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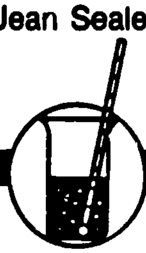
ABSTRACT

The reform movement in science education as characterized by the development of new science curricula in the 1960s is analyzed in this information bulletin. An overview of the historical context and the financial extent of the movement is presented. Perspectives on the curricula are offered in a question format. The questions include: (1) what did we learn? (reviewing gains and criticisms associated with the new curricula); (2) how were they different? (enumerating the common characteristics of the new and traditional curricula); and (3) what are the implications for today? (listing recommendations for the improvement of science education). The goals of science education in the 1960s are compared and contrasted to the goals of the 1980s and beyond. A summary statement of the goals of science education and a checklist for assessing whether the goals are reflected in classroom practices are also included. Biology topics and goals are offered as examples. (ML)

Curriculum Development Projects of the Sixties

Jean Sealey



QUESTION: *What became of the curriculum development projects of the 1960s? How effective were they? What did we learn from them that will help teachers in today's classrooms?*

During the Golden Age of Science Education (1955-1974), public and private funds poured into new science programs, college campuses teemed with teachers taking science and mathematics refresher courses, and students enjoyed dramatic gains in science achievement and in improved attitudes toward science (3, 5).

Today we face a crisis in science education that is similar to the crisis we faced in the 1950s (1). When our students are compared to students in the Soviet Union, Japan, and some West European countries, the poor standing of American students is cause for national concern. It has been called a "national tragedy." Most American students "lack a solid foundation for further training; they cannot even apply basic mathematics and science to simple jobs" (6).

To more fully appreciate the relevance of the curriculum development projects to our current crisis, we need to look at the events that preceeded and followed them. Even before the end of World War II, American scientists and science educators were troubled about the superiority of other countries' educational accomplishments, particularly those of the Soviet Union. It was not until the Russians launched *Sputnik* in 1957, however, that the problem became one of popular national concern.

The National Science Foundation, established in 1950, became the vehicle through which federal monies were funneled into curriculum development projects. In 1954 its curriculum development budget was a mere $1,725. The increase in curriculum development funds over the next 20 years was phenomenal. The figure grew to $15,000 in 1955, and to $500,000 by 1957. In 1959, the Foundation's budget for curriculum development had grown to slightly less than $5.5 million. By 1968—the peak year—the figure was just under $12.25 million. Overall, more than $117 million was spent for 53 separate projects from 1954 through 1975 (4).

By the mid-1970s, America appeared to have regained its lead over the Soviets in space exploration. The American public was no longer concerned with science education; new political,

OVERVIEW

The Golden Age of Science was a response to a crisis in American science education. The Russian *Sputnik* proclaimed Russia's scientific and technological superiority to the world, and Americans reacted with the development of new science curricula in an attempt to meet the challenge presented by the Russians. Over $100 million was spent in the 20-year period. Once again, educators and scientists are warning that American science education is lagging behind the rest of the industrialized world. What did we learn from the previous round of reform that can help us meet today's challenge? Here we discuss the science curriculum development projects in their historical context, what they taught us, and how we can use what we learned. More information about science education can be found in *Research Within Reach: Science Education*, developed by the Research and Development Interpretation Service (3). The numbers in parentheses correspond to references listed at the end of the article.

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economic, and social pressures claimed the public's attention (3). By 1976, National Science Foundation funds for teacher education had been terminated. The Golden Age of Science Education ended abruptly. No major curriculum projects have been funded by the National Science Foundation for the past several years (1).

WHAT DID WE LEARN?

THE SCIENCE CURRICULA DEVELOPED IN the 1960s are still controversial. Critics say that the curricula failed and, furthermore, that they are responsible for declining student scores on standardized achievement tests. Proponents say that students learned more and enjoyed science more. They feel that the curricula were denied an adequate trial. Who is right? What do we really know about the effects of the curricula on students?

