only biological science (33.3%) with 56.6% studying at least one biological science subject. In the area of physical science the trends are quite different. Female teachers who have studied only physical science total only 3.4% while male teachers who have studied only physical science total 13.3%. Nearly half of the male teachers have



studied at least one physical science subject (46.7%) while only 16.9% of the female teachers have done so.

*Table 5.4*

The science subjects studied in Years 11 and 12 by male and female teachers.

|  | Male |        | Female |        | Total |        |
|--|------|--------|--------|--------|-------|--------|
|  | Freq | %      | Freq   | %      | Freq  | %      |
| None   | 4    | 13.3%  | 5      | 8.5%   | 9     | 10.1%  |
| Biology  | 7    | 23.3%  | 20     | 33.9%  | 27    | 30.3%  |
| Human Biology  | 0    | 0.0%   | 10     | 16.9%  | 10    | 11.2%  |
| Biology and Human Biology/<br>Physiology               | 3    | 10.0%  | 13     | 22.0%  | 16    | 18.0%  |
| Physics or Physical Science                            | 4    | 13.3%  | 2      | 3.4%   | 6     | 6.7%   |
| Physics and Chemistry                                  | 5    | 16.7%  | 4      | 6.8%   | 9     | 10.1%  |
| Biology and Chemistry                                  | 3    | 10.0%  | 0      | 0.0%   | 3     | 3.4%   |
| Human Biology and Physics                              | 1    | 3.3%   | 1      | 1.7%   | 2     | 2.2%   |
| Human Biology and Chemistry                            | 0    | 0.0%   | 2      | 3.4%   | 2     | 2.2%   |
| Human Biology and/or Biology,<br>Physics and Chemistry | 1    | 3.3%   | 1      | 1.7%   | 2     | 2.2%   |
| Other  | 2    | 6.7%   | 1      | 1.7%   | 3     | 3.4%   |
| Total  | 30   | 100.0% | 59     | 100.0% | 89    | 100.0% |

The most common subject studied by both males and females is Biology with 57.6% of female teachers and 50.0% of male teachers

studying the subject. Aside from the 'Other' category the least studied subjects are Chemistry for female teachers (11.9%) and Human Biology for male teachers (16.7%). In contrast, Human Biology rates as the second most studied subject for the female teachers (45.8%) as does Chemistry for the male teachers (30.0%).

Due to the small number of teachers in some of the categories for Year 11 and 12 science subjects these categories were condensed for the purposes of applying a valid one-way analysis of variance into: 1) none ( $n = 9$ ); 2) one biological science subject ( $n = 38$ ); 3) two biological science subjects ( $n = 16$ ); 4) one or two physical science subjects ( $n = 15$ ); 5) one biological science subject and one physical science subject ( $n = 7$ ); 6) one or two biological science and two physical science subjects ( $n=2$ ); 7) one biological science and one other science subject ( $n = 2$ ).

Half of the teachers surveyed (50.0%) have been inserviced in science in the past year. Only 15.9% of teachers have never been inserviced in science. Of this 15.9%, most (57.1%) have less than four years teaching experience and it is likely that they will be inserviced in science in the near future. However, it is a concern that there were three teachers with more than eighteen years experience who had never been inserviced in science.

#### Science Related Behaviours of Teachers

Table 5.5 shows the frequencies and percentages, by gender, of teachers who subscribe to science journals or magazines, listen to science radio programs and watch science television programs.

Table 5.5

The percentages of male (M) and female (F) teachers who subscribe to science journals or magazines, listen to science radio programs and watch science television programs.

|       | Journals/Magazines |       |       | Radio |       |       | Television |       |       |
|-------|--------------------|-------|-------|-------|-------|-------|------------|-------|-------|
|       | M                  | F     | Total | M     | F     | Total | M          | F     | Total |
| Yes   | 9                  | 6     | 15    | 7     | 8     | 15    | 22         | 42    | 64    |
|       | 30.0%              | 10.2% | 16.9% | 23.3% | 13.6% | 16.9% | 73.3%      | 71.2% | 71.9% |
| No    | 21                 | 53    | 74    | 23    | 51    | 74    | 8          | 17    | 25    |
|       | 70.0%              | 89.8% | 83.1% | 76.7% | 86.4% | 83.1% | 26.7%      | 28.8% | 28.1% |
| Total | 30                 | 59    | 89    | 30    | 59    | 89    | 30         | 59    | 89    |
|       | 100%               | 100%  | 100%  | 100%  | 100%  | 100%  | 100%       | 100%  | 100%  |

As the data in Table 5.5 show only a small percentage of teachers subscribe to science journals or magazines (16.9%) or listen to science radio programs (16.9%) while the majority of teachers do watch science television programs (71.9%). More male teachers subscribe to science journals or magazines (30.0%) and listen to science radio programs (23.3%) than do female teachers (10.2% and 13.6% respectively). The percentages of female and male teachers who watch science television programs, however, are similar.

Not all of the teachers surveyed taught science, but the reasons given for this were: science was taken by another teacher for administration relief or support time, the respondent was a support or specialist teacher and science was not part of their teaching duties or the teacher swapped science with another teacher for some other subject, such as social studies. Therefore, science was taught in all of the classes of the teachers surveyed, but not always by the major class teacher.

Questions 19 and 20 were posed to find any difference between the time teachers plan for science and the amount of time they actually teach the subject. The findings from these two questions are presented in Table 5.6. From this data it can be calculated that the average amount of time teachers plan for science is within the 31-60 minutes range, as is the amount of time science is actually taught. From additional comments made by some teachers it appears that science is usually timetabled for about 60 minutes each week, so the average time science is planned and taught is likely to be in the upper levels of the 31 to 60 minutes range. There appears to be little difference between the amount of time science is planned for and the amount of time the subject is actually taught. In fact, the amount of time science is taught, when averaged numerically, is slightly more, not less as was expected. Some teachers could not give a time frame for teaching science because they taught the subject within an integrated programme.

The majority of teachers who teach science teach it as a separate subject (54.3%). Of the remaining teachers 31.4% teach science within a fully integrated programme and 14.3% teach science as both a separate subject and within an integrated programme.

*Table 5.6*

A comparison of the amount of time teachers plan for science instruction weekly and the amount of time science is actually taught each week.

|                  | Time planned |            | Time actually taught |            |
|------------------|--------------|------------|----------------------|------------|
|                  | Frequency    | Percentage | Frequency            | Percentage |
| 1 - 30 minutes   | 14           | 22.2%      | 8                    | 12.7%      |
| 31 - 60 minutes  | 25           | 39.7%      | 34                   | 54.0%      |
| 61 - 90 minutes  | 22           | 35.0%      | 20                   | 31.7%      |
| 91 - 120 minutes | 1            | 1.6%       | 0                    | 0.0%       |
| > 120 minutes    | 1            | 1.6%       | 1                    | 1.6%       |
| Total            | 63           | 100.0%     | 63                   | 100.0%     |

The most common time science is taught in the classrooms of the teachers surveyed is in the afternoon. Of the teachers who responded to this question 76.9% only teach science in the afternoon, most for only one afternoon per week. Wednesday afternoon is the most popular time for science to be taught, followed by both Tuesday and Thursday afternoons. Only a small percentage of teachers, 13.5% teach science only in the morning. It must be noted that only 52 teachers responded to the question and, hence, the findings may not be very reliable.

