Iowa Science Teachers Journal

Volume 7 | Number 2 Article 9

1969

Science for Students Today and Tomorrow

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Teaching science as a body of peculiar knowledge which exists for students to learn is still a common approach in American secondary schools. This is true today even with the so-called "new" science programs and their added impetus to the idea of teaching and emphasizing the processes of science in addition to the traditional content of a given discipline. The last ten years have seen great advances. However, much more is needed before we can talk of science in in our schools that is relevant for students both presently and in the future. We have too often accepted new ideas because they are new and not because we have any real understanding of them. We too often merely give "lip service" to acceptance of a given curriculum design, a kind of teaching strategy, and/or a new evaluation technique concerning certain student learnings.

As teachers of science we must attempt to understand our own experiences that have resulted in our being science teachers. The fact that we went to college makes us different from the majority of students in our classrooms. Most of them will not enroll in a college. The fact that we enjoyed studying *about* science in our precollege and college education makes us even more unlike a greater majority of our students. Most of our students will not continue to study science beyond the required sequence in high school. The fact that we are teachers and have experienced a teacher-training program makes us unlike our students to a further degree. Relatively few of our students will become teachers and even fewer teachers of science.

It is unfortunate that we rarely consider these facts as we think about our tasks as science teachers. In this age when science is so important and exerts such an influence upon the very being of us all, we need to break the pattern of teaching science for the few —for the few who are like ourselves or the few who will become practicing scientists. We must begin to understand better our tasks as effective teachers in a swiftly changing society. We need to produce different kinds of high school graduates in terms of their experiences with science if our students are going to be ready for the life that they must live next year and in future years.

We are all victims of our environment. We all became teachers of science because we enjoyed science, because we liked our experiences as students of science, or merely because we completed courses in science in college. We tend to teach science as

it was taught to us. Unfortunately some of the worst teaching of science occurs at the college level. The primary goal is usually for greater understanding of scientific information. We, the persons who became teachers, enjoy this method and this goal or we wouldn't complete the necessary courses at the collegiate level to qualify as teachers. Perhaps the best teachers of science would be those who fail college courses or those who drop out of a major program in science because they have questioned the relevancy of the instruction. Instead, the person who "plays the game" and adapts to the system is rewarded with graduation and a teaching credential. We are such people, this is our common past environment.

What does this have to do with selecting the science and teaching behaviors for the students who will be in the world tomorrow? It has much to do with both the science and the needed methodology for science instruction! We need change. However, this change must come as a result of teachers recognizing the problem and trying to solve it. If this is done, it will represent the first time in American education that the instruction in the secondary school will dictate the kind of science and the kind of methods that the students will demand at the college level. This will be true even when the number of students who go on to college and who major in science is still a minority of all students we serve and influence in the secondary schools. While doing this we will be providing the majority of students who will not go to college with science experiences that will be relevant to their lives.

Still we have a great many secondary teachers who judge their success by how well their students do in college science courses—how easy the more advanced courses are in college—how pleased their students are with the great preparation they have to succeed in fact-mastery courses in college. We have teachers who hesitate to try new approaches to curriculum and to methodology for fear their students who go to college will be penalized. It is my contention that such teachers are displaying little concern for science instruction for their students—at least instruction that has any worth for the majority of students—either today or tomorrow.

What kinds of science give promise of greater relevancy for students? Certainly the typical courses in junior high science (i.e., life, earth, physical or science 1, 2, 3) and in high school, biology, chemistry, and physics contain little relevant content while they lend themselves well to content-centered (fact-mastery) approaches. The titles for the courses do little to capture the imagination or to suggest relevancy. Some of the new courses common to language arts and social studies are proving popular and are making these curriculum areas appear more relevant. Certainly courses such as cinematography, the issues in Viet Nam, the American newspaper, political parties, and creative writing are more exciting than courses entitled history, government, English III, etc. Yet in science we commonly retain biology, chemistry, and physics as course titles and in many cases these courses present the total high school offering in science.

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has cautioned us that all of the "new" science programs in the high school have been concerned with development of courses and not with a science curriculum. Biology, chemistry, and physics *courses* have been developed. By and large, all of these "new" courses are concerned with the same approach to the content and recommend similar techniques of instruction regardless of the curriculum project. Although these programs do not represent the first major attempts for accomplishing the same ends, they represent significant progress toward meeting the goal. The goals may be too limited for the 1970s.

It must be remembered that science operates as a part of society. Science is affected by society just as it affects society. Certainly a secondary student needs to consider these aspects of science and needs to be confronted with the significance of such consideration. This may well be an area where social studies and science teachers can cooperate with the instruction in special courses. This may be an area where the concept of team teaching can come into its own. Surely the student must consider problems of life which do not fall neatly into traditional departments such as science, language arts, social studies, mathematics, and foreign language. Neither social studies nor science teachers may feel equipped to teach such courses. However, the obvious need for such study and the desire to try by teachers and a school may well be significant to students primarily because the attempt was made when there is potential for failure.