The National Science Foundation asked such questions about the curricula developed with its support. After the 1976 cutoff of funds, it sponsored three large-scale status studies to determine the impact of the new curricula: a national survey of teaching practices, an intensive case study analysis of 11 school sites, and a review of the research literature from 1955 through 1975. Also in the 1970s, the National Assessment of Educational Progress published the results of a large-scale investigation into American students' scientific knowledge and attitudes toward science Numerous smaller studies are still compiling and reporting information comparing student outcomes of the new and traditional curricula. Finally, meta-analysis has given researchers a method to simultaneously compare the results of many studies.

This is what we know. Students exposed to the new curricula showed an increase in scientific knowledge and skills across grade levels and in all science disciplines. Gains were evident regardless of individual student, teacher, or school characteristics. Furthermore, these students developed better attitudes toward science than students who had traditional courses (1, 3, 4, 5).

Let's compare some of the criticisms of the curricula with the actual results of the evaluation research (5):

Criticism: The new curricula did not produce achievement in the sciences because they emphasized process over content.

Analysis of the evaluation research shows that achievement scores of students exposed to a new science curriculum raised 14 percentile points. The increase was consistent among elementary, junior high, and high school students. Female students, urban students, and low and high SES students showed the greatest achievement score gains.

Criticism: The new science curricula were responsible for declining scores on standardized achievement tests.

Most of the new curricula were never adopted by school systems, and no single new curriculum was adopted on a large scale. In fact, none was adopted by more than 25% of the school districts in the nation. These low adoption rates, coupled with the data on enhanced achievement of students who were in the new science curricula, make this criticism unfounded.

Criticism: Students need to return to the "basics." The new curricula's emphasis on process and analytical skills detracts from learning content.

Again, the evaluation research makes this a difficult position to defend. When researchers looked at student achievement in related skill areas, they found that "student performance in related skill areas at the elementary level was greatly enhanced by the new science curricula" (5). The related skills in which students showed gains included mathematics, reading, social studies, and oral and written communication.

HOW WERE THEY DIFFERENT?

WHAT MADE THE CURRICULA DEVELOPED during this period different from traditional curricula? In a comparison of the two, researchers defined new science curricula as programs that "were developed after 1955; emphasized the nature, structure, and processes of science; integrated laboratory activities into course discussions; and emphasized higher cognitive skills and an appreciation and understanding of the nature of science." Traditional curricula were those that were developed before 1955 (or patterned after these programs); "emphasized knowledge of scientific facts, laws, theories, and applications; and used laboratory activities as verification exercises or secondary applications of concepts previously covered in class" (5).

Numerous curricula were developed, but they all had some common characteristics (3):

1. Scientists, educators, psychologists, and teachers joined forces to write texts and develop the curricula. The new curricula, then, were a combination of the latest research-based information on learning, teaching, and the various scientific disciplines.

2. Teacher guides and inservice training focused on methods and strategies designed around learning theories. There was less emphasis on having students memorize facts.

3. Laboratory activities were more than verification exercises. As an integral part of the class discussions, laboratory exercises emphasized the development of higher cognitive skills and an appreciation of science.

4. The new curricula emphasized the nature and processes of science. Students and teachers devoted

much of their class time to "identifying the central themes, the conceptual schemes, the unifying ideas, and the patterns of thinking of each of the science disciplines."

Before the new science curricula, the textbook defined the school science program, as it does again today (8). The textbook determines the content, the order, and the application of the content of science instruction. Yet most experts in science education warn that, unless science is taught in relation to the individual and to society, we will continue to fall behind in scientific advancements and in meeting the challenges of modern society.

WHAT ARE THE IMPLICATIONS FOR TODAY?

NO ONE RECOMMENDS ADOPTING THE 1960s curricula across the board. The issues and goals of science education are different in the 1980s, as Table 1 shows (3). The world crises we face now outshadow the embarrassment we faced as a nation in the 1950s. Acid rain, nuclear arms, "star wars" weapons — threats to the quality of life if not to our existence — are the issues we will have to consider as we strive to improve the scientific literacy of our students.