To obtain a realistic idea of the strategies teachers use to teach science the responding teachers were asked to indicate the strategies they used in the last science lesson they had taught at the time of completing the survey. This was a multiple-response item, that is, the teachers could select more than one strategy. It was found that of the teachers responding to this question (n = 71) 78.9% had used 'Hands-on child-centred learning' and 74.6% had used 'Group investigations'. Other prevalent strategies were 'Hands-on teacher-directed learning' (49.3%) and 'Textbooks, workbooks and worksheets' (47.9%). All other strategies listed were utilised by less than 40% of the teachers.

The majority of teachers have some sort of science equipment or display set up in their classroom or school environment (87.8% of the 74 teachers responding to this question). The most common items were 'Science books' (62.2%), 'Animals' (52.7%) and 'Plants' (47.3%).

The majority of teachers, 81.3% do not involve their classes in any special science projects or activities such as the Double Helix Science Club, Ribbons of Blue Project or Science Talent Search. The reason for this may partially be due to lack of opportunity, as it is often school policy which decides participation in projects or the implementors of the projects themselves may select schools to participate. In addition to this, participation rates in these activities and projects may have decreased during the time of survey circulation because of the industrial situation which had led to most teachers with union membership placing work bans on any extra duties other than teaching.

Most teachers, 67.6%, stated that they would be likely to hold one to two science excursions each year (assuming no industrial action). The teachers who would be likely to take their class(es) on more than two science excursions totalled 15.5% while 16.9% of teachers stated they would probably hold no science excursions in the period of one year.

### Attitude, Preference and Confidence

The teachers' attitude toward science (Question 14), preference for teaching science (Question 13) and confidence in teaching science (Question 12) are the three items from the survey that the study questions focus on. To complete the data analysis necessary to address the study questions SPSS for Windows, a computer statistical package, was utilised. One-way analysis of variance (ANOVA) and t-tests were carried out on the data to determine if results were statistically significant. Alpha was set at .05 for all tests.

The correlation coefficients of the three possible relationships between attitude toward science, preference for teaching science and confidence in teaching science were calculated to give an indication of any relationships existing between any two of the dependent variables. The weakest correlation coefficient of 0.52 was found between teachers' preference to teach science and their confidence to teach the subject. A correlation coefficient of 0.59 was found between teachers' attitude toward science and their confidence to teach the subject. The strongest correlation coefficient of 0.64 was found between teachers' attitude toward science and their preference to teach the subject.

The tables presented below, Table 5.7 to 5.10, show a summary of the average attitude, preference and confidence of the different groups of teachers for the independent variables of qualifications, Year 11 and 12 science subjects, number of years teaching and date of last science inservice. These tables are referred to where necessary in the following sections on attitude, preference and confidence.

*Table 5.7*

The average attitude, preference and confidence of teachers with different qualifications.

|            | qualifications |      |      |      |      |      |
|------------|----------------|------|------|------|------|------|
|            | 1              | 2    | 3    | 4    | 5    | mean |
| attitude   | 2.17           | 1.69 | 1.63 | 1.91 | 1.00 | 1.78 |
| preference | 4.33           | 4.33 | 3.84 | 4.35 | 3.00 | 4.18 |
| confidence | 2.10           | 2.13 | 2.18 | 2.07 | 2.25 | 2.13 |

Table 5.7 key    1 Teachers certificate with or without a higher certificate  
                       2 Diploma of teaching  
                       3 Bachelor of Arts in Education  
                       4 Bachelor of Education  
                       5 Non-teaching degree plus a Diploma of Education



*Table 5.8*

The average attitude, preference and confidence of teachers who studied different Year 11 and 12 science subjects.

|            | Year 11 and 12 science subjects |      |      |      |      |      |      |      |
|------------|---------------------------------|------|------|------|------|------|------|------|
|            | 0                               | 1    | 2    | 3    | 4    | 5    | 6    | mean |
| attitude   | 1.78                            | 1.84 | 1.75 | 1.73 | 1.85 | 1.50 | 2.00 | 1.80 |
| preference | 3.75                            | 4.51 | 4.50 | 3.93 | 4.29 | 2.00 | 3.50 | 4.24 |
| confidence | 2.09                            | 2.25 | 2.15 | 2.03 | 1.71 | 2.50 | 1.75 | 2.13 |

|               |   |   |
|---------------|---|---|
| Table 5.8 key | 0 | None  |
|               | 1 | One biological science subject                                  |
|               | 2 | Two biological science subjects                                 |
|               | 3 | Two physical science subjects                                   |
|               | 4 | One biological science and one physical science subject         |
|               | 5 | One or two biological science and two physical science subjects |
|               | 6 | One biological science and one other science subject            |

*Table 5.9*

The average attitude, preference and confidence of teachers with different years of teaching experience.

|            | number of years teaching |      |      |      |      |
|------------|--------------------------|------|------|------|------|
|            | 1                        | 2    | 3    | 4    | mean |
| attitude   | 1.72                     | 1.73 | 1.74 | 2.13 | 1.80 |
| preference | 3.39                     | 4.27 | 4.59 | 4.47 | 4.24 |
| confidence | 2.09                     | 2.20 | 2.14 | 2.07 | 2.13 |

Table 5.9 key    1    Less than five years experience  
                      2    Five to twelve years experience  
                      3    Thirteen to twenty-four years experience  
                      4    More than twenty-four years experience

Table 5.10

The average attitude, preference and confidence of teachers with different dates of last science inservice.

|            | date of last science inservice |      |      |      | mean |
|------------|--------------------------------|------|------|------|------|
|            | 1                              | 2    | 3    | 4    |      |
| attitude   | 1.84                           | 1.57 | 2.00 | 1.77 | 1.82 |
| preference | 4.21                           | 3.93 | 4.56 | 4.33 | 4.25 |
| confidence | 2.05                           | 2.09 | 2.34 | 2.12 | 2.12 |

Table 5.10 key 1 Within the last year  
2 Within the last one to three years  
3 More than three years  
4 Never

The teachers responses to the question on attitude (Question 14) and the results of the tests carried out on the data to address the study questions focusing on this dependent variable are summarised in the following section. The sections on preference and confidence are presented after the section on attitude and follow the same format.

### *Attitude*

None of the teachers surveyed rated their attitude toward science as 'Very negative'. As already discussed this may have something to do with teachers' perception of this term. Teachers who rated their attitude toward science as either 'Very positive' or 'Positive' totalled 86.6% while 11.2% of teachers stated a 'Neutral' attitude and only 2.2% stated a 'Negative' attitude. The average attitude for the entire sample,

from a high of one to a low of five, was 1.80, just above the rating of 'Positive'.

