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PERCEPTIONS OF SCIENCE : CHANGES NEEDED

Alvin M. Pettus
Secondary Education, Library Science
and Educational Leadership Department
James Madison University, Harrisonburg, VA 22807

ABSTRACT

Current perceptions of science as a discipline discourage students from participating in the study of science. Changes are needed in the way science is presented in schools and by scientists to change the popular perception of science as a separate and unique area of study and to increase student enrollments in science courses. Science instruction must be adapted to enable learners to associate level of understanding of science with quality of life and potential for success. Science instructors must view science as a basic area of study for all students at all school levels and they must be willing to adapt their instructional procedures to reflect that view.

INTRODUCTION

What accounts for the lack of interest in science among American students at a time when there is much publicity about the importance of science? The lack of interest is evidenced by low enrollments in elective science courses in public schools and by relatively low enrollments in science majors in colleges. The premise of this paper is that because of the manner in which science is presented, students develop perceptions which inhibit them from choosing to participate in science.

It has been evident for some time that many students begin to develop negative attitudes about science by middle or junior high school.(Yager, 1982). Some authors (DeRose, Lockard, and Paldy, 1979) have suggested that the causes of the negative attitudes were inappropriate instruction in the earlier grades and insufficient time and emphasis placed on participation in science learning activities. Raizen and Kaser (1989) indicated that teachers often spend so much time on the "so called" basics of reading, mathematics, and writing in elementary schools that science receives very little attention. They also stated that the lack of time devoted to science is compounded by the ineffective instructional approaches used by teachers of science. Fensham (1986/87) appeared to blame the condition on the nature and emphases of the science curriculum, especially the science curriculum programs that were developed and implemented during the 1960s and '70s. He associated the content and emphases or themes of the curriculums with "elite science" or being suited to only a small proportion of students.

PERCEPTIONS OF SCIENCE AND SCIENTISTS

Much of the current problem in science education seems to stem from perceptions that science is unique and different from other meaningful and profitable endeavors and that those who pursue study in science have special aptitudes and in many ways are unique and different from other people. Scientists are often viewed by students, teachers, and other citizens as uniquely bright or smart and sometimes even strange. Those who are highly motivated to study science are sometimes seen as being antisocial types who would rather mix their chemicals and

derive their formulas than associate with "normal" people. In recognition of this perception, a 1990 issue of Newsweek carried a cover story about science titled "Not Just For Nerds." (Cowley et al., 1990).

Schibeci (1986) reviewed reports to ascertain the image of science and scientists in the popular culture, community attitudes toward science and scientists, and student perceptions of scientists. His report indicated that the portrayal of scientists in the popular media has been stereotyped and that the images the popular culture holds of scientists are based on the more outlandish characteristics or behaviors of the broad range of behaviors found among scientists. Scientists have typically been portrayed as white males in white coats who are "obsessive and socially maladjusted." (Schibeci, 1986). Not surprisingly then, was the finding that students of all ages generally hold stereotyped images of scientists, or at the very least, hold unfavorable or negative images of scientists. A study by Chambers (1983) indicated that the problem may be somewhat international in scope. His study included school children from Canada and Australia as well as from the United States and he concluded that the stereotypes appear early in school children and increase as students advance through the grades. Schibeci's (1986) report related that part of the problem may be due to a general bias against intellectuals. He stated that "We need to begin to examine this important area and to attempt to identify ways in which science in popular culture might influence the teaching and learning of science in our primary and secondary schools" and that we need to place school science in the "human context."

Over the years, teachers and professionals in science have done little to dispel the notion that participation in science is a unique endeavor. Many elementary school teachers tend to hold the same images of science and scientists as the popular culture. They do not like science, enroll in only the minimum number of science classes, and teach as little science as they can. Because these teachers often do not feel comfortable teaching science, when they do teach it, it is done as a series of facts without great interest or enthusiasm. Of course, many of these teachers do not have the experiences or background to do otherwise.

Based on my observations, teachers of required science courses in secondary schools continue to emphasize the facts and vocabulary of science over its utility and the common aspects it shares with other fields. Many of these teachers demand that students who have not yet been "turned on" to science do time-consuming science fair projects as course requirements. These experiences further alienate the students, especially if they see no relationship between the experiences and everyday life.

"With no taste for science developed in their early years, it should not be surprising that most high school students breathe a sigh of relief as they end their study of science in ninth or tenth grade in a required introductory biology course." (Fort, 1990). Unless the students plan to enter a traditionally science related occupation, they see no reason to enroll in additional science courses. John Bishop (1992) reported that only 20 percent of tenth graders saw a relationship between taking the type of science and mathematics courses usually offered in the last three years of high school and becoming qualified for their occupation of choice.

Teachers of elective science courses in high school often demand that students have several prerequisites in science and mathematics. They may also use guidance

counselor accomplices to require minimum grades in the prerequisites. Therefore, the teachers of upper-level science courses usually end up teaching relatively small classes containing the very brightest students, based on the criteria applied in schools. Darling-Hammond (1990) stated that one reason for the low student participation rate in certain advanced courses in American schools is that the schools have tended to ration curricula opportunities to a small number of students who are presumed to be headed for intellectual pursuits. This perpetuates the "science for the few unique and brightest" perception.

