WHAT HAS HAPPENED TO THE "NEW" SCIENCE CURRICULA?



JAMES A. RUTLEDGE*

IT CAN probably be safely said that no other curricular reform has ever been attempted under such favorable circumstances as that which had its beginnings in the mid-fifties and essentially involved virtually every school science.

In the years following World War II, critics of school science had grown more strident with recurring complaints that school science programs were repetitive, inadequately articulated, and insufficiently developmental in character. More specific criticisms were leveled that science course content was too broad, chiefly descriptive, insufficient in depth, included undue emphasis on technology and applied science, and involved too little of fundamental ideas and principles.

The concern was also expressed that too little emphasis was being given to the philosophy and processes of science and that meaningful laboratory work was not an important part of most school science.

Growing out of these criticisms and given impetus by the dismayed reaction in this country to the Russian "Sputnik," a massive effort was mounted to develop new and improved precollege science curricula. Ample funds were provided, in large part by the National Science Foundation, to support the projects which were developed to organize and channel the work.[1]

Spearheaded chiefly by interested college and university scientists—people who were closer to the "cutting edge" of science than had been the authors of school science curricular materials of the previous several decades—an array of scientific talent never before available in such concentration for curriculum work, backed up by a number of educational specialists and science teachers, was assembled in the various projects. In developing their materials, many of the projects used a somewhat similar series of steps involving planning, writing, experimental or trial teaching, feedback, revision, and retrial.

Although triggered by a dramatic event that made immediate response seem neces-

[1] Examples of early influential projects in their fields were the Physical Science Study Committee, Chemical Bond Approach Project, Chemical Education Material Study, Biological Sciences Curriculum Study, Science—A Process Approach (AAAS), Earth Science Curriculum Project, and Introductory Physical Science Program (ESI).

* *James A. Rutledge, Associate Dean, Graduate College, University of Nebraska, Lincoln*

sary, the new curricula for school science were not viewed as stopgap measures. Rather these were seen as fundamental changes aimed at correcting what were perceived as being deep-seated shortcomings and inadequacies of the traditional school science curricula. Tinkering was not seen as a productive enterprise; a fresh start was viewed as the only acceptable move.

Common Threads

Although embodying a variety of approaches and some unique means of development, many common threads ran through almost all of the new school science curricula. Science was depicted primarily as a mode of inquiry, frequently referred to as process, and teaching-learning procedures were developed that would emphasize the use of inquiry, placing great emphasis on the use of "real" materials and upon laboratory inquiry as differentiated from laboratory exercises.

Emphasis was placed on conceptualization of science knowledge—developing generalizations and patterns which can be used to develop mental models useful in bringing order and meaning into otherwise discrete and seemingly unrelated facts—and experiences were planned which would encourage such intellectual activity.[2]

Technological aspects and so-called "practical applications" were given very limited treatment in most of the basic curricular materials developed. PSSC physics, for example, confined its treatment of technology largely to certain supplementary materials. Breadth of subject matter coverage was sacrificed for development in depth of a relatively small number of key themes, such as the nine "unifying" themes of the BSCS materials[3] or selected processes of inquiry such as in AAAS Science—A Process Approach.[4]

Seeking Acceptance

Obviously curriculum efforts of such magnitude had received considerable publicity and curiosity had been aroused among both school people and the public. As the materials resulting from the earlier projects began to assume final form, project by project, and became available for general purchase and use in the schools, science teachers, curriculum specialists, and school administrators were alerted to the materials through a variety of procedures.

Among the approaches for teachers were a continuing series of NSF-supported summer and in-service institutes, based on one or more of the new curricula and usually involving rather intensive familiarization with its content, emphasized processes, and suggested teaching methodologies. College instructors of methods courses, both preservice and advanced, were urged to deal with the new curricular materials.

Short familiarization meetings were held at a number of sites for school administrators, to give them a better understanding of the new materials. Representatives of the projects wrote articles which were included in various periodicals, both lay and professional, and appeared on the platforms and before small groups at many professional meetings to discuss the purposes and progress of their respective projects. Representatives also worked in various sections of the country with groups of teachers and schools to stimulate interest and encourage adoption. Teachers who had worked with the trial teaching of the new curricula also helped publicize the materials.

Reception in Schools

When the early project materials became available, the times were ripe for new

[2] The points of view supporting these changes have been stated in an articulate manner in: Joseph J. Schwab and Paul F. Brandwein. *The Teaching of Science*. Cambridge, Massachusetts: Harvard University Press, 1962.

[3] Biological Sciences Curriculum Study. *Biology Teacher's Handbook*. New York: John Wiley & Sons, Inc., 1963. p. 31.

[4] Arthur H. Livermore. "The Process Approach of the AAAS Commission on Science Education." *Journal of Research in Science Teaching* 2: 271-82; 1964.

materials and new approaches. Many school people were still smarting from the criticisms of school science which followed "Sputnik"—they welcomed changes that might prevent further criticism. The prestige of the scientists permeated the new school science curricula. School boards were receptive. Science as a human endeavor was in its heyday—the need for many different kinds of scientists in our society was judged to be great, and it was readily accepted that all citizens needed "scientific literacy" to live effectively in a science-oriented world.