The teachers with a Teachers Certificate, with or without a Higher Certificate, had the lowest average attitude of 2.17. The highest average attitude of 1.00 occurred in the group of teachers who had completed a non-teaching degree and added a Diploma of Education (see Table 5.7 for the average attitude ratings of each group of teachers with different qualifications). It was found through a one-way ANOVA that there was not a significant difference in the average attitudes toward science for teachers within the five different qualification categories,  $F(4, 81) = 2.36, p = .06$ .

The average attitude ratings of teachers who had studied different types of science subjects in Years 11 and 12 had a small range from 1.50 (one or two biological science and two physical science subjects) to 2.00 (one biological science and one other science subject) and no significant difference,  $F(6, 82) = .14, p = .99$ , found through the application of a one-way ANOVA. See Table 5.8 for the average attitude ratings of teachers with different Year 11 and 12 science subjects.

Teachers with the least experience, less than five years, had the highest average attitude toward science of 1.72 while teachers with the most experience, more than twenty-four years, had the lowest average attitude toward science of 2.13. The average attitude toward science decreased as teacher experience increased (see Table 5.9 for the average attitude ratings of teachers of different experience). However, these

results were not found to be significant through a one-way ANOVA,  $F(3, 10) = .55, p = .66$ .

The time of teachers' last science inservice and their attitude toward science did not appear to show any trends with the highest average attitude (1.57) being held by teachers who were inserviced in the last one to three years and the lowest average attitude (2.00) being held by those teachers inserviced over three years ago (see Table 5.10 for the average attitude ratings of teachers with different inservice times). These results showed no significant differences between groups when a one-way ANOVA was carried out on the data,  $F(3, 83) = .91, p = .44$ .

The data revealed that male teachers had an average attitude toward science (1.63) that was slightly higher than the attitude toward science of female teachers (1.88). This difference between male and female teachers was not found to be significant through a t-test carried out on the data,  $t(87) = -1.54, p = .128$ .

### *Preference*

Question 13 asked the teachers to number eight subject areas in order of their preference for teaching them. The average preference for teaching science was 4.24, with a score of 1 being the highest and 8 the lowest. Only 4.6% of teachers ranked science first out of the eight areas with a slightly higher percentage of teachers, 5.7%, ranking science eighth. The most frequent ranking was four with 21.8% of responding teachers placing science in this position. The overwhelmingly frequent first place response was language with nearly half of the

responding teachers, 47.7%, placing language in this position. Mathematics also featured prominently.

The teachers with a Bachelor of Education qualification showed the lowest preference for teaching science with a score of 4.35. The highest preference of 3.00 was shown by those teachers with a non-teaching degree plus a Diploma of Education (see Table 5.7 for the average preference ratings for each group of teachers with different qualifications). These differences in preference for teaching science, and others shown between the groups of teachers with different qualifications were not found to be significant by a one-way ANOVA,  $F(4, 79) = .61, p = .66$ .

The teachers' average preference for teaching science ranged from 2.00, for those teachers who had studied one or two biological science and two physical science subjects in Years 11 and 12, to 4.51 for those teachers who had studied only one biological science subject (see Table 5.8 for the average preference ratings for teachers with different Year 11 and 12 science subjects). However, no significant difference was found between the groups when a one-way ANOVA was administered on the data,  $F(6, 80) = .95, p = .47$ .

Teachers' preference to teach science did not show a tendency to either increase or decrease with years of teaching experience, but as with attitude toward science the teachers with the least experience, less than five years, showed the highest average preference for teaching science (3.39). See Table 5.9 for the average preference ratings of teachers with

different experience. No significant difference was found between the groups in an ANOVA,  $F(3,10) = 3.01, p = .08$ .

The average preference of teachers to teach science ranged from 3.93 for those teachers inserviced in science in the last one to three years to 4.56 for those teachers inserviced in science over three years ago. See Table 5.10 for the average preference ratings of teachers with different science inservicing times. A one-way ANOVA found no significant difference between these groups of teachers,  $F(3, 81) = .32, p = .81$ .

The average preference for teaching science was higher for male teachers (3.50) than female teachers (4.63). This difference was found to be significant through the application of a t-test on the data,  $t(85) = -2.92, p = .004$ .

A significant difference was found, through the use of a t-test, between whether or not teachers subscribe to science journals or magazines and their preference for teaching science,  $t(85) = 2.23, p = .03$ . Those teachers who do subscribe to science journals or magazines had a preference for teaching science of 3.29 while those that do not had a preference of 4.42.

The teachers who listen to science radio programs had an average preference for teaching science of 3.43 while those who do not had an average preference of 4.40. No significant difference was found between these two groups in a t-test,  $t(85) = 1.88, p = .06$ .

A t-test identified a significant difference between the preference to teach science of teachers who do and do not watch science television programs,  $t(85) = 2.01$ ,  $p = .047$ . The average preference to teach science for teachers who did watch science television programs was 4.00 while the average preference for those teachers who did not was 4.84.

### *Confidence*

Teachers rated their confidence to teach science in four different topic areas: animals, plants, matter and energy. These ratings were performed on separate five-point scales, each ranging from 'Very high' to 'Very low' (see Table 5.11). A general confidence rating for each teacher was determined by averaging their four topic confidences, with the highest general confidence being one and the lowest being five.

*Table 5.11*

Teachers' confidence to teach four topic areas of primary science.

|           | Animals |        | Plants |        | Matter |        | Energy |        |
|-----------|---------|--------|--------|--------|--------|--------|--------|--------|
|           | Freq    | %      | Freq   | %      | Freq   | %      | Freq   | %      |
| Very high | 36      | 40.4%  | 30     | 35.3%  | 11     | 12.8%  | 16     | 18.2%  |
| High      | 43      | 48.3%  | 42     | 49.4%  | 34     | 39.5%  | 27     | 30.7%  |
| Neutral   | 8       | 9.0%   | 10     | 11.8%  | 32     | 37.2%  | 32     | 36.4%  |
| Low       | 1       | 1.1%   | 3      | 3.5%   | 9      | 10.5%  | 12     | 13.6%  |
| Very low  | 1       | 1.1%   | 0      | 0.0%   | 0      | 0.0%   | 1      | 1.1%   |
| Total     | 89      | 100.0% | 85     | 100.0% | 86     | 100.0% | 88     | 100.0% |



The teachers were most confident to teach animals (average confidence 1.74), followed by plants (average confidence 1.84), matter (average confidence 2.45) and energy (average confidence 2.49). The average general confidence was 2.13. All of these confidence levels show values above neutral (3.00), that is, for no topic did the average confidence show teachers as having low or very low confidence.

The five groups of teachers with different qualifications reported very similar confidence levels from a high of 2.07 (Bachelor of Education group) to a low of 2.25 (Non-teaching degree plus a Diploma of Education group). The confidence level of teachers with different qualifications did not show a significant difference in a one-way ANOVA,  $F(4, 81) = .09, p = .99$ . See Table 5.7 for the average confidence ratings for each group of teachers with different qualifications. There was also no significant difference ( $p > .05$ ) in the confidence of teachers with different qualifications to teach the four stated topic areas.

