Liberty University
DigitalCommons@Liberty University

Faculty Publications and Presentations

School of Education

9-1-1993

Factors that Influence the Decision of Preservice Elementary Teachers to Concentrate in Science

Scott Watson
Liberty University, swatson@liberty.edu

Follow this and additional works at: http://digitalcommons.liberty.edu/educ_fac_pubs

Part of the Education Commons

Recommended Citation
Watson, Scott, "Factors that Influence the Decision of Preservice Elementary Teachers to Concentrate in Science" (1993). *Faculty Publications and Presentations.* Paper 15.
http://digitalcommons.liberty.edu/educ_fac_pubs/15

This Article is brought to you for free and open access by the School of Education at DigitalCommons@Liberty University. It has been accepted for inclusion in Faculty Publications and Presentations by an authorized administrator of DigitalCommons@Liberty University. For more information, please contact scholarlycommunication@liberty.edu.

Factors that Influence the Decision of Preservice Elementary Teachers to Concentrate in Science

Lynn C. Sutton, Scott B. Watson, Helen Parke, and W. Scott Thomson
East Carolina University

According to results from several recent research reports, students in the United States are falling behind their counterparts in other countries in knowledge of science (Stevenson, 1990). There exists a critical need for knowledgeable science teachers and adequate science instruction at the elementary level, and yet schools in the United States average only 18 minutes of science teaching per day in grades K-3 and 29 minutes of science teaching per day in grades 4-6 (Weiss, 1987).

Even when science is taught, the quality may be questionable. Lawrenz (1986) found that many elementary school teachers have very poor backgrounds in physical science, and many of them have serious science misconceptions. In the 1986 National Assessment (Mullis & Jenkins, 1988), 19% of third graders said they never performed experiments in science class, and 40% of third graders had conducted no science experiments in the previous month.

Shymansky, Yore, and Good (1991) conducted a study investigating elementary school teachers' beliefs about teaching science. They discovered that teachers view reading science in the same way they view reading narrative material. They also discovered that covering as many topics as possible is still an objective for most elementary teachers.

In a study conducted by Weiss (1987), only 27% of elementary teachers surveyed felt well-qualified to teach life science, and only 16% felt well-qualified to teach physical or earth science. According to the National Science Foundation (1980) only 22% of all elementary teachers feel "very well qualified" to teach science while nearly 66% feel "very well qualified" to teach reading. Another area of concern is that many preservice elementary teachers have many of the same science misconceptions as elementary students (Stepans, Dyche, & Beiswenger, 1988).

Harlen (1986) indicates that there is a relationship between teachers' attitudes toward science teaching and how the subject is taught. Fraser-Abder (1989) points out that "teachers need to feel that they have adequate knowledge of science, can teach it without fear, are comfortable using science equipment in the classroom, and are interested in science and can pass on this interest to their students before they can be classified as good elementary science teachers" (p. 561). Westerback (1982) determined that the teacher is the single most important influence on attitude toward science. Many elementary teachers are reluctant to teach science. Westerback attributes this reluctance to two major variables: (a) inadequate science background and (b) high anxiety levels which accompany poor academic performance.

Abell (1990) asked if we could reasonably expect all elementary teachers to possess the necessary conceptual understanding to teach science effectively and also achieve this same level of understanding in other areas. She proposed the concept of the elementary science specialist, an elementary education major with additional course work in science. In order to encourage prospective elementary teachers to concentrate in science, factors that influence the decision to concentrate in science must be identified. Once these factors are identified, consideration must be given to what can be done to positively influence their interest in science.

Purpose of the Study

The major objectives of this study are: (a) to identify factors that influence the decision of preservice elementary education majors to concentrate or not concentrate in science; and (b) to identify steps that might be taken in order to increase the percentage of elementary education majors concentrating in science.

Design of the Study

Survey research was utilized for data gathering related to the objectives of this study. Specifically, a questionnaire was administered to all students taking part in the study. Further information was then gathered using interview techniques with a subset of the original sample.