Under these conditions, there could have been expected more substantial adoption and use of these materials than actually occurred. Actual statistics on use have been very difficult to secure since partial adoptions, uses of project materials as "supplemental," and failure to use the materials even when "adopted" as well as a complete lack of information in many quarters have beclouded the use status. But it appears clear from what firm data are available that overwhelming adoption and use have never become a reality.

Obviously, there has been wide variation from project to project. Some materials produced have had fairly wide acceptance, while others have never enjoyed very extensive use. Chemical Bond Approach Chemistry is an example of the latter group.

The reasons for somewhat limited acceptance of the new school science curricula were many. It is very difficult for some science teachers of long experience to replace those standard materials with which they are familiar and which they have used as the basis for their teaching through many revisions with new and unfamiliar materials, however good they may be. For some teachers, there was genuine mistrust of this "new" science, so different in emphasis from the science they perceived as college and university students. Many familiar aspects were gone—the technology, the application. The new materials seemed difficult and foreign—and indeed some of the new materials were difficult, being pitched to only the very able students.

For some school people there was the gnawing fear that they were being asked to accept a national curriculum, something designed by experts and being foisted upon the local schools.

Emphases in the new school science were different from the emphases found in typical undergraduate science. Even newly graduated science teachers were not equipped by their experiences in their own undergraduate science courses to deal adequately with the new curriculum materials. They became candidates upon graduation for an institute to present the science and the point of view necessary for them to handle the new school science materials. The point of view espoused by the forefront thinkers responsible for the new school science did not seem to be the point of view held by the typical college science instructor.

A further deterrent was the fact that the new curricula were not developed with any coordinated plan. Teachers who were seeking a developmental, articulated program were to be disappointed. The fact that the first of the newly developed materials was in physics rather than in elementary school science is illustrative of this problem. The new materials appeared as bits and pieces, with little attempt at coordination.

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More recently, student and public disenchantment with science and the lack of emphasis on social implications and humanistic elements [5] in many of the new school science materials have taken their toll.

Continuing Effects

Some of the more widely accepted new school science curricula will undoubtedly persist for several years and will be revised and improved in one manner or another to continue their viability. More of these curricular materials will persist with major modifications in the publications of subsequent authors and publishers who are permitted to utilize the original materials or use them as they enter the public domain, adapting as they see fit.[6]

Perhaps more far-reaching is the effect on authors and publishers of so-called "standard" curricular materials. Whether they wish it or not, they have been forced to adopt some of the content and procedures of the new school science curricula and have been stimulated to develop innovative approaches of their own in order to compete. The "standard" curricular materials will never be the same again.

The centrality of investigation and experiment in school science has been so strongly affirmed that few authors dare to ignore their import. These and other major emphases of the projects have been fixed almost indelibly in school science curricula; and while certain elements such as technology, social implications, and humanistic elements may soon become more pervasive, the thrust of the projects will not be lost for decades.

The standard of excellence set by the supplementary materials generated by many of the projects and the values to be derived from sets of integrated curricular materials will influence future curriculum developments.

The quality of the handbooks and aids for teachers which were developed have established the worth of these efforts in improving instruction and in assisting the curriculum developer in communicating with the teacher in the classroom.[7]

The projects have stimulated science curriculum development at all levels. The fact that several of the projects dealt with elementary school science has reinforced the importance of this level of school science in the total precollege science experience and has set the stage for further curriculum development at this level. The impact of the new school science curricula has been felt at the college level, and many introductory science courses have been revamped as a result of the type of preparation many entering students now bring. Inevitably, the demands upon the teacher of the new curricula have caused revision and reorientation in undergraduate courses in science both for prospective teachers and for other science students. Post-baccalaureate level science courses for teachers have also to a larger degree been designed with the specific demands of the new curricula in mind.

Perhaps one of the most far-reaching effects of the early influential projects has been the establishment of a favorable climate for curriculum innovation utilizing the joint expertise of the scientist and the educator in science. This favorable climate has led to a large number of efforts to improve science curricula from the local school level through continuing establishment of further major efforts by relatively large groups.[8]

Many millions have been spent in these project efforts. More time will be needed to assess truly their worth, but, to this author, what has happened seems on balance to have improved school science. □

[5] A notable exception is the humanistic approach to physics in the Project Physics materials which became available in late 1970.

[6] An example of such a procedure is found in: Robert W. Parry, Luke E. Stiner, Robert L. Tellefsen, and Phyllis M. Dietz. *Chemistry: Experimental Foundations.* Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970. In the preface it is stated that the book is an authorized revision of the original CHEM Study textbook.

[7] The previously cited *Biology Teacher's Handbook* is an excellent example.

[8] For projects under way, see: *Eighth Report of the International Clearinghouse on Science and Mathematics Curricular Developments, 1972.* College Park: Science Teaching Center, University of Maryland, 1972.

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