No significant differences were found in a one-way ANOVA between teachers' Year 11 and 12 science subjects and their confidence to teach animals ( $F(6, 82) = .18, p = .98$ ), plants ( $F(6, 78) = .81, p = .56$ ), matter ( $F(6, 79) = 1.06, p = .39$ ) or energy ( $F(6, 81) = 1.21, p = .31$ ). Also, a one-way ANOVA located no significant difference between teachers' Year 11 and 12 science subjects and their general confidence to teach science,  $F(6, 82) = .92, p = .48$ . See Table 5.8 for the average confidence of teachers with different Year 11 and 12 science subjects.

The highest average confidence for teaching science, of 2.07, was shown by the teachers with more than twenty-four years experience.

However, the average confidence for each group of different years of teaching experience were very similar with a total range of only 0.13. See Table 5.9 all of these confidence ratings. No significant difference was found between the groups through a one-way ANOVA,  $F(3, 10) = 1.02, p = .42$ .

Very little range in average confidence (0.29) was found between the teachers of different science inservice times. See Table 5.10 for the average confidence of teachers with different science inservice times. No significant difference was found between the average confidence of these groups through a one-way ANOVA,  $F(3, 83) = .70, p = .56$ .

The average confidence of male teachers to teach science (1.95) was higher than the average confidence of female teachers to teach science (2.23). However, this difference in confidence was not found to be significant in a t-test carried out on the data,  $t(87) = -1.85, p = .68$ .

Although the female teachers were found to have slightly higher levels of confidence than male teachers to teach the science topics of animals (female: 1.68, male: 1.87) and plants (female: 1.82, male: 1.87), these differences were not found to be significant in t-tests applied to the data,  $t(87) = 1.11, p = .27$  and  $t(83) = .28, p = .78$  respectively.

Male teachers were found to be more confident than female teachers to teach the topics of both matter (male: 2.12, female: 2.62) and energy (male: 2.00, female: 2.74). These differences were found to be significant in both cases through t-tests,  $t(84) = -2.73, p = .008$  and  $t(86) = -3.58, p = .001$ , respectively.

### Barriers Toward More and Better Teaching of Primary Science

At the completion of the survey the teachers commented on the barriers toward more and better teaching of science in primary schools (see Appendix C for the teachers' views on the barriers toward science and Appendix D for extra comments made). Sixty-seven of the participating teachers chose to comment on the barriers. Some trends emerged from this information resulting in the barriers stated being grouped into twelve area of concern, listed in order of frequency in Table 5.12.

*Table 5.12*

Teachers' perceptions of the barriers toward more and better teaching of science in primary schools.

| Barriers   | Freq | %     |
|--|------|-------|
| Availability of equipment, materials and resources     | 41   | 61.2% |
| Time and organisation of science lessons               | 22   | 32.8% |
| Lack of inservicing in science                         | 10   | 14.9% |
| Lack of teacher training and knowledge in science      | 9    | 13.4% |
| Lack of science funding                                | 8    | 11.9% |
| Large classes, problems of control, supervision, room  | 8    | 11.9% |
| Deficiencies in texts/syllabus, lack of teaching ideas | 7    | 10.4% |
| Not a priority subject, lack of school support         | 7    | 10.4% |
| Few areas for experiments, equipment and displays      | 6    | 9.0%  |
| Teacher interest, attitude and confidence              | 5    | 7.5%  |
| Timetable difficulties                                 | 5    | 7.5%  |
| Other  | 3    | 4.5%  |

The most common barrier, according to the teachers is the availability of equipment, materials and resources to teach science (61.2%) followed by the amount of time and organisation it takes to set up effective hands-on science lessons (32.8%). All other barriers were stated with much smaller frequency.

### Summary of Major Findings

- Weak correlations were found between teachers' preference to teach science and confidence to teach science and teachers' confidence to teach science and attitude toward the subject. A slightly stronger correlation, that still indicated a relatively weak relationship, was found between teachers' attitude toward science and preference to teach the subject.
- No significant differences were found, through the use of one-way ANOVA and t-tests, between the independent variables of qualifications, Year 11 and 12 science subjects, number of years teaching and inservicing and the dependent variables of attitude toward science, preference for teaching science and confidence to teach science.
- No significant differences were found, through the use of t-tests, between the independent variable of gender and the dependent variables of attitude toward science and confidence to teach science.
- A significant difference was found, through the use of a t-test between the independent variable of gender and the dependent variable of preference to teach science.
- Through the use of t-tests, significant differences were found between the independent variables of whether or not teachers subscribe to science journals or magazines and watch science

television programs and the dependent variable of preference for teaching science. No significant difference was found when the independent variable was whether or not teachers listen to science radio programs.

- The barriers teachers suggested to be acting against more and better teaching of science in primary schools centred around the lack of science resources and the organisation required for effective science instruction.

## Chapter 6

### Discussion of Findings

This chapter will discuss how the findings of the study relate to the study questions presented in Chapter 3. The similarities and differences between these findings and similar topics presented in the literature will also be examined.

The study described in this paper found a majority of teachers, 86.6%, had a 'Positive' or 'Very positive' attitude toward science. However, many studies and research articles have commented on the majority of teachers, or in some cases student teachers, having negative attitudes toward science (Grindrod et al., 1991; Pedersen & McCurdy, 1992; Shrigley, 1983; Stefanich & Kelsey, 1989; Young & Kellogg, 1993). No studies could be found that reported a majority of teachers or student teachers with positive attitudes toward science. The reasons for the difference between the literature and this study are not known, but there are many possibilities. The difference may have been due to the wording of the question, resulting in teachers answering in a biased manner, some teachers may not have liked to admit to a poor attitude toward science or the teachers with a poor attitude may comprise most of the sample who did not respond.

It is possible that there was a positive bias in the responding teachers. Table 5.2, which is shown in Chapter 5, shows a prevalence in the sample of teachers who teach the higher year levels (years five to seven). It may be, in fact, that this table shows the teachers with generally a positive attitude and high confidence and that these

teachers tend to teach the higher year levels. One of the teachers who participated in the pilot study for the research stated that she was much more confident to teach science in the junior grades because it is much simpler than senior grade science and you don't need much background knowledge. She stated that her confidence to teach junior primary science would be 'Positive' while her confidence to teach senior primary science would be 'Negative'. If many teachers feel this way it may be the case that teachers in the higher year levels are those who generally have a positive attitude and high confidence toward science. Teachers without this attitude and confidence may prefer the lower year levels where science is simpler.

Past research on the topic of teachers' attitude toward science appears to demonstrate confounded indicators of 'attitude'. In the literature many different terms are interchanged or used to indicate the term 'attitude', for example: motivation, interest, perception, belief, stance, confidence, preference and enjoyment. Many of these studies present an attitude rating or comment on teachers' attitude without having directly asked teachers what their attitude is. As the correlation coefficients reported in this study show, confidence in teaching science and preference for teaching science are not the same as attitude toward science and cannot be validly used to determine this attitude. Also, there are problems with using the other terms mentioned to measure attitude toward science as, for example, a teacher may enjoy science but not have a positive attitude toward teaching the subject. The only study found that directly asked teachers to comment on their attitude toward science was that by Grindrod et al. (1991) who found very different results to the study reported on in this paper, with only 15%

of trainee teachers stating a 'Positive' or 'Very positive' attitude toward science.

