Science Centers and Outdoor Education Centers Provide Valuable Experience for Pre-service Teachers.

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The science curricula of elementary schools in Australia are being revised to reflect ten common goals for national schooling (AEC, 1989). This revision process is supported by initiatives such as the Science Curriculum and Teaching Program (Curriculum Corporation, 1992) and the National Primary (elementary) Science Project (Australian Academy of Science, 1992). One of the priorities of the National Primary Science Project is the professional development of teachers who are reluctant to teach science. While this addresses the needs of the current workforce, it is important to acknowledge that many pre-novice teachers are also reluctant to teach science (DEET, 1989). The Discipline Review of Teacher Education in Mathematics and Science (DEET, 1989) and the report of the Prime Minister's Science Council (1990), found that many pre-service teachers in elementary education were entering the profession without the basic skills necessary for effective science instruction. As they lacked the confidence and background knowledge needed, they were reluctant to teach science (DEET, 1989). Thus, even if the National Primary Science Project succeeds with many of the teachers currently in schools, the issue of reluctance to teach science may re-occur as new teachers enter schools and replace those who retire or resign.

This paper reports on a project that provided pre-service teachers with experiences designed to increase their background knowledge of science, and to encourage them to teach sclence.

Background

After reviewing recent studies such as those mentioned previously, the science educators at the University of Wollongong decided that the issue of teacher reluctance in science education needed to be addressed. The literature had shown that many in-service and pre-service teachers were hesitant when they involved children in "hands-on" activities (DEET,1989). Therefore, it was decided to employ a strategy that allowed preservice teachers to instruct hands-on science to small groups of children. An interactive science center and an outdoor field study center were chosen as venues for the hands-on teaching experiences. These venues were chosen because: visiting children were arranged in small groups so teaching students were available, pre-service teachers could modify and repeat unsuccessful activities, hands-on material was readily available, and teachers and lecturers were available to supervise and video tape lessons for evaluation purposes.

The pre-service teachers contributed to the programs offered at both venues, by extending and diversifying what was currently offered to visiting schools. Except for minor travel expenses, there was no cost to the students or the university.

The Science Center

The science center used is located on the university campus. It serves schools as well as the general public and is open seven days a week with weekday sessions restricted to school bookings. Evenings are available for various public groups such as scouts, service clubs, and church groups. A study of the effects of family visits to science centers by Gennaro and Hereid (1986) showed that the experience had encouraged participating families to re-visit the original center and to visit other centers. They also reported that the visit stimulated an increased interest in science and technology.

Oppenheimer, founder of the San Francisco Exploratorium, felt that visitors to interactive science centers needed time to experiment and discover. He stated that "only a limited amount of understanding comes from watching someone behave; one must watch what happens as one varies the parameters that alter the behaviour" (Oppenheimer, 1972). Therefore, exhibits can be thought of as a "library of props" that can be used to demonstrate scientific concepts through self-exploration and hands-on experiences.

Discovery by self-exploration is one of the strengths of the science center used in this study. However young children, in particular, do not yet have the skills to fully appreciate the exhibits without careful guidance from explainers (Chamberlain, 1987). The explainer's task is to instil confidence and to guide in the learning process as well as to keep order. Often they do this by guiding small groups of children and, as a result, have to learn considerable communication skills (Finson & Enochs, 1987). This benefits both the children and the explainer (Danilov, 1986).

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Diamond et al (1987) interviewed over 800 explainers from the San Francisco Exploratorium and found that the experience had strong and persistent impacts. Working as an explainer "had a major influence on the development of their curiosity, interest and confidence in learning science," and approximately one-third of the respondents indicated that the program strongly stimulated their interest in science.

The Outdoor Field Study Center

The outdoor field studies center is located in a rainforest area 10 kilometres from campus. It has two full-time teachers who collaborate with lecturers and pre-service teachers to plan the instructional activities related to this study. All instructional activities relate to the three main themes of the center: education in, education about, and education for the environment. A typical day visit to the center commences with activities that develop skills of observation and manipulation so that visiting children can effectively learn in the environment. This is followed by a series of activities designed to instruct children about the environment. Activities employed during the final part of the day are designed to encourage children to participate in action for the environment.