Sample

A total of sixty-two students from three sections of an elementary science methods course were included in this study. Approximately 95% of the students were female, 90% were white, and 95% had achieved junior level standing or above. The age range of students taking part in the study was from 20 to 38 years of age.

Volume 4, Number 4, Pages 109-114
Copyright © The Association for the Education of Teachers in Science
Correspondence regarding this article should be sent to: Scott B. Watson, Department of Science Education, East Carolina University, Greenville, NC 27858-4353.

Students in the classes involved were asked to volunteer to take part in the questionnaire. All of the enrolled students volunteered, even though no incentives were offered for doing so. Students were asked to volunteer a second time for the interview portion of the study, which was more involved and did take them out of class for 15 to 20 minutes. Approximately 25% of the students in the original sample took part in the interview portion of the study.

Data gathering for this study took place during Fall semester, 1991 at East Carolina University in Greenville, North Carolina. The required program for education majors at East Carolina University presently requires four years (eight semesters) for completion. As part of their planned program, elementary education majors must choose a 24 semester hour subject area concentration. General science is one of the many possible concentrations. It should be noted that concentrating in science does not necessarily mean that the student will eventually be a science specialist. It simply means that they will have a greater knowledge of science than most other elementary education majors.

Procedures

The questionnaire developed specifically for this study was administered to students in three different sections of an elementary science methods course. The survey was an open form in which subjects could make written responses if they wished. The results of the questionnaire were compiled and ranked in the order most frequently cited by students. The questionnaire was followed approximately two weeks later by individual student interviews. Each interview lasted approximately fifteen minutes. The interviews were semi-structured. The interviewer had an interview guide, but some deviation was permitted. The students were encouraged to explain their answers at length.

Instrumentation

A search of the traditional sources and of related literature failed to reveal an instrument suitable for gathering information for this study. For this reason, a questionnaire was developed specifically for this purpose based on an earlier questionnaire designed for use with chemistry teachers (Koballa, 1991). The following questions were asked:

1. What do you see to be the advantages of concentrating in science?
2. What do you see to be the disadvantages of concentrating in science?
3. Why would you pick another concentration over science?
4. Have your past experiences in science influenced your decision to concentrate or not concentrate in science? If so, how?
5. If science classes were geared more towards methodology of teaching, would you be more likely to choose science as a concentration?
6. Who would be most likely to convince you to concentrate in science?
7. Do you see teaching science as an advantage or disadvantage to your teaching career? Explain.
8. Does your mathematics background have anything to do with your decision to concentrate or not concentrate in science?

Results from the written survey were used to structure the open-ended interviews. In addition to asking the questions in the original questionnaire, the subjects were asked for more detailed information about their past experiences with science in their elementary, secondary, and college courses. They were also asked if a university presentation to freshmen preservice elementary teachers might influence students to concentrate in science. The students were asked what type of presentation should be given, the information that should be included in such a presentation, and who would be most effective in giving such a presentation.

Findings

The questions asked in the surveys and the interviews fell into three basic categories: (a) advantages and disadvantages of concentrating in science, (b) past experiences and their effects on the decision to concentrate in science, and (c) direct influences on the decision to concentrate in science. Each question is listed below in the proper category along with responses to the interview questions. Fifteen students were included in the formal interview process.

Advantages and Disadvantages

What do you see to be the advantages of concentrating in science?

When asked about the advantages they could see in a science concentration, nine students mentioned that they would be better science teachers if they had a concentration in science. Several students said that science would be a fun subject to teach because it involves hands on activities. Two students thought that a science concentration might make it easier for them to find a job.

What do you see to be the disadvantages of concentrating in science?

When asked about the disadvantages of choosing a science concentration, five students reported that they saw none. Four thought that science courses required much time. The other six students mentioned such things as not having

a strong science background, not being "good" in science, not feeling comfortable with science, not enjoying science, and being intimidated by mass lecture courses as disadvantages of concentrating in science. One student summed up her feelings with the phrase "Science scares me."

Why would you pick another concentration over science?