Of the responding teachers 4.6% ranked science as their first teaching preference and 41.3% ranked science as their fourth or fifth teaching preference out of eight subject areas. These findings are similar to those reported in the literature. Studies located that have examined teachers' preference for teaching science (Manning et al., 1982; Mechling et al. and Westerback, cited in Pedersen & McCurdy, 1992; Pedersen & McCurdy, 1992) have all come to similar conclusions. A study carried out at the University of Nebraska found science was ranked fourth or fifth out of seven curricular areas by 37.50% of the responding teachers (Pedersen & McCurdy, 1992). A study by Manning et al. (1982) found 4% of teachers ranked science first while 51.9% ranked science fourth or fifth out of five subject areas. The difference of eight subject areas as opposed to five does not have much bearing on the similarity of the results as two of the extra three subjects to be ranked in this study (art and music) were commonly placed seventh or eighth.

The study presented in this paper found the responding teachers to have an average confidence level of 2.13, indicating that the majority of teachers surveyed rate their confidence to teach science as 'High' or 'Very high'. However, the literature portrays teachers as exhibiting a general lack of confidence (Goodrum et al., 1992; Grindrod et al., 1991; Jane et al., 1991; Manning et al., 1982; Skamp, 1991). The average confidence of the teachers surveyed by Manning et al. (1982), when converted into a numerical score, was 3.18 (from a high of one to a low



of five). The reasons for the difference between the teachers in this study and other studies are not known but may be similar to those mentioned for the difference in attitude between the findings of this study as compared to the findings in the literature.

The study found that teachers do not feel as confident to teach physical science topics as they do biological science topics. This was found to be particularly relevant to female teachers, who were markedly more confident teaching biological science but also applied to male teachers, who were slightly more confident to teach biological topics. These findings were similar to those found in the literature (Yates & Goodrum, 1990; Jane et al., 1991; Grindrod et al., 1991) but not as severe as the lack of confidence portrayed in the literature.

The most common subject studied by the responding teachers in Years 11 and 12 was Biology. In addition to this, male teachers had studied more physical science than female teachers in Years 11 and 12. These findings are also reflected in the literature (Jane et al., 1991; Skamp, 1991).

The study revealed a finding of 'no significant difference' between the Year 11 and 12 science subjects studied by teachers and their attitude toward science, preference for teaching science and confidence to teach science. Skamp (1991) found "the influence of secondary school science and/or technology studies as the main knowledge source [for teaching science] declines considerably after two years at University" (p. 294). This trend may explain the above finding, that is, the influence of the teachers' Year 11 and 12 science subjects may have lessened in their

years at college or university and were little influence on their attitude, preference and confidence feelings at the time of completing the survey.

The majority of the responding teachers who taught science as a separate subject stated they teach science within the 31 to 60 minutes per week range (54.0%). As previously discussed, the average is likely to be in the upper levels of this range. This average is similar to that reported in much of the literature. Yates and Goodrum (1990) reported 94% of teachers teach science weekly for an average time of one hour, Goodrum et al. (1992) reported that most Year 6 teachers plan to teach science for one hour each week, and J. Rowe (1992) reported teachers taught science for 61 minutes each week in 1990. M. Rowe (cited in Stefanich & Kelsey, 1989) and Manning et al. (1983) found the average time science is taught each week by American teachers to be considerably more than all of the Australian findings located.

Similar to the most prevalent thoughts by teachers in this study, the teachers reported on in the literature mention the difficulties associated with the general lack of science resources in schools and the time and effort it takes to organise science (Aubusson and Webb, 1992, Goodrum et al., 1992 and Grindrod et al., 1991). It is interesting to note that in this study few teachers, only 7.5%, mentioned that teacher interest, attitude and/or confidence were barriers to the more and better teaching of science in primary schools. However, this low percentage does appear reasonable in the context of the study as the majority of responding teachers had both a positive attitude and high confidence toward science (interest toward science was not surveyed).

Like the participants in the study by Goodrum et al. (1992) it appears that the participating teachers feel that the barriers toward science teaching are not related to their attitude toward science but are the result of factors within the school system, such as a lack of materials and funding, not enough time, lack of inservicing, deficiencies in teacher training and so on. In fact, of all of the reasons suggested by teachers 'Teacher interest, attitude and confidence' was the only barrier that they could change, all other barriers were largely beyond their control.

In conclusion, the findings of the study relating to teachers' attitude toward science and confidence in teaching science were not supported by the literature. However, parallels were found, in direction but not severity, between the confidence of teachers participating in the study and the confidence of teachers reported on in the literature to teach different science topics. Strong similarities were found between the preference of teachers to teach science in this study and the preference of teachers surveyed in the literature.

## Chapter 7

### Conclusion

#### Limitation of the Interpretations Placed Upon the Findings

##### *Sample size and composition*

The sample selected for participation was not very large to begin with (152 teachers) but was further reduced with the return rate of 58.6%, or 89 of the 152 teachers. The small number of participating teachers and the medium level return rate reduces the strength of all findings as little is known about the 63 teachers who did not respond and the 89 teachers who did may not represent any other population but their own. A larger sample size and a higher return rate would have increased the strength of the findings and more generalisation may have been possible.

##### *Industrial situation*

As previously explained, at the time of survey distribution, completion and collection a rather tense industrial situation had developed in the WA Department of Education schools. It is likely that this situation was an influence on the return rate but it also may be possible that the responses to survey questions were influenced by the situation. This factor may reduce the reliability of the findings as under different industrial circumstances the same survey may yield different findings.

##### *Anonymity*

Teachers were ensured of anonymity but this factor may still have concerned some teachers, resulting in them deciding not to participate in the study, that is, not complete the survey. A few teachers had to be

re-approached after survey collection as they had not signed the form that accompanied the survey (see Appendix B), giving their consent to participate. One of the teachers stated that their reason for not signing the survey consent form was that the survey had to be handed back to the principal and she did not want him to see what she had written.

Other teachers may not have answered all of the questions with total honesty because they were worried about being identified for negative views. After completing the survey one teacher stated that many teachers at her school may not have been totally truthful and that to gain a real understanding of teachers' attitude toward science "you need to listen to teachers in the staffroom". In the extra comments section on the survey another teacher stated "In a school focused on science and technology, I'm almost afraid to say I need help with that subject. We are expected to be good at it". Factors such as these may have influenced teachers answers.

#### *Wording of questions*

As previously discussed the wording of some questions may have skewed the findings slightly. Two questions (nine and ten) were omitted from the data analysis due to ambiguity and two other questions (12 and 14) used terms that may have been viewed as unfavourable for selection by the teachers and could have biased findings. It is possible that the average attitude and confidence ratings calculated for the sample may be higher than teachers' actual attitude toward science and confidence to teach science in practice.