The most convenient time to organise instruction by pre-service teachers was at the start of a day visit because times and locations were known in advance, but before any instruction commenced, the staff of the field studies center inspected the locations for potential safety hazards. Preservice teachers worked with small groups of five or six children. Thus a class of thirty children could be divided into five groups to accommodate five pairs of preservice teachers. Most activities consisted of hands-on investigations of the natural environment at a series of selected locations along a short section of a nature trail. To avoid overcrowding, each pair of preservice teachers was allocated to a different section of the trail.

Method

The study involved 103 second year B. Ed. pre-service teachers enrolled in a one semester subject that was part of the Bachelor of Education program at the University of Wollongong. All students enrolled in this subject were required to instruct a small group of elementary school children at each venue, and this task was a compulsory component of the subject.

The science center

All pre-service teachers attended a briefing session at the science center. This consisted of a guided tour plus a period of self-exploration. After the briefing, they observed an explainer who worked with visiting children over a two hour period. The explainer was observed welcoming children to the center, outlining the behaviour expectations, guiding them through a series of exhibits with explanations, and then supervising them in the exploration of the hands-on exhibit area. Pre-service teachers were then allocated a time to return and guide a group of approximately eight children through the center.

The field studies center

The rationale for the activities employed at the field studies center was presented by the subject lecturer, prior to the visit to the field studies center. All students visited the field studies center for a briefing session led by the director. After the briefing preservice teachers were divided in class sized groups (typically 30) and then taken along a section of a nature trail where they participated in hands-on investigations that would be suitable for visiting classes.

After the visit, pre-service teachers were required to return to the field studies center and work in pairs to prepare, implement and evaluate a forty minute sequence of outdoor education instruction as described previously. Because the campus was so close, pre-service teachers did not have difficulties in returning to the field studies center to implement planned instruction. Their preparation, implementation and evaluation of outdoor environmental instruction was assessed by peers and teachers at the center. At the end of the semester the pre-service teachers were asked to write an evaluation of their teaching experiences at the science center and the outdoor field studies center. They were asked if they had prior experience with the centers, and then to indicate any major effects that the experiences had upon them. Finally, they indicated on a five point scale (1-very high to 5-very low) how strongly the experiences had affected their desire to teach science to young children.

Twenty subjects (10 male and 10 female) were randomly selected for interviews after the original responses had been collated, coded and analysed. Each of these subjects were interviewed by the author who followed the same schedule each time. Questions developed for the interview schedule were designed as a reliability check for the pattems of data that emerged from the written responses.

Results

Four pre-service teachers (3 males, 1 female) had visited the science center before the program commenced, and two females had previously visited the outdoor field studies center. Therefore, both centers provided a new experience for most pre-service teachers.

At the end the program 94% of females and 89% of males indicated that they had greater self-confidence in their ability to instruct children in science. Fourteen subjects (10 female, 4 male) interviewed said that they did not feel

confident at the start, because their previous experience with science hands-on experiments at high school were very limited. Four of this group (3 female, 1 male) also mentioned that they were also unsure of their own knowledge and understanding of science concepts. The written evaluations indicated that they viewed the experience as valuable and rewarding, and many remarked on the enjoyable aspects of this approach to learning. Typical responses about the science center included:

Female 1: It made science fun and gave simple explanations for complex displays. Explaining was a good experience for me, one that will help me in investigating science with my own class.

Male 1: Children leave the center with the belief that science is fun- the center has served its purpose well.... It was a good experience for me, one that will help me with investigating science with my own class.

Female 2: The first thing that occurred to me when observing in the interactive science center was that a great many things which I had not really related to science were in fact science.... I learnt that when guiding children you must bring yourself to their level, discover with them if you don't know the answers.

Male 2: If anything is going to popularise, de-mystify and involve a broad spectrum of the population in science, the interactive science center certainly will.

Female 3: I have come away from my visit to the science center with a much more positive and interested attitude toward science.

Similarly the pre-service teachers also found the experiences at the outdoor field studies center to be valuable and rewarding. Typical responses included:

Male 4: The experience was a great learning activity for both myself and the students. All the children were enthusiastic and very interested.

Female 4: I thought that the program was very helpful, and I would be very eager to teach in an outdoor center like this again.

Male 5: I thought that the teaching at the center was very relevant to my teaching. I thoroughly enjoyed my teaching and thought that my lessons were more successful than in the past.

Female 5: I found the entire experience to be very useful and enjoyable. Having participated in this activity, I now appreciate the field studies center and definitely plan to use it in my future teaching.