The students were asked what factors would influence their decision if they had to choose a subject area concentration. All of the students said that they would choose a subject they enjoyed because it would be easier for them to teach it, they would know more about it, and it would be easier to express themselves in that area. One student noted that people will always choose what seems easier to them. Several of the students thought that language arts and math are more important in elementary school than science.

Past Experiences

Have your past experiences in science influenced your decision to concentrate or not concentrate in science? If so, how?

Elementary school science experiences. Based on the surveys and the interviews, past experiences seem to be the most important factor on a student's decision to concentrate or not concentrate in science. Only five of the students interviewed remembered anything about science from their elementary school years. Two of them enjoyed science in elementary school. One student vividly remembered a fourth grade teacher who conducted a lot of experiments that the children could repeat for their parents. The other students that recalled having science experiences in elementary school did not enjoy them. They remembered science as being taught using a textbook and worksheets. It was the perception of these students at a very early age that science was dull and boring.

Junior high school science experiences. Most of the students remembered science instruction in middle school or junior high school, and several of them reported that they did not like it. These students did very few activities or experiments, if any, during this time. Science was perceived as difficult and full of facts. The teachers seemed to reinforce this perception by presenting science as a series of facts to be memorized.

High school science experiences. All of the students remembered taking science classes in high school. Some of them disliked all of their science courses, some liked some courses and disliked others, and three students enjoyed all of their courses. The one factor that came up in every interview was the influence of the teacher. Several of the students mentioned having some nice teachers who they believed to be smart, but who just couldn't teach well. Students enjoyed classes where the teacher conducted activities and used examples. They also liked teachers that attempted to relate science to real life.

Many of the students indicated that there were several high school science courses that they did not enjoy. These classes were characterized as requiring the students to "just learn a lot of facts." The teachers lectured, used worksheets, and tried to cover the textbook. The students reported that science was too complex for them to understand, and that the textbook contained too much "scientific jargon."

College science experiences. There were many negative comments about college science courses, and the course that received the most criticism from the students was general biology, which was perceived as a series of facts that the instructors were trying to cover in a short period of time. All of the biology courses taken by the students were taught by the mass lecture method in a large auditorium. Four of the students mentioned that the size of the class was too large, which made it difficult to ask questions.

A few of the students said that they liked the general biology course. They also had biology as a lecture course in a large auditorium, and they were questioned about the difference in their experiences as compared to the other students. One student said that she had a good background in high school biology, and another student said that the teacher taught the definitions first and then the processes, which made it easier for her. The third student said that the teacher made the course work seem like a story and then tied everything together instead of allowing it to remain a group of disjointed facts. The fourth student was the most interesting. She took biology twice because she failed it the first time. She described the first teacher that she had as very "technical" and stated that she had a "hard personality." The second teacher made the course more interesting and brought in lots of examples of the things about which she was lecturing.

Three of the students interviewed had completed a course in environmental biology, and all three said that they had enjoyed it. They did activities, took field trips, and learned about the world around them. They felt that everything they learned could be applied to real life.

Chemistry, physics, physical science, and geology were other college science courses that the students had completed. Again, the students did not enjoy courses that according to them covered large amounts of material in a short amount of time. Some of them also mentioned having trouble with the math involved in these courses. The students seemed to like the instructors who presented the information in a straightforward way and attempted to relate it to the real world.

The course which all of the students in the sample had taken was the science methods course for elementary preservice teachers. All of the students except for one said they enjoyed the course, which involves hands-on activities

through which the students are encouraged to inquire and explore. They indicated that this course is very applicable to their lives because they are learning how to teach elementary aged children. Many said that even though they were supposed to be learning how to teach science, they were also learning basic science concepts that they had never learned before.

Does your mathematics background have anything to do with your decision to concentrate or not concentrate in science?

The students were asked if their mathematics background had any effect on their achievement in and attitude toward science. Six of the students felt that mathematics had no effect on science at all, and all six of these students claimed to have a strong mathematical background. The other nine students had varying mathematical abilities, and they thought that mathematics was interrelated with science, especially in courses such as chemistry.