### *Specific findings*

It was found that there was no difference in the attitude, preference and confidence of teachers who had last participated in science inservicing at different times. This is an interesting contrast to the 14.9% of teachers who stated that a lack of inservicing is a barrier to more and better teaching of science in primary schools. Although this percentage is not high, it appears that there are teachers who feel that inservicing in science would aid science instruction in the primary school. However, it is not known what sort of inservicing the teachers feel is necessary. For example, do the teachers feel they need inservicing on science teaching methods, science content knowledge, how to effectively utilise science resources or science teaching ideas?

A significant difference was found between teachers of different gender and their preference for teaching science, confidence to teach 'matter' and confidence to teach 'energy'. These results show that gender is the variable that is influencing the difference. However, conclusions such as this cannot be drawn from the other significant results of teacher preference for teaching science being related to whether or not teachers subscribe to science journals or magazines and watch science television programs. Significant differences were found in t-tests but it is not known if teachers with higher preference participate in these activities, if participating in these activities increases preference for teaching science or if there is a cyclic relationship, that is, both variables affect each other.

### Recommendations for Further Research

It would appear that a large number of the limitations of the research could be minimised or prevented by conducting a study through interviews instead of a survey. Teachers may be more willing to share their thoughts, feelings and perceptions in a face to face situation. However, this could cause time and organisation difficulties, which is usually why surveys are used in preference to interviews.

There is a need for some research into the type of preservice and inservice science courses teachers are taking. For example, How many teachers chose non-compulsory science courses or units?; What is the content of these courses?; Are the courses effective in increasing and improving science instruction? Research needs to be carried out on the type of inservice courses that will increase, or have previously increased, the quality and quantity of science teaching.

Teachers view the lack of resources, equipment and materials for science as a large barrier toward the teaching of science. It would be interesting to view a study that determines if resources really do make a difference to the quality and quantity of science instruction. This could be carried out through the observation of two similar schools, one as a control, receiving no additional science resources, and the other as the dependent school, receiving all resources required for effective hands-on science instruction. However, it must be noted that a study such as this could prove expensive and difficult to implement. The schools and teachers would need to be very similar to begin with (perhaps impossibly so) in terms of school size, school resources and teachers' initial attitude.

### Implications of the Study

Science first needs to be recognised as an important subject and a priority in schools. It is only when science is viewed with the importance it so deserves within the school that the problems and deficiencies in science instruction and education can be seriously addressed.

More funding needs to be devoted to science instruction in schools, which will help resolve the problems of the severe lack of equipment and resources that so many teachers struggle with. More time also needs to be devoted to science education, not necessarily by teachers who feel their time is already stretched to the limit, but by curriculum developers to make science less time consuming in terms of teacher preparation and more rewarding for the pupils. This is already being addressed through the implementation of programs such as *Primary Investigations*.

Inservice in science needs to focus on what teachers feel they need, not what the designers of these courses think teachers need. There are many areas that need to be addressed, such as the management of resources, ideas for science activities and how to successfully manage a science program where the teacher is lacking in scientific knowledge (and probably confidence). Preservice courses can also help here. Effective preservice science courses in the first place can decrease the need for inservice courses later in teachers' careers.



One of the easiest ways to aid effective science instruction is to have teachers sharing their ideas and talking about their own science teaching. By doing this, teachers would be taking control of their own learning in science. However, this does take time and a commitment by teachers to increase the quality of the science instruction in their school and with all the different priorities and demands being placed on teachers and schools and the industrial concerns at the present this may not be a possible or attractive alternative for teachers.

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## **APPENDIX A**

### **PRIMARY SCHOOL TEACHERS' BELIEFS AND ATTITUDES TOWARD SCIENCE SURVEY**

# Primary School Teachers Beliefs and Attitudes Toward the Subject of Science

## PART A: To be completed by all teachers

1. Gender?

- ☐ Male  
☐ Female

2. Teaching status?

- ☐ Permanent  
☐ Permanent on probation  
☐ Temporary  
☐ Relief

3. Are you a/an:

- ☐ Administrator?  
☐ Full time teacher of one class?  
☐ Part time teacher and part time administrator?  
☐ Tandem Teacher?  
☐ Support Teacher?  
☐ Specialist Teacher? (area/s) \_\_\_\_\_

4. What year level(s) are you currently teaching? \_\_\_\_\_

5. What post secondary qualifications do you have?

| Institution | Award | Year |
|-------------|-------|------|
|             |       |      |
|             |       |      |
|             |       |      |
|             |       |      |
|             |       |      |

6. Have you had any occupations other than teaching?

- ☐ No  
☐ Yes (Please specify occupation/s and years in each)

| Occupation | Years |
|------------|-------|
|            |       |
|            |       |
|            |       |
|            |       |
|            |       |

7. How many years have you been teaching? ☐

8. Which science subjects did you study in Years 11 and 12?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Coding  
(office use)

☐
☐
☐
☐
☐
☐
☐
☐

9. How many science curriculum or teaching methods units have you completed in your pre service and post service teacher training? ☐

10. How many science content or knowledge units have you completed in your teacher training or in any other post secondary education? ☐

11. I last participated in science in-servicing:

- ☐ Within the last year  
☐ Within the last 1 - 2 years  
☐ Within the last 2 - 3 years  
☐ Within the last 3 - 5 years  
☐ Over 5 years ago  
☐ Never

12. When teaching the following science topics my confidence is:

|           | Animals | Plants | Matter | Energy |
|-----------|---------|--------|--------|--------|
| Very high |         |        |        |        |
| High      |         |        |        |        |
| Neutral   |         |        |        |        |
| Low       |         |        |        |        |
| Very low  |         |        |        |        |

13. Rank the following subject areas in order of your preference for teaching (from 1-most preferred to 8-least preferred).

- |                                   |   |
|-----------------------------------|---|
| <input type="checkbox"/> Art      | <input type="checkbox"/> Health             |
| <input type="checkbox"/> Language | <input type="checkbox"/> Mathematics        |
| <input type="checkbox"/> Music    | <input type="checkbox"/> Physical Education |
| <input type="checkbox"/> Science  | <input type="checkbox"/> Social Studies     |

14. My attitude toward science when teaching my preferred year level(s) is:

- ☐ Very positive  
☐ Positive  
☐ Neutral  
☐ Negative  
☐ Very negative

15. Please indicate if you do any of the following:

- ☐ Subscribe to a science journal or magazine  
☐ Listen to science radio shows  
☐ Watch science television programs

16. Do you teach science at the present time?

- ☐ Yes  
☐ No (please specify why you don't teach science)



**PART B:** To be completed only by teachers who teach science

17. Do you teach a single class only?

- ☐ Yes  
☐ No (If no, go to question 21)