Scientists in higher education have not provided much help in changing the uniqueness myth either. Tobias (1990) indicated that some universities offer large class sections of introductory science courses which are designed to weed out all but the most competitive and persistent students. She speculated that faculty members adhere to the belief that "true science students will not need to be appealed or pandered to," but will persevere. She argued convincingly that the manner in which science professors provide instruction in colleges and universities tends to have an adverse affect on the number and types of students who continue their study and preparation in the sciences. Based on information collected from a group of college freshmen, Brush (1979) concluded that students may avoid enrolling in the physical sciences because their self-image is far different from their view of science and their perceptions of the professors who teach the science courses. He stated that, "if students can see little of the creativity of scientific inquiry and much of the mundane drudgery, then it seems reasonable that they would shy away from the field and people in it."

As a result of his research findings, Schibeci (1986) suggested that scientists themselves often cultivate the stereotypic images of science and the scientist. When scientists display their knowledge and ability by presenting demonstrations that impress their audiences as mystical and magical, the scientists may be confirming in these people the popular and undesirable perceptions of science and scientists.

CHANGES NEEDED

If the goal is to have a scientifically literate society, we must determine how to get the non-science oriented students and the non-scientist citizenry to develop some minimum level of knowledge and understanding of science and its implications. An important part of the process involves changing the popular perceptions that science is a difficult area of study which should be reserved for people with unique interests and aptitudes and that science is a discipline that has little practical relationship to other disciplines or to non-science careers. If people perceive science knowledge and understanding as being related to their quality of life, it is likely they will be motivated to participate in activities to learn science. Another part of the process is to present science learning activities so that the target audiences can readily understand them. This part of the process is particularly important if the objective is to increase the level of understanding among all learners rather than to select from among them those who already have high levels of knowledge and interests in science.

Elementary and middle school science teachers must be required to get enough science preparation to confidently provide appropriate science instruction for their students. In addition to making sure the teachers have an adequate amount of science preparation, emphasis must be placed on adapting the preparation to

enable them to effectively apply it in teaching situations. Most elementary school teachers perceive of themselves as non-scientists. Therefore, science instruction for these teachers must be designed to help them understand the links between science and other curricular and life activities and to help them be as comfortable teaching science as they tend to be while teaching other components of the curriculum.

At the secondary school level, there is a need to provide science instruction as an integral part of the basic curriculum for all students. Hurd (1991) indicated that the content of science curricula, as well as the perspective of science instruction, needs to change. He stated that science content needs to reflect human experience and show the connections between science and personal development and social concerns. The perspective needs to change from "a historical one to a focus on learning to learn." This involves emphasizing the knowledge and skills needed to keep learning and adapting throughout life rather than emphasizing current facts related to a specific area of science.

Science teachers, school counselors, and school administrators need to subscribe to the idea that science study is appropriate for all students during every year of school. Effort should be made by those who implement curriculum to make the science offerings appropriate and relevant for students of all ability and interest levels. All students should feel welcomed to elect to take science courses throughout their secondary school years, regardless of their scholastic ability and career aspirations.

Science teachers and scientists must pace their teaching activities and presentations to avoid causing confusion and developing negative attitudes about science among students and non-scientists. This may require taking the time to make sure the non-scientists understand the vocabulary to be used and have the prerequisite knowledge and skills needed. The Association for the Advancement of Science (1990) indicated that teachers and scientists who attempt to communicate with non-scientists must be selective in the use of specialized vocabulary and terms usually associated with specialized fields in science. When used, the specialized vocabulary should be placed in a context that is meaningful to the target audience.

Science educators and scientists must accept the responsibility of communicating with and informing average students and non-scientists about science and display patience, tolerance, and empathy during the process. Brush (1979) suggested that science instructors at the college level try establishing better rapport with students by demonstrating warmth, sensitivity, and a sense of humor and by emphasizing creativity, independence, and the worth of the individual. Science instructors need to rethink the often expressed objective to have students learn to think like scientists and consider how they, as science educators, can learn to think like non-scientists so they can adapt their instruction accordingly.

SUMMARY

There is evidence that the manner in which science is treated and presented by instructors, scientists and the media has contributed to the development of perceptions of science that are undesirable and, perhaps, detrimental to the realization of a scientifically literate society. To change those perceptions, changes must be made in the traditional approaches to presenting science, especially in schools. Science must be thought of and presented as an important and practical endeavor for all.

The connections between science and other disciplines and between understanding science and success in personal life and non-science occupations must become evident to motivate serious study of science by non-science oriented students. The connections should be made evident as science lessons are taught and through the manner in which the school curriculum is structured.

Science teachers and others who present learning activities in science need to adapt those activities to the learners. They must show patience and compassion for those who may not already have great interest in science study. They must make sure the learners have the requisite vocabulary, knowledge, and skills to understand the information and activities to be presented. While continuing to accommodate and challenge the few who show exceptional aptitude and interest in science, science educators must also make effort to get all students to view on-going science study as relevant, rewarding, and basic. If this is not done, science courses will continue to be obstacle courses for "weeding out" students who do not already have high levels of interests and knowledge in science rather than serve as avenues for effectively promoting scientific literacy.

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