Many suggestions for improving science education have emerged from a study of the science curriculum development projects of the 1960s. "Project Synthesis" was the research effort of 23 science educators to synthesize and interpret more than 2,000 pages of information from the three National Science Foundation status studies and the National Assessment of Educational Progress report mentioned earlier. *What Research Says to the Science Teacher* reports the group's findings and urges teachers, administrators, and other concerned citizens to work for changes in science education. The report makes recommendations such as these (2):

1. Set new goals for science education that take into account the complexities of modern society. School science should be much more than a preparation of a few students for further study in science.
2. Design science curriculum to meet these new goals. Focus on student experiences, technology, and the concerns of individuals and the society.

Table 1

Goals of Science Education in the 1960s Compared to the Goals of the 1980s and Beyond

During the 1960s	*During the 1980s and Beyond*
1. The demand was to produce more scientists and engineers to solve perceived problems.	1. The needs are related to current social problems rooted in science and technology, e.g., depletion of energy sources, fear of nuclear energy, genetic engineering.
2. Programs were designed to meet the goals of past times in each of the science disciplines. Acquisition of knowledge was still important.	2. There is an urgent need to recognize current societal problems. The knowledge that should be considered important is that which will be useful and relevant to the solution of social problems.
3. Science was taught as a means of advancing knowledge and explanation. Science was therefore preparing future scientists.	3. Science and technology are considered to be a means for improving society. Science education therefore should be preparing the future citizens.
4. Science and science education were oriented to the present and immediate past.	4. Science and science education must be oriented to the future in light of its potential impact in helping to resolve societal problems and concerns.
5. Science education concentrated upon the development of cognitive skills.	5. Science education must focus not only on cognitive skills, but upon affective, ethical, and aesthetic understandings as well.
6. Science was viewed as value-free, empirical science.	6. Today's science is more accurately portrayed as value-laden science in which there are moral and ethical dimensions.
7. Science demanded linear thinking and emphasized inquiry skills.	7. Science must be concerned with systemic thinking and emphasize decision-making skills.
8. The goals of science teaching were internal to the various disciplines of science.	8. The goals of science teaching are derived from the interaction of science, technology, and society.

SCIENCE
Goals of Science Education

Goals, implied or expressed, are reflected in practice. Practices evident in science classrooms today reflect goals that were established over two decades ago: goals that focus on knowledge. Consequently, science education prepares students to pursue further studies in science and engineering. Other goal areas of science education — personal needs, societal needs, and career awareness — are largely ignored by classroom practices and in the textbooks (2).

What difference does it make? It makes a difference in what we expect students to learn. If we prepare students for further study, we expect them to learn discrete pieces of information. If we incorporate personal and societal needs in instruction, we expect students to know how the knowledge they've gained relates to them personally and to society in general. If we include career awareness as a goal of instruction, we expect students to know that a variety of careers exists in research and supportive vocations, such as the work of technicians, computer programmers, and equipment designers. Students then have an opportunity to develop an interest in, and explore the possibility of, careers in medicine, horticulture, or animal care, for example.

The table below shows how student outcomes differ in three goal clusters for some biology topic areas If our goal is for students to learn scientific ideas and processes — information that would be necessary for advanced study in biology — we would concentrate on the Salient Knowledge Goal Cluster (column 3). In genetics, we would expect students to be able to list some of the factors that may increase mutations. If we expand the goals to include the Personal Needs Goal Cluster (column 1), we would expect students to understand how the transmission of genetic diseases and birth defects could affect them personally. If we go a step further and include the Societal Issues Goal Cluster (column 2), we would expect students to know how genetic principles can be used to improve plants and animals.

How are these goals reflected in the classroom? A biology classroom that emphasizes personal needs, social issues and career awareness, as well as salient knowledge, has certain distinguishing characteristics (1). We've listed these characteristics in checklist form so you can determine how well your instruction reflects current goals. Keep in mind that although we have chosen biology as an example, much of this discussion is general and can be applied to other areas of science.

