ELEMENTARY TEACHERS' UNDERSTANDING OF SCIENCE AND ITS METHODS

JERRY B. AYERS
Tennessee Technological University, Cookeville, Tennessee 38501

ABSTRACT

The purpose of this study was to measure the understanding of science and its methods possessed by a group of elementary teachers. The Processes of Science Test was administered to a sample of 161 elementary and prospective elementary teachers in order to determine background deficiencies. Results of the study indicated that the subjects had difficulty answering questions related to the scientific method, concepts of science; judging the results of scientific experiments; and quantitative relationships. The study has implications for curricula change in the science methods requirements of prospective elementary teachers.

INTRODUCTION

Since the mid-fifties many changes have been taking place in the teaching of science. The focus of instruction in the elementary grades has shifted from a passive role for the student in which he read about science to an active role in which the student works with the tools and techniques of the scientist. Curriculum materials have been developed that focus on increasing student understanding of scientific principles and the methods of science. The major intent has been to help students develop appreciation of what a scientist does, i.e., how to set up an experiment, how to interpret hypotheses, and what conclusions may be properly drawn from the results of a given experiment. As a result of these curriculum changes, emphasis on teacher training has shifted.

Traditionally, prospective elementary teachers in Tennessee have completed a minimum of 18 quarter hours in natural sciences including a study of the basic uses of natural resources. Their major is in either an undergraduate or graduate teacher education program (Tennessee State Board of Education, 1975). Also, many prospective elementary teachers have completed a course in methods of teaching science in the elementary school. Recently questions have been raised relative to the level and type of scientific knowledge prospective elementary teachers should complete as undergraduates. For example, in a limited study conducted by Ayers (1974) it was found that almost 85 percent of all of the graduates of the Tennessee Technological University, who complete requirements for certification as an elementary teacher, had taken only courses in the biological sciences. However, it should be noted that the results of studies conducted by the American Association for the Advancement of Science (1970) revealed that there was little correlation between the amount of science courses completed and success in teaching a modern elementary science program; such as Science: A Process Approach. Therefore, based on finding this might be concluded that an individual who had completed the science requirement for high school graduation was not necessarily prepared to be an elementary school science teacher. It would, therefore, seem desirable to ascertain the level of understanding of science and its methods that prospective elementary teachers have based on the level of a high school student.

The purposes of this present study were to measure the understanding of science and its methods possessed by a group of elementary teachers utilizing a standardized high school level examination to determine the results of the study in order to aid college instructors in the pure sciences and in science methods in course improvement.

METHODLOGY

The subjects for this study were 161 students (16 males and 145 females) enrolled in eight sections of a three hour science methods course (Science for the Elementary Teacher) over a two year period (Summer 1973 through Summer 1975) at Tennessee Technological University. The subjects were either current or former science majors pursuing a teaching credential in science or teaching certification in the K-8th grades in Tennessee. Most of these teachers were enrolled in the elementary education or early childhood education or they were certified teachers taking additional work to add a teaching endorsement as an elementary teacher. The median teaching experience of the subjects was two years with a range from zero to a maximum of 15. The mean number of hours completed in the study of the formal sciences was 20 with a range from 12 to a maximum of 64. Most individuals had completed their science requirements as undergraduates by taking one or more years of biology.

The Processes of Science Test (POST) was administered to the students representatively as one of the elementary science methods courses. The POST was originally developed by the Biological Science Curriculum (BSCS) and was designed to provide an estimate of a high school student's understanding of science and its methods. The test was designed so that a student would not be penalized for scoring high on the test. The test was comprised of multiple choice and free answer items. The test was scored according to the following scale: 1 point for an exact answer; 0.5 point for an answer that was close but not quite correct; 0 point for an answer that was incorrect. The test is composed of three subscales which measure biological science (15 items), understanding of science (10 items), and crisis of paradigm existence of the scientific method (5 items). The results of the test indicate an understanding of scientific information and evidence, and the ability to form conclusions about data and the ability to screen and judge the design of experiments. The test was designed to help a student to recognize adequate criteria for accepting or rejecting hypotheses and evaluating experiments. The test is designed to examine an experimental design in science including the need for controls, predictability, adequacy of measurement. These abilities are also necessary prerequisites for an individual teaching elementary school science utilizing the modern elementary science program: such as Science: A Process Approach. Therefore, based on finding this study, it was determined that a science teacher should possess: 0.5 points were awarded on the subscale measuring biology; 0.25 point were awarded for the subscale measuring understanding of scientific information and evidence; and 0.25 point were awarded for the subscale measuring crisis of paradigm existence of the scientific method. The mean score and standard deviation for the POST was 49.6 and 12.8, respectively. A 2-tailed t-test of the difference between the mean score on the POST and the mean score on the BSCS was not significant (p > .10). The results of the POST test were compared with the mean scores of two other science test for which the mean scores were 58 and 60. It was determined that the POST scores were not significantly different from the mean scores on the other tests.

AAAS 142nd ANNUAL MEETING SET FOR BOSTON 18-24 FEBRUARY 1976

Washington, D.C.—"Science and Our Expectations: Biologic Frontiers And Beyond" is the theme of the 142nd Annual Meeting of the American Association for the Advancement of Science (AAAS), to be held 18-24 February in Boston. Several thousand scientists are expected to attend the 7-day meeting in the Sheraton-Boston Hotel and the adjacent John H. Hydes Auditorium at the Prudential Center. Some 180 symposia will be presented on topics centered around three sub-themes: Frontiers of Biological Science. Uses of Science and Technology. The scientific community, in 20 daily concurrent sessions, speakers will explore not only advances in research in various areas of science, engineering, and medicine, but also the applications of science and technology and the social and ethical implications of such use. The AAAS meeting also will feature ten public lectures by noted scientists on such topics as "Exploration of the Mid-Atlantic Riff," "Toward a Human Scientist," "The Emergence of Biochemistry," "Income Distribution," and "Looking Beyond History." The meeting will begin Monday, 18 February, and end Saturday, 23 February. In addition to the extensive scientific program, there will be an exhibition of scientific instruments and publications, which will be an integral part of the meeting for the second consecutive year.

As a part of its new Project on the Handicapped in Science, AAAS will make this year's meeting fully accessible to people who are in wheelchairs, who have visual or auditory disabilities, and who need assistance because of other impairments.

For further information, see the 14 November issue of Science, write to the AAAS Meetings Office, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036, or contact Carol L. Rogers, 202-467-4485.