18. Do other people beside yourself teach science in your class?

- ☐ No  
☐ Yes (please specify) \_\_\_\_\_

19. Over a usual week how much time do you plan for science:

- ☐ 0 minutes  
☐ 1 - 30 minutes  
☐ 31 - 60 minutes  
☐ 61 - 90 minutes  
☐ 91 -120 minutes  
☐ >120 minutes

20. Over a usual week what is the approximate average time you would actually teach science?

- ☐ 0 minutes  
☐ 1 - 30 minutes  
☐ 31 - 60 minutes  
☐ 61 - 90 minutes  
☐ 91 -120 minutes  
☐ >120 minutes

21. I generally teach science as a:

- ☐ Separate Subject  
☐ Integrated Programme (Go to question 23)

22. Which of the following times do you teach science:

|                  | Monday | Tuesday | Wednesday | Thursday | Friday |
|------------------|--------|---------|-----------|----------|--------|
| In the morning   |        |         |           |          |        |
| In the afternoon |        |         |           |          |        |

23. Which of the following strategies did you use during your most recent science lesson? (Tick as many as applicable)

- ☐ Excursions  
☐ Group Investigations  
☐ Hands-on child-centred learning  
☐ Hands-on teacher-directed learning  
☐ Researchable questions and problem solving  
☐ Structured experiments with a standard write-up  
☐ Television and videos  
☐ Textbooks, workbooks and worksheets  
☐ Other (please specify)

24. Which of the following science equipment and displays do you currently have set up in your classroom(s) or school environment? (Tick as many as applicable)
- |                          |   |
|--------------------------|---|
| <input type="checkbox"/> | Animals   |
| <input type="checkbox"/> | Science Books   |
| <input type="checkbox"/> | Chemistry set and/or materials                        |
| <input type="checkbox"/> | Environmental equipment (compost, recycling)          |
| <input type="checkbox"/> | Lego  |
| <input type="checkbox"/> | Plants  |
| <input type="checkbox"/> | Recycled materials for design and technology ("junk") |
| <input type="checkbox"/> | Other (please specify) _____                          |
25. Which of the following science activities or projects do you typically involve your class(es) in?
- |                          |                              |
|--------------------------|------------------------------|
| <input type="checkbox"/> | None                         |
| <input type="checkbox"/> | CSIRO Double Helix Club      |
| <input type="checkbox"/> | Ribbons of Blue Project      |
| <input type="checkbox"/> | Science Talent Search        |
| <input type="checkbox"/> | Other (please specify) _____ |
26. Assuming no industrial action how many times a year would you be likely to take your class(es) on science excursions?
- |                          |           |
|--------------------------|-----------|
| <input type="checkbox"/> | 0 times   |
| <input type="checkbox"/> | 1-2 times |
| <input type="checkbox"/> | 3-4 times |
| <input type="checkbox"/> | 5-6 times |
| <input type="checkbox"/> | >6 times  |
- Please specify possible locations of these excursions
- \_\_\_\_\_
- \_\_\_\_\_
27. What do you see as the barriers to more teaching and better teaching of science in primary schools?
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
28. Please use the section below to make any other comments you have about the teaching of science in primary schools.
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

☐
☐
☐
☐

## **APPENDIX B**

### **PARTICIPATION CONSENT LETTER**



EDITH COWAN  
UNIVERSITY

WESTERN AUSTRALIA  
BUNBURY CAMPUS

Robertson Drive, Bunbury  
Western Australia 6230  
Telephone (097) 80 7777  
Facsimile (097) 21 6994

Dear Teachers

Your school has been selected to participate in a project to investigate primary school teachers attitudes toward the subject of science.

This study is being carried out as a requirement for the completion of a Bachelor of Education with Honours course at Edith Cowan University, Bunbury. Permission for the study has been granted by Mr Neil McNeil, the district superintendent.

All that will be required of you is the short amount of time it will take to answer the questions given overleaf. There are no expected risks or discomfort to you from your participation in the project.

The benefits that may result from the project are an increase in the quality of preservice science courses, increased support for primary school science, a higher quality of science inservicing and the development and implementation of more appropriate science teaching materials that are more focused on teachers needs.

Any questions concerning the project entitled "The Beliefs and Attitudes of Primary School Teachers Toward the Subject of Science" can be directed to myself, Michelle McKeon, on 97 1071, or to the supervisor of the project, Mr Geoff Lummis, lecturer in Science Education, Edith Cowan University, on 80 7724.

If you agree to participate in the project described above please sign the statement below and complete the attached questions. Please complete all questions; unless instructed to do otherwise.

As it is imperative to gain a return rate of at least 70%, it would be much appreciated if you could complete the questions and return the survey, along with this form, to your school administration within one week's time.

Thank you for your assistance.

Michelle McKeon

-----  
I have read the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this activity, realising I may withdraw at any time.

I agree that the research data gathered for this study may be published provided I am not identifiable.

School \_\_\_\_\_

\_\_\_\_\_  
Participant (Signature only)

\_\_\_\_\_  
Date

## **APPENDIX C**

### **PRIMARY SCHOOL TEACHERS' PERCEPTIONS OF THE BARRIERS TOWARD MORE AND BETTER TEACHING OF PRIMARY SCIENCE**

The barriers stated by teachers were divided into 12 categories. These categories, with the specific barriers mentioned by the teachers are listed below in order of the frequency in which they were stated. The numbers following the statements listed under the barriers do not indicate frequencies, they indicate the code of the survey on which the comment was made. The surveys were coded from one to 89.

Availability of equipment, materials and resources

Lack of equipment, or access to equipment (1, 6, 22, 29, 31, 33, 44, 47, 50, 51, 66, 73, 76, 82, 87, 89)

Availability of resources, lack of resources or suitability of resources (4, 8, 15, 16, 30, 34, 36, 37, 48, 65, 67, 82, 84, 85, 87, 89)

Access to materials, availability of materials, collection of materials (11, 13, 15, 27, 42)

Availability of appropriate activities and equipment for relative age groups to explore science equipment and ideas (20)

Lack of equipment for some individuals (39)

Available materials that are easy to obtain (61)

Only laziness by class teachers to round up materials!!! (62)

Low supply/lack of equipment desired for a specific lesson (72)

Having access to materials and enough material to go around (75)

Poor management of resources (81)

The 'consumable' nature of some science activities - glue for glue guns, batteries, candles etc (82)

Resources - I buy most of my own materials and I'm not rich! Ask my union! (83)

### Time and organisation of science lessons

Time (11, 24, 34, 35, 63, 69, 84)

Time it costs to set up/organise equipment (14, 25, 38)

Time consuming to collect gear and pack away (14)

Lack of preparation time (15, 16, 17, 18, 68, 75, 76)

Preparation time to set up experiments (21, 85)

Time restraints in preparing equipment/materials (39)

Time to prepare room and materials (for hands on child centred learning through investigation) (43)

Gathering equipment, etc, is time consuming and needs lots of forward planning (70)

Time to organise resources, purchase and re-order (85)

Time to clean up science store room (85)

### Lack of inservicing in science

Inservicing (29, 34, 48)

On going of inservicing in schools (3)

Lack of in-servicing (12, 58, 69)

Not enough in-service courses (19)

Not enough inservices for those who are "afraid" of science (and have been since high school) (28)

I need inservicing in personal scientific knowledge (57)

### Lack of teacher training and knowledge in science

Teacher training (1)

Teacher knowledge (2, 35, 84)

Uneducated teachers in the science areas (19)

Not enough specialised teachers to teach trainee teachers (19)

Better understanding of the topics to be taught (22)

Teacher education (30)

Lack of content knowledge in some areas (39)

Having some individuals control the body of knowledge of science in a school (58)

#### Lack of science funding

Funding (1, 8)

Not enough money for an equipped science room (14)

Lack of funds for equipment (25, 47)

Money to buy essential items (66)

Expense of science equipment (72)

Area not budgeted for (81)

#### Large classes, problems with control, supervision and room

Class size too large for quality discussion and observations (4)

Causes trauma by children mucking around (14)

Lack of space in classrooms (25, 88)

Class organisation (35)

Supervision of children working on their own or in groups (39)

Size of classes makes working with equipment, supervision, organisation, time management very difficult (64)

Number of children in a class (67)

#### Deficiencies in texts and syllabus, lack of teaching ideas

Adequate texts (1)

Suitable references for the less science minded to use (13)

Syllabus - that allows greater consistency from year to year (33)



Good curriculum (61)

Ideas utilised in other schools being discussed - a general sharing of ideas between teachers (3)

Teaching ideas (22)

Peer education and sharing of ideas would be beneficial to me if I had to teach science (28)

Not a priority subject, lack of school support

Developing a whole school plan so things done in lower grades aren't unnecessarily repeated in higher grades (13)

More emphasis placed in language studies (19)

Lack of support in schools (52)

It not being a priority area (58)

Priority of the school (63)

Not valued (82)

Lack of assistance (84)

Few areas for science experiments, equipment and displays

Resources in schools to set up various experiments and to make displays etc (6)

Storage space for equipment and display area (21)

No appropriate areas for experiments (25)

Space to store equipment in classroom/school (54)

Storage for junk resources (82)

Lack of available classroom space to set up on going work (89)

### Teacher interest, attitude and confidence

Teacher interest (2)

Teacher confidence and attitude (13)

Lack of confidence in subject matter (36)

Confidence, lack of (18, 50)

### Timetable difficulties

Timetables in primary schools (not pre-primary) (10)

Not enough time allocated in timetable (19)

Inflexible timetables - subjects taught in blocks of time (81)

Weekly alterations to timetable (24)

Time - other subjects (74)

### Other

Accessibility to places like Scitech (8)

Teachers not being prepared to take on new ideas (12)

Industrial situation (81)

## **APPENDIX D**

### **ADDITIONAL COMMENTS MADE BY TEACHERS AT THE COMPLETION OF THE SURVEY**

#### Respondent Number 6

Close correlation with language and maths - problem solving.

Hands-on activities.

Science programs for computers.

Follow on units (themes), a science continuum - not just "flavour of the month" etc.

#### Respondent Number 12

Since taking on 'Primary Investigations' which I think is terrific, I now tend to teach science in isolation rather than as an integrated area. As I become more familiar with 'PI' I hope to return to a more integrated programme.

#### Respondent Number 13 (paraphrased due to length of comment)

Science/technology where children are guided towards findings things out for themselves generates far more interest and enthusiasm and 'after hours' activity than 'one off' type series of lessons. Children need time to explore and extend ideas as far as they want to. Children also seem to respond far better when they are given a task, told the constraints, and then 'let go' to explore/find out for themselves and to learn from their mistakes rather than following a series of step-by-step instructions, especially if the instructions are from a book. I find science sessions function best when children work either in pairs or threes but sometimes I see a need for each person to also work as an individual. I see my priority in science as getting children interested and enthusiastic and wanting to 'do science' - the skills and understandings are then developed much easier and more naturally.

Respondent Number 14

Since our new 'Primary Investigations' has been introduced we seem to have a more positive attitude. It's nice to have a set programme to teach.

Respondent Number 15

Science in our school has been much easier to teach and a more interesting and varied program has been available since we began science investigations and have had a central storage area for equipment purchasing and junk collections.

Respondent Number 17

Should be specialist teachers.

Respondent Number 20

Updated curriculum with clearly identified outcomes related to a variety of activities and ways of integrating with other curriculum areas are very desirable. Seems to be a mismatch (to some degree) between the scientific approach to learning and child discovery leaning about science topics.

Respondent Number 24

I am at present using Primary Investigations as a basis but I also add to this any incidental or topical areas in which the children show interest.

Respondent Number 26

Since 'Primary Investigations' introduced this year I believe science has been more meaningful and interesting for teacher and children.

Respondent Number 28

There needs to be more resources available aimed at those teachers afraid to teach science. (Such as well explained, illustrated and simple yet interesting experiments to teach children).

More inservices! In a school focused on science and technology, I'm almost afraid to say I need help with that subject. We are expected to be good at it.

Respondent Number 30

Primary Investigations approach and total purchase of required resources directed by a school science coordinator has improved Science Ed in this school. Lack of resources is always the greatest setback to science teaching - I've taught in a lot of schools.

Respondent Number 34

Science in pre-primary is on going and incorporated in all subject areas.

Respondent Number 35

Teachers in junior grades are primarily concerned with teaching basic language and basic maths. Science in these classes - by necessity - can not be a major feature but is often used as a theme.

Respondent Number 47

Science should be experiment oriented - to pose a question to the children and it should be hands on and enjoyable fun.

Respondent Number 61

We have started using Primary Investigations across the whole school and the level of science lessons and overall enthusiasm has improved greatly.

Respondent Number 64

Many teachers lack science background and feel insecure.

Respondent Number 66

Evaluation in group or child centred investigation is difficult and very time consuming.

Respondent Number 67

We need more exciting interesting and simple science experiment ideas for year one children.

Respondent Number 70

Science in an integrated programme is much easier than trying to teach it as a separate subject.

Respondent Number 73

I thoroughly enjoy teaching science and with hands on equipment children really catch on to new concepts taught.

Respondent Number 74

I enjoy it especially as it's possible to investigate.

Respondent Number 81

It is probably about time the science syllabus documents were updated.

Respondent Number 82

Unless science is identified in the school plan it is a 'poor' cousin due to the high profile of language due to first steps. The focus on technology is getting teachers (who would otherwise ignore science) 'back in'.

Respondent Number 83

Very little help for physical or ideas resourcing. Need for better inservice and PD being available. Being female I'm often overlooked or patronised when asking for help. Usually the male specialists don't give the same help, female = thick! can't possibly know about science and technology.

Respondent Number 85

Kids love 'hands on' approach and science is an avenue for this and comes straight from the curriculum.

Respondent Number 89

Generally I am very happy to teach the subject of science and would integrate it where possible, I have seen Primary Investigations books and feel they would add to my confidence in areas where I lack it, ie matter and energy. I would use a variety of teaching strategies with the focus on hands-on collaborative learning.