STUDENT OUTCOMES in Three Goal Clusters

Topic Area	(1) Personal Needs	(2) Societal Issues	(3) Salient Knowledge
Genetics	Can interpret basic concepts of human genetics as they relate to susceptibility, transmission, probability and meaning of birth defects, genetic diseases, and health maintenance.	Knows that genetic principles can be applied to improving plants and animals.	Knows some factors that may increase mutations
Nutrition	Knows the long-range effects of poor diets (anorexia, prenatal nutrition, aging, hyperactivity and mental ability) and recognizes the changes necessary to improve the diet.	Knows about and supports research for the improvement of food products and nutrition.	Knows the classes of foods (fats, proteins, carbohydrates) and their biological functions in maintaining growth, energy, and health requirements.
Behavior	Appreciates that human behavior is influenced by a wide variety of interacting factors: the natural, social, and cultural environments; genetic makeup; life experiences, personal factors (sex); and learning.	Knows the conditions and effects of chemicals (drugs like alcohol and tranquilizers, nutrients, etc.) used to modify human behavior and the need for social controls.	Knows that behavioral patterns are distinctive within species and between species (individual and group patterns), but that there are commonalities within species.
Continuity	Understands that the continuity of human life on earth is maintained through a process of reproduction.	Recognizes that human population growth can seriously influence the quality of life in various ways (economic, social, food, energy, etc.)	Understands the processes of reproduction, sexual and asexual
Life Cycle	Appreciates the unique and special aspects (both positive and negative) of the various life stages.	Understands how achievements in science, especially biology, may influence the life cycle of human beings.	Knows patterns of development among plants and animals.
Energetics	Knows that the energy exchange system within human beings is related to a larger energy cycle that makes it possible for all forms of life to survive.	Identifies and evaluates the ways that human beings may influence the energy cycle through changing the biomass (green revolution, hybridization of improved nitrogen-fixing plant species, etc.)	Understands the significance of various processes of bioenergetics, such as photosynthesis, respiration, digestion, circulation, enzymatic reactions, and chemical cycles (nitrogen, oxygen, carbon dioxide, etc.)

TEACHER CHARACTERISTICS

YES NO

Personal Needs Goals are Incorporated in Instruction:

_____ _____ 1. I solicit and tolerate conflicting views as long as students support their views with facts.

_____ _____ 2. I use classroom discussions to enhance interpersonal and communication skills.

_____ _____ 3. I don't force closure on issues, rather I introduce new information, ask open-ended questions, and express my own opinions appropriately.

_____ _____ 4. I use both individual and group activities effectively.

_____ _____ 5. I respect and care for adolescents, and I relate the content of the course to individual problems.

Societal Issues are Incorporated in Instruction:

_____ _____ 6. I show students how group dynamics in the classroom can be applied to social issues.

_____ _____ 7. I encourage group problem solving, cooperative decisionmaking, and conflict resolution.

_____ _____ 8. I recognize and encourage students to take an active role in the classroom, the school, the community, and society.

_____ _____ 9. I am aware of current social problems, recognize their relationship to biological knowledge, and see possible avenues of resolution.

Salient Knowledge is Incorporated in Instruction:

_____ _____ 10. I know the concepts of biology and can relate these concepts to personal needs and societal issues.

_____ _____ 11. I know the basic concepts of related disciplines (psychology, sociology, economics, anthropology) and recognize their relevance for teaching biology in a human context.

_____ _____ 12. I assume responsibility for contributing to curriculum development and for updating my own skills and knowledge, both of which are ongoing processes necessary for teaching problem-centered, action-oriented, personal-social biology.

Career Awareness is Incorporated in Instruction:

_____ _____ 13. I give students information about biology-related careers or direct them to appropriate sources of information.

_____ _____ 14. I use community resources (places where biologists are employed in different research, professional, technological, and industrial fields) to develop career awareness in students.

CLASSROOM PRACTICES

_____ _____ 15. I use a problem approach to organize the curriculum and instruction, that is, biological knowledge and science advances are presented in the context of social problems and issues.

_____ _____ 16. I individualize instruction as necessary to meet students' needs.

_____ _____ 17. I encourage students to work cooperatively to resolve problems and issues.

_____ _____ 18. I provide opportunities for experiential, field-oriented laboratory activities.

_____ _____ 19. I require students to locate information sources or to discover information as appropriate.

_____ _____ 20. I place more emphasis on decisions or consensus based on ethical and moral considerations than on conclusions.

