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SOME NATIONAL TRENDS IN HIGH SCHOOL SCIENCE EDUCATION AND THEIR INFLUENCE IN IOWA

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National Trends

In August, 1978, a NEW sponsored National Assessment of Educational Progress (NAEP) report was issued entitled, *Three Assessments of Science: Changes in Achievement 1969-77*. (1) The report indicated a 4.7 percent decrease in science achievement scores for 17 year-old high school students since 1969. During the same time period, 2.5 percent and 1.4 percent declines were reported for 13 and 9 year olds in science, respectively. Declines were observed to be greater in the physical than the biological sciences.

The national assessment of Educational Progress begun in 1964, is a survey of knowledge, skills, understandings and attitudes of young Americans. Surveys are conducted on high school students, ages 9, 13, 17, as well as adults (ages 26-35). Studies are conducted at approximately 3-year intervals in the areas of Science, Math, Reading, Writing, Social Studies, Citizenship, Literature, Art, Music, and Career and Occupational Development. Science surveys have been conducted in 1969-70, 1972-73, and 1976-77. Scientists involved in the study attributed at least part of the reason for the decline in science achievement scores to the deemphasis of science education in the United States schools. A study reported in July, 1978 issue of *Science News* entitled, *High School Science Students Lag in Science*, stated that "the number of students taking science courses in high school had dropped from 18 percent in the late 1960's to less than 10 percent now." (2)

Arthur Livermore, Director of the Office of Science Education for the American Association for the Advancement of Science (AAAS) reported that "for 17 year-olds anyway — the steep decline in physical science achievement is related to decreasing enrollments of high school students in physics and chemistry. In fact, less than half the high schools in the country even have physics courses." (2)

John Akey, past president of the National Science Teachers Association, commented that the "back to basics" movement, in conjunction with efforts to reduce the cost of education, has resulted in the elimination of science equipment and labs. (2)

The study thus isolated three negative trends in science education which must be closely examined for aversion in Iowa.

Table 1

Total Science Enrollments for Grades 9-12
for Iowa Public Schools 1974-77

Year	School Enrollments	Chemistry Enrollments		Physics Enrollments		Other Science Enrollments		Total Science Enrollments	
	No.	No.	%	No.	%	No.	%	No.	%
	1971-72	196,957	15,027	7.6	7,052	3.6	87,150	44.2	109,229
1972-73	199,205	14,570	7.3	6,919	3.5	91,408	45.9	112,097	56.3
1973-74	197,179	14,528	8.3	6,604	3.3	99,459	50.4	120,673	61.2
1974-75	197,296	14,714	7.5	6,091	3.1	93,678	47.5	114,483	58.0
1975-76	200,531	15,232	7.6	7,561	3.8	99,514	49.6	122,307	61.0
1976-77	202,196	16,872	8.3	7,561	3.7	101,976	50.4	126,409	62.5
1977-78	201,017	15,557	7.7	6,995	3.5	94,345	46.9	116,897	58.2

Table 2

Projected Science Enrollments for Grades 1-12 for Iowa Public Schools
Based on Average Enrollment Percentage Trends (4)

Year	School Enrollments*	Chemistry Enrollments	Physics Enrollments	Other Science Enrollments	Total Science Enrollments
1978-79	196,057	15,292	7,050	93,911	115,477
1979-80	189,833	14,887	6,644	90,930	111,812
1980-81	181,556	14,616	6,355	87,098	106,936
1981-82	172,878	13,484	6,051	82,886	101,825

* -0.26 = Percent of Error (Projection to Actual)

1. Major declines in percentages of students enrolling in high school science courses.
2. Declines in science achievement scores for high school students.
3. Declines in emphasis on science as a basic, and essential, curriculum component.

Iowa Science Enrollments

With modest fluctuations, enrollments in high school science courses have been reasonably consistent in Iowa, since 1971-72 (Table 1). When the percentages of students taking science courses in Iowa are compared to the 1977-78 national average of 10 percent, it is obvious that Iowa's 58.2 percent was atypical.

Average enrollments for science in Iowa high schools for years 1971-72 through 1977-78 were calculated to be: 58.9% — total science, 3.5% — physics, 7.8% — chemistry, and 47.9% — all other sciences. Applying these data, and projected total enrollments (calculated by the Department of Public Instruction for years 1978-79 through 1981-82) science enrollments were projected for 1978-79 through 1981-82 (Table 2). It is obvious that with projected enrollment declines, even if percentages of students enrolling in science courses remains relatively constant (55-63%), there will be significant declines in science enrollments.

The State Law

Education in Iowa is premised on local control, with minimal statutory mandates. Thus, relatively high percentages of students enrolling in science courses can only be partially attributed to satisfying the Department of Public Instruction (DPI) requirements. The DPI acts as an administrative, supervisory and consultative agency under the direction of the Superintendent of Public Instruction and the State Board. The DPI responsibilities include providing professional leadership and guidance, and carrying out such policies, procedures, and duties authorized by law or by the regulations of the State Board and the school laws of Iowa. Where applicable to science for grades 9-12, Iowa school law states:

257.25 (6) In grades nine through twelve, a unit of credit shall consist of a course or equivalent related components or partial units taught throughout the academic year. The minimum program for grades nine through twelve shall be:

- (6a) Four units of science including physics and chemistry; the units of physics and chemistry may be taught in alternate years. (3)

Within these guidelines, local education agencies are provided extensive latitude to establish indigenous graduation requirements for science. As of the 1977-78 academic year, Iowa was subdivided into 15 Area Education Agencies and 449 school districts. The graduation requirements for science varies in those districts from 0 to 4.0 units of credit. (Table 3)

Table 3*

Science Credits Required for Graduation	No. of Districts With Such Requirements
0.0	1
0.5	3
1.0	157
1.5	7
2.0	273
2.5	1
3.0	6
3.5	0
4.0	1

*Total Districts — 449

It appears from these statistics that most students in Iowa are provided a great deal of flexibility in selecting science courses and that many of them are enrolling in science electives beyond minimal graduation requirements. However, with 1978-79 being the first year that 9-12 enrollments have declined significantly, it will be a critical year to observe the effects of enrollment declines on the number of students electing to enroll in science.

Science Achievement

The Iowa Test of Education Development (ITED) has been utilized in Iowa, and nationally, since 1942 to assess the academic achievement of students in grades 9-12. The major purpose of the ITED tests and programs are as follows:

1. To provide teachers with a periodic, objective description of student achievement — a description that permits comparisons between broad areas of achievement at the beginning of each year and evaluation of growth within each area from year to year.
2. To provide administrators with a dependable basis for judging the relative strengths and weaknesses of the academic portions of the educational offering; to provide a program that reflects the achievements of all pