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ABSTRACT

In a speech presented at the National Science Teachers Association (NSTA) convention in New York in April, 1972, Dr. Hurd examines social problems and goals in the perspectives of scientific and technological influences. To achieve the objectives of acculturation, skill acquisition, and intellectual attitudes, he advocates that science be taught in the context of society, with a focus upon the welfare of mankind. Therefore, emphasis upon application to human affairs is needed, requiring a more holistic view of curriculum goals. (CP)

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EDUCATIONAL GOALS IN SCIENCE FOR THE 1970'S

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The blast off of Russia's Sputnik in 1957 marked the beginning of a science curriculum reform in America. Its primary goal was to increase the supply of scientific and technical manpower in the United States. New curricula were prepared to display science in the classical sense. The emphasis in the new courses was upon the theories and constructs important for knowing "the structure" of a discipline and upon investigatory processes which characterize scientific research.

In July 1969 Americans were the first to walk on the moon, thus ending the technological crisis, and with it much of the rationale for the "new" science.

Coinciding with this event was the emergence of the

counter-culture, with youth not only questioning the American way of life but also expressing doubts about the "relevance" of their education. The issue to them was not how much better life is now than it used to be, but how bad society is today compared with what it could be. They view contemporary society as "sick", pointing out the seemingly endless piling of crises upon crises: economic, political, educational, environmental, technological, and others; not to mention the tensions of everyday life, for example, war, loneliness, racism and violence. In the span of only a few years the counter-culture moved from "acid" and overt revolution to drugs and a disturbing quiescence. Whether the revolution has failed or is seeking direction we have yet to learn; I suspect the latter. There is no doubt, however, but that the America of the 1970's is not the America of even five years ago.

Where do science and technology stand today? We find both are on trial: technology, which has maintained the strength of our economy for decades, is now regarded as an enemy of the

natural environment and as a major force in the dehumanization of man. Scientists, who have enjoyed the isolation of the objective world for centuries, are now put upon by the general public to direct their research activities toward the common good and to add a dimension of social responsibility to the scientific enterprise. There exists a fear in our society of further technological developments without a prior assessment in terms of human values. Science is also on the defensive, characterized by an anti-science sentiment in students and the general public alike. Gerald Holton describes the educational change as a movement toward a "post-classical science" period.[1] The more pessimistic writers see approaching an end to continued progress and a slowdown in human achievement. These social changes and the fact that the very nature of the scientific enterprise is today different from the 1960's force the need to reassess the science teaching goals of the past decade.

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1. Gerald Holton. "Improving College Science Teaching: Lessons from Contemporary Science and the History of Science." Journal of College Science Teaching. 1:1:31 (October 1971).

One of the most important issues to consider is how to bridge the various gaps that exist between science, society, technology, the individual and the school curriculum. We must do this at the very time society is undergoing extensive cultural transformations and much soul searching in an effort to find itself. Albert Schweitzer described the situation several years ago with this comment: "The difficulty of our times is a difficulty of the human spirit." We require a new vision about the kind of world we can possibly achieve with the resources of science and what individuals prize most in this life.

Science, through its technologic applications, forms a delicately balanced system that influences in a major degree our economic and political life both nationally and internationally. These conditions have advanced to the point where they can no longer be considered separate from the social forces which determine the course of human activities and our manner of living. This means that the new goals for science

teaching ought to be in the context of society and taught with a focus upon the welfare of mankind.

To achieve these broad purposes will require that science be taught with as much emphasis upon its application to human affairs as upon its theoretical structure and investigative processes. It is technology with its application to agriculture and industry that provides meaning to whatever we describe as modern living, not only in material ways but in the very texture of our thinking. On one hand it provides us with more physical comforts than man has ever known before and on the other hand creates poverty. Better food and a healthier existence have not only resulted in a longer life but made over-population a problem. The continuing increase in available consumer goods is rapidly making the world a garbage dump and blighting our environment physically as well as aesthetically. Over the past decade a unity of science and technology has developed in a way that makes both essential to human welfare. Science and technology all the way from "pure"

research to invention are on a continuum within which no meaningful lines of demarcation can be shown. A major goal for science teaching in the 1970's is to help people learn how to live in a modern technological society. I hasten to add, however, not in the terms technology was taught during the 1940's and early 1950's.

It is evident that science has become linked in various ways to nearly all aspects of human existence. There may be a question as to whether science is the servant of society or society the handmaiden of science, but there are no doubts that each depends upon the other for survival. No longer ought science be taught as a subject valued for itself, independent of the rest of society, governed by its own rules and directed entirely by its own policies. The natural, social and behavioral sciences need to be brought into a relationship and presented with a consideration for man's welfare. This will require that we take a more holistic view of curriculum goals than we have in the past. The problems that concern man

most -- disease, malnutrition, pollution, urban living, longevity, social disintegration, aggression, equality and others -- are not those than can be solved within the limits of isolated disciplines. Again it becomes evident that science should be taught in a social and humane context.

Much of the present crisis in science and in science teaching lies in the relationship between knowledge and values. The questions that greatly bother young people are these: What are the social responsibilities of science? Does science have a commitment to humanity or only to the advancement of a discipline? Can fact and value be separated at the practical level? Scientists and sociologists alike, have observed that a great deal of the conflict and turmoil we are experiencing in American life today results from a poverty of values, from too little we really care about, and from a paucity of social commitments. Is it not strange that in this period of history, when we have the knowledge and material resources to do about anything we wish, we are the most confused about what is worth

doing? Values provide guidance and direction for the use of knowledge, but unfortunately, our present science curriculum is both value-free and anti-idealistic. Science teaching at present is mostly concerned with matters of fact, ignoring to what end. This leads me to suggest that if science is to be meaningful for developing a higher level of human responsibility and rationality, then the opportunities for students to develop worthy values must be given high priority. This does not mean that schools should seek to institutionalize a particular set of values, but that young people be allowed to participate in planning their own destiny. A science course in which a consideration of values is absent has only information to offer; there is no way a student can convert what he learns into wisdom.

Educational programs for centuries have been planned with the idea that tomorrow will not be much different from today. One result of this action is that today's problems are perpetuated. How we design the curriculum today and the goals

we accept, so the morrow will be. Those who wish to leave the future to the future are defending the status quo. This generation of young people seek an education that has the possibility of developing a world in the direction of something better than already exists. The issue is complex, but the message is clear; young people want an education for that period of time in which they will be spending most of their adult life. They do not want an education that has the historical setting of their parents or even that of their teachers, for they will never live in those times. A science curriculum ought to prepare students to cope with a world of change by achieving "maximum adaptability" during periods of cultural transition. A science program which neglects man's future is an essay on history.

The process of education should do more than insure the acculturation of an individual; it should provide him with the skills and intellectual attitudes essential to understand the emerging world and to mediate the future. We are at a point in history where the future is spilling into the present.

The entire issue of "environmental quality" and its attending problems is an example of what I mean. The future is the only period of time in our life over which we actually have any control. Our present mode of science teaching is on a collision course with the future because the student is permitted little opportunity to free himself of the present and to consider ways in which a more satisfying future for mankind might be planned. The educational problem is how best to teach and learn the future, how to reach from the here and now to the there and then. In planning curricula with a future orientation we do much to shape this future and minimize the possibility that man himself may become a victim of cultural lag.

We are moving into a period sometimes described as a "post industrial" society in which learning and knowledge are likely to be the primary economic resources of the world. However, this will not be in the sense of a "knowledge explosion" like that of the past quarter of a century. For decades we have been content to simply add more and more knowledge to

the stockpile we already have without much regard as to how it will be used. Consequently, a tremendous chasm has developed between the creation of knowledge and the use of knowledge. Today we have access by one means or another to nearly all the knowledge that ever existed. Individually and collectively we know more than any other society has ever known in the past, and a startling result of all these efforts is increased ignorance. We know less about how to solve contemporary problems of life and living than in the past; witness our ecological irresponsibility, our racial prejudice, our national disunity, the disenchantment of youth with existing societal goals, the "identity crisis," to mention a few. A new educational effort is needed to upgrade the quality of knowledge in science courses to the point where there is a reasonable chance that the complex science-social problems of the 1970's can be attacked by citizens. Michael Marien describes the image of the "ignorant society" as "a condition in which societal learning needs outdistance attainment."[2]

2. Michael Marien. "The Discovery and Decline of the Ignorant Society, 1965-1985" in Educational Planning Perspective, Thomas Green, Ed., Surrey, England: IPC Science and Technology Press, 1971

To achieve the proposed goals for science teaching in the 1970's will require a problem-centered curriculum with a man-societal bias. Human and cultural-based problems typically have roots not only in several sciences but also in non-science fields; they are multidisciplinary in character. The fragmented knowledge of discrete disciplines is too limited for interpreting human experience. A greater inter-penetration of subject matter between sciences and between the sciences and other fields of learning is needed. This is especially important if we expect the student to become a better citizen in the sense of being more informed, more concerned, and more competent to reach science-social decisions. The specialization of knowledge, which has brought us this far along the course of cultural revolution, is not adequate to deal with either today's science or social questions. There is need for a cohesiveness of knowledge and a plurality of approaches to problems. The most active fields of research in science are not in highly refined specialties but at the interface of such

disciplines as biology and physics, chemistry and physics, and biochemistry. In a similar way the problems of life and living will not be resolved in separated disciplines, but through the integration of knowledge and interrelated modes of knowing.

Over the past decade there has been a great emphasis in science teaching on the development of inquiry and discovery processes, but for the most part these are not suitable procedures for solving science-based social problems. Rather, the need is for skills that help one to apply knowledge to problems for which there is conflicting data but for which decisions must be made. The problems students must deal with in "real life" are more task oriented than experimental and data must be considered in qualitative as well as quantitative terms. They are problems which call for decisions and there are few conclusions. Decision making is more a way of maximizing the meaning of information than simply interpreting

data. During the 1960's in science teaching the emphasis was upon how data are obtained, for the 1970's the priority is how data are used. In another way this is the difference between knowledge in being and knowledge in action.

Here then, as I see it, are a few of the educational goals for the teaching of science in the 1970's. Progress is being made in translating these goals into curricula and appropriate teaching styles, but it will undoubtedly take a decade or more to move science teaching from "yesterday to tomorrow."