_____ _____ 21. I view laboratory activities as a beginning to thought, action, experience, and learning.

_____ _____ 22. I believe that my classroom is a tool to help students see the interconnectedness of events, people, and biological knowledge.

_____ _____ 23. I emphasize the use of the natural environment, community resources, and students as objects of investigations; new equipment, supplies and facilities are of secondary importance.

_____ _____ 24. I evaluate student performance in terms of the student's ability to (a) apply biological facts to personal needs and societal issues, and (b) formulate rational decisions in the context of personal needs and societal issues.

References

1. Harms, N.C., & Yager, R. E. (Eds.) (1981). *What research says to the science teacher* (Vol. 3). Washington, DC: National Science Teachers Association.
2. Holdzkom, D., & Lutz, P. B. (Eds.) (1984). *Research within reach: Science education.* Charleston, WV: Research and Development Interpretation Service, Appalachia Educational Laboratory

3. Give attention to teacher preparation and inservice programs. Teachers must have support and assistance so that the new goals and new curriculum can be internalized.
4. Incorporate research findings in curriculum design, in textbooks, and in instructional methods.
5. Evaluate the effectiveness of new programs. We can't afford to leave important decisions about science education to whim or chance.
6. Seek out and study exemplary teaching and science programs locally. We can all benefit from a study of techniques and materials that work.

Obviously, these recommendations will require the cooperation of the larger community of educators and researchers over a period of years. There are things teachers can do today — now — to take advantage of what we've learned from past efforts to reform science education (4, 7):

• Make science relevant and interactive in your classroom. Introduce societal and individual concerns into the instruction. Focus on laboratory activities, study guides, and materials to supplement and expand the content of textbooks. Broaden the goals of science instruction *beyond* preparing students for the next academic level.

• Work for curriculum improvements within your school and local district. Become familiar with methods and texts that have been researched and tested. Recommend and work for their adoption.

• Read professional journals and research synthesis reports to keep informed of new methods, new issues, and new materials. Discuss what you read with other teachers and with your students. Be flexible; use research-based strategies and materials in your classroom.

• Join local chapters of professional organizations for science educators. Organize other teachers in your school and district who share your concerns and philosophies. Exchange ideas and work together to implement change.

SUMMARY

REVIEW OF THE PAST IS RELEVANT TO our present problems in science education. Studies indicate that American students lag behind students in other countries in mathematics and science. We know, too, that our students today do not compare favorably with American students of generations past. During the 1960s, we attempted to improve science education with a series of science curriculum development projects. Although these projects faced severe criticisms, an analysis of research studies on their effectiveness shows that students' achievement improved and their interest in science increased. Even though the content of the curricula may no longer be directly applicable to today's science classrooms, the principles underlying the development of the curricula are.

References

1. Brandt, R. (1983/84). We tried that but... *Educational Leadership*, *41*(4), p. 3.
2. Harms, N.C., & Yager, R. E. (Eds.) (1981). *What research says to the science teacher* (Vol. 3). Washington, DC: National Science Teachers Association.
3. Holdzkom, D., & Lutz, P. B. (Eds.) (1984). *Research within reach: Science education.* Charleston, WV: Research and Development Interpretation Service, Appalachia Educational Laboratory.
4. Jackson, P. W. (1983). The reform of science education: A cautionary tale. *Daedalus*, *112*(2), 143-166.
5. Shymansky, J. A., Kyle, W. C., Jr., & Alport, J. (1982). Research synthesis on the science curriculum projects of the sixties. *Educational Leadership*, *40*(1), 63-66.
6. Wirszup, I. (1983/84). Education and national survival: Confronting the mathematics and science crisis in American schools. *Educational Leadership*, *41*(4), 5-11.
7. Yager, R. E. (1983/84). Toward new meaning for school science. *Educational Leadership*, *41*(4), 12-18.
8. Yager, R. E., & Stodghill, R. (1979). School science in an age of science. *Educational Leadership*, *36*(6), 439-445.

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