Direct Influences

If science classes were geared more towards methodology, would you be more likely to choose science as a concentration?

The students were asked if they thought that more elementary education majors would concentrate in science if the courses were taught in a similar manner to their science methods course, and twelve of the students thought that they would. One student suggested that science methods should be taught first in order to get students interested in science. Another student said that other science courses were just too abstract to be taught in that manner.

Who would be most likely to convince you to concentrate in science?

The students were asked who might influence them or other elementary education majors to specialize in science. Seven of the students suggested that a good science professor might convince them. Other suggestions included elementary science teachers, someone who actually specialized in science, or an elementary education major who enjoyed science.

If the science education department gave a presentation to preservice elementary education majors, what type of information should be presented, who should conduct the presentation, and would it have any effect on the decisions of elementary education majors to concentrate in science?

Some of the students said that a presentation would not be effective at all, and that most students will choose the concentration that is easiest for them. The students who felt that a presentation might have an effect suggested having someone who is believable come in and talk to them. The students suggested bringing in teachers who are currently teaching elementary science and having them tell about the things they do. They also felt that someone closer to their own age would be believable, particularly an elementary education major who has specialized in science. The presentation must catch their interest, and one student suggested that the students should actually perform an experiment during the presentation.

Other students thought that students should be told to forget everything they have ever learned about science. They feel that students enter elementary education with negative attitudes toward science, and that these attitudes are usually reinforced when they take their first few science courses. A few students suggested that special science courses should be offered just for elementary education majors.

Discussion

When the students were asked about the advantages of concentrating in science, the most popular responses were that they would be better science teachers because they would have a stronger science background and that they could perform lots of hands-on activities. These findings are similar to the findings of Atwater, Gardner and Kight (1991) who found that urban elementary teachers recognized the importance of hands-on science activities but felt they had an inadequate knowledge to teach science effectively.

The students mentioned several disadvantages of concentrating in science, including such factors as not enjoying science, science being hard and complicated, and having a poor science background. These responses were not unexpected and are similar to the findings of Lazarowitz, Baird, and Allman (1985) who identified several reasons for why students do not like science, including not doing well in science and not feeling that science is useful.

Past experiences seem to have a very significant effect on attitude toward science. When the students were describing the science courses they liked and disliked, the teachers of the courses were mentioned in almost every instance. These findings correspond with the findings of Koballa and Crawley (1985) and Westerback (1982) who found that the teacher has a very large effect on attitude toward science.

When the students described the science courses they enjoyed, they mentioned such things as activities, concrete examples, straightforward information, and experiencing success. These findings are similar to those of Hall (1990) who found that activity-oriented, process approach instruction promotes positive attitudes toward science.

Several students felt that their mathematics ability affected their achievement in science, particularly in the physical sciences. These results are consistent with the

findings of Gabel and Sherwood (1981) who found that mathematics skills were the best predictor of success on science content achievement tests.

Twelve of the students interviewed felt that more people would choose a concentration in science if the classes were taught in a manner similar to their elementary science methods course. These results seem to confirm the findings of Cox and Carpenter (1989) who found that a properly designed methods course resulted in significant gains in perceived ability to teach science.

When asked if a university presentation might be effective in increasing the percentage of the elementary education majors concentrating in science, several of the students thought that incoming freshmen already had negative attitudes toward science. These responses support the findings of Nordland and Devito (1974) who found that freshmen elementary education majors have a strong negative attitude toward science when they first enter the university. Many of the subjects interviewed thought that it would be possible to convince some students to concentrate in science, suggesting that an elementary science teacher or a good science professor should show them how much children enjoy participating in science activities. These responses support the communicator credibility findings of Martin (1985) who found that a science instructor and a university supervisor were ranked as the most credible communicators by elementary education majors enrolled in a science methods course.