Male 6: The field studies activity gave us a well rounded view of teaching outdoors. I felt that it was definitely a worthwhile experience, but am disappointed that we cannot continue with these experiences next semester.

Table 1 shows that the science center had a slightly lower rating than the field studies center. However, there were a number of factors that could have affected the rating of the science center. Firstly, the experiences were more diverse and demanded a wider range of management skills. Secondly, the times that pre-service teachers guided children at the center were staggered across the duration of the

Table 1
How strongly the experiences influenced their desire to teach science
Males (M =26) and females (F=77)

	Percentage in each category				
	V.high	high	moderate	low	V.low
	1	2	3	4	5
science center					
F	62	19	19	0	0
M	64	19	17	0	0
field studies center					
F	72	24	4	0	0
M	74	26	0	0	0

semester. Therefore, those whose turn occurred early in the semester may have found the experience more daunting than those whose turn occurred later in the semester. During interviews pre-service teachers indicated that more orientation visits to the science center would be beneficial, and this modification will occur in 1994.

Interview data confirmed that the low risk and supportive atmosphere created by peers and lecturers were also contributing factors. Examples of some comments follow:

Female 7: You were encouraged to try things for yourself...it didn't matter if you made mistakes.

Male 7: You could discuss experiments and rehearse them before you taught it.

Female 8: The ideas were easy to use with children...we all helped each other.

Male 8: I never knew that science could be so much fun...everybody in my group always helped each other.

Conclusion

It is recognised that data from self-reporting and interviews alone cannot be regarded as conclusive, and that the findings have to be treated with some degree of caution. Nevertheless, it appears that the experiences of pre-service teachers led to an increased desire to instruct children in hands-on science. The findings from the science center support the conclusions of Diamond et al (1987) who suggested that relatively short-term programs at science centers, may be successful in stimulating self-confidence, communication abilities and interest in science. The self-reports and the interview data also suggest that it is likely that these gains will transfer to the classroom.

It is vital that teacher educators continually make use of new strategies that help trainee teachers to become more competent and enthusiastic teachers of science. This innovation is one example that had significant outcomes for the pre-service teachers involved, and follow-up studies planned for 1994 should indicate if the outcomes were sustained.

References

Australian Education Council. (1989). *The Hobart declaration on schooling: Common an agreed national goals for schooling in Australia.* Canberra: Australian Government Printing Service.

Australian Foundation for Science. (1991). First Steps in Science and Technology: Summary of the Science Education Focus Group discussions held at the Australian Academy of Science, 28-29 May, *Focus on Science and Technology Education No. 1.* Canberra: Australian Government Printing Service.

Australian Academy of Science. (1992). Primary school project announced. *Australian academy of science newsletter. 17*(1),.Canberra: Australian Government Printing Service.

Beardslee, D. C., & O'Dowd, D. D. (1961). The college student image of scientists. *Science, 5*(133), 997-1004.

Brush, L. R. (1979). Avoiding of science and stereotypes of scientists. *Journal of Research into Science Teaching, 16*(3), 237-241.

Chamberlain, A. (1987). At the exploratorium: Teaching art and science. *Educational Perspectives, 24*(2), 11-16.

Chambers, C. W. (1983). Stereotype images of scientists: The draw a scientists test. *Science Education, 67*(2), 255-265.

Chenoweth, K. (1989). A museum is something you do: Science museums help teachers bring hands on approach to class. *American Educator ,13*(3), 24-29.

Curriculum Corporation. (1992). The science curriculum and teaching program. *STCP News,* No. 1 June, 1992, Canberra: Australian Government Printing Service.

Danilov, V. J. (1986). Discovery rooms and kidspaces: Museum Exhibits for children. *Science and Children,* January 1986, 6-12.

Diamond, J. et al. (1987). The exploratorium's explainer program: The long term impacts on teenagers of teaching science to the public. *Science Education, 71*(5), 643-656.

Finson, D. F., & Enochs, L. G. (1987). Student attitudes toward science-technology resulting from visitation to a science technology museum. *Journal of Research into Science Teaching, 24*(7), 593-609.

Gennaro, D., & Hereid, D. (1986). A study of the latent effects of family learning courses in science. *Journal of Research into Science Teaching, 23*(9), 771-781.

Oppenheimer, F. (1972). The exploratorium: A playful museum combines perception and art in science education. *American Journal of Physics, 40* (July 1972), 979-982.

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