The "new" science courses are not to be ignored. Certainly the time, effort, and the results of each of these efforts has been significant. Materials which were not previously available have been created. Teaching guides and suggestions are available to assist teachers with improving their approaches to classroom situations. Probably these courses are the best available in terms of exemplifying science as inquiry. The laboratory sequences, the research experiences, and the writing style are all designed to illustrate science as a process of investigation instead of a collection of details about life, matter, and/or energy. These courses are designed to add much to the total curriculum in science—especially for college preparatory students. Perhaps this approach and the content is not relevant for the noncollege students of least ability. At least repeated exposure to such courses for six years in the secondary school promises to provide little in student motivation or feelings of relevancy. At best such courses provide experience with only one dimension of science in the general education of all.

The "new" programs tend to ignore technology or at least to relegate it to a position of lesser importance. Certainly it is easier to consider the effect of technology upon all of our lives than it is to exemplify science as a specific enterprise of man. If technology is approached as a product of science, it certainly should be a part of the total curriculum. Some of the recent writings of Marshall McLuhan are suggestive of the concern on the part of many of the dangers of this part of our culture. (McLuhan's ideas concerning the evils of education are also most intriguing and appropriate

to this discussion. See *Playboy*, March, 1969, pages 62-64.)

Students who are interested in engineering and some of the other applied areas might well find a consideration of electronics, transportation, photography, nutrition, food chemistry, and similar courses of vital interest and significance. Such courses could also provide great intrigue and relevancy for many noncollege students. Too often such courses are relegated to industrial arts, home economics, physical education, and other departments in order that we science teachers can remain "pure." At the very least such offerings should be jointly sponsored and taught with science teachers involved. We too often let our own interests and our own environments show. We want to deal with the superior student who hopefully will continue in science in college. If science instruction is to seem relevant, science teachers must deal with areas and materials that are relevant to all students.

The kind of science for students today and tomorrow will be different from the science that now characterizes courses in biology, chemistry, and physics. The question is: Are we as science teachers ready to experiment with new courses that will be useful and interesting to all students? Will we be willing to plan courses around such problems as pollution, and the population explosion, new sources of energy, family living, drug abuse, and inheritance?

What kinds of methods are suggested for this kind of science instruction? Certainly the teacher-dominated classroom with the traditional lecture with the "verification-type" of laboratory has no place. In fact, the traditional situation in which the teacher plans the lesson, determines what investigations thirty students will all do in a given fifty-minute period, and prepares quizzes and examinations over the content is out-of-date and nonrelevant.

Although not free of problems, recent attempts with individualized instruction provide intriguing possibilities for activity-centered courses. Students can select investigations to illustrate or to extend a basic core. They can pace their own study of given problems and areas. Such self-pacing can characterize a whole course or the activity that characterizes a given unit which has been predefined in terms of time. Such approaches enable the students to gain experiences with the processes of science and to experience the more creative aspects of "sciencing." The teacher becomes a manager and a guide giving clues, encouraging certain actions, evaluating certain activities, suggesting alternative actions.

There is much new material for implementing programs involving individual instruction. Audiovisual materials can be produced or purchased to strengthen such an approach. Certainly the use of remedial as well as enrichment materials is enhanced with the individual approach over group instruction. Such approaches enable teachers to meet individual differences and to approach each student at his level. Teachers involved are unanimous in their report of a feeling of "knowing students better" with such an approach to teaching.

Use of real research projects and in-depth laboratory blocks provide other

approaches which are designed to emphasize the complexities and the interrelation of scientific ideas. These materials can be used as a part of a course and again utilize such materials at a research level while maintaining basic features of group instruction.

Seminar approaches lend themselves to some of the problem courses and to the courses dealing with philosophy of science and the interrelationship of science and society. These methods where inquiry techniques are utilized are now common in the new approaches to instruction in the social studies.

The project approach which was common fifteen to twenty-five years ago has a new place in connection with instruction in the technologically related courses. Such activity retains interest while providing the students an opportunity and a need to review basic concepts. Differences between science and technology can also be emphasized. It is important for the students to discover the dependency of technological advances upon basic science.

In summary. The secondary science curriculum has not changed significantly while we have been concerned with the great interest and activity involved with producing "new" science courses on the national scene. Some changes are needed if the science instruction in our schools is to be relevant to all students both now and in the future. We need to cooperate with other departments and other teachers in a concerted effort to make our study of science meaningful to the present and future lives of students. We need certain basic curriculum changes as well as new instructional patterns if our effect upon students in secondary science is to be realized to its fullest potential. We need science programs which are relevant now and tomorrow. We need science instruction which is different from the programs and methods which *we* have experienced as students.

NSTA Science Source Book for Junior High Teachers Available

"A Universe to Explore," a source book resulting from a joint project of the National Aeronautics and Space Administration and the National Science Teachers Association, features illustrated lessons in space science that have been successfully performed by junior high school students.

Twenty junior high school teachers coordinated their planning with officials at NASA's Goddard Space Flight Center, Greenbelt, Maryland. The teachers worked out the activities described in the book with their students who contributed significantly to the material.

Content ranges from the earth and the celestial sphere to solar cells and power sources for spacecraft. One section details how to simulate the space environment in the laboratory.

"A Universe to Explore" is available for $4 from the National Science Teachers Association. A discount of 10 per cent is applicable on request for more than one copy to ten. With an order of ten or more copies, a 20 per cent discount applies.