Recommendations

1. College science professors should be encouraged to instill positive attitudes toward science in introductory science course work. This may be achieved by addressing student questions, covering important concepts more thoroughly, providing more inquiry activities, and teaching fewer concepts to a greater depth.
2. More activity and inquiry oriented science courses should be offered, and courses should apply to the specific needs of elementary education majors.
3. A presentation should be made to interest elementary education majors in science during their freshman year.
   (a) The presentation should be given by (1) a teacher currently teaching science in elementary school, (2) an elementary education major already specializing in science, and (3) a professor who can promote the positive qualities of the available science courses.
   (b) Students should be shown a brief videotape depicting children actively participating in science activities.
4. Students' advisors should be informed regarding the requirements of the science program and encouraged to direct some of their advisees toward science as a concentration.

References

Abell, S. K. (1990). A case for the elementary science specialist. *School Science and Mathematics, 90*(4), 291-301.

Atwater, M. M., Gardner, C., & Kight, C. R. (1991). Beliefs and attitudes of urban primary teachers toward physical science and teaching physical science. *Journal of Elementary Science Education, 3*(1), 3-12.

Cox, C. A., & Carpenter, J. R. (1989). Improving attitudes toward teaching science and reducing science anxiety through increasing confidence in science ability in inservice elementary school teachers. *Journal of Elementary Science Education, 1*(2), 14-34.

Fraser-Abder, P. (1989). Participation in a curriculum development model and its effect on teacher attitude toward science teaching. *School Science and Mathematics, 89*(7), 561-570.

Gabel, D. L., & Sherwood, R. D. (1981). High school science courses do make a difference. *School Science and Mathematics, 81*(6), 502-506.

Hall, D. A. (1990). *The effects of an innovative activity-centered biology program on attitude toward elementary teachers.* (ERIC Document Reproduction Service No. ED 284 731).

Harlen, W. (Ed.). (1986). Primary science teacher training for process-based learning. *Report of a Commonwealth Workshop.* England.

Kahle, J. B., & Lakes, M. K. (1983). The myth of equality in science classrooms. *Journal of Research in Science Teaching, 20*(2), 131-140.

Koballa, T. R., Jr., & Crawley, F. E. (1985). The influence of attitude on science teaching and learning. *School Science and Mathematics, 85*(3), 222-232.

Lawrenz, F. (1986). Misconceptions of physical science concepts among elementary school teachers. *School Science and Mathematics, 86*(8), 654-660.

Lazarowitz, R., Baird, J. H., & Allman, V. (1985). Reasons why elementary and secondary students in Utah do and do not like science. *School Science and Mathematics, 85*(8), 663-673.

Martin, R. E. (1985). Is the credibility principle a model for changing science attitudes? *Science Education, 69*(2), 229-239.

Mullis, I. V. S., & Jenkins, L. B. (1988). *The science report card: Elements of risk and recovery. Trends and achievement based on the 1986 National Assessment.* Princeton, NJ: Educational Testing Service.

National Science Foundation. (1980). *Science data book.* Washington, DC: Author.

Nordland, F. H., & Devito, A. (1974). The improvement of the undergraduate science education of prospective elementary teachers. *Science Education, 58*(3), 383-390.

Shymansky, J.A., Yore, L.D., & Good, R. (1991). Elementary school teacher's beliefs about and perceptions of elementary school science, science reading, science textbooks, and supportive instructional factors. *Journal of Research in Science Teaching, 28*(5), 437-454.

Stepans, J., Dyche, S., & Beiswenger, R. (1988). The effect of two instructional models in bringing about a conceptual change in the understanding of science concepts by prospective elementary teachers. *Science Education, 72*(2), 185-1995.

Stevenson, H. W. (1990, October). *A longitudinal study of American, Chinese, and Japanese students.* Paper presented at the Project Director's Meeting, Research in Teaching and Learning. Washington, D.C.: National Science Foundation. October 10-12.

Weiss, I. R. (1987). *Report of the 1985-86 national survey of science and mathematics education.* Research Triangle Park, NC: Research Triangle Institute.

Westerback, M. (1982). Studies on attitude toward teaching science and anxiety about teaching science in preservice elementary teachers. *Journal of Research in Science Teaching, 19*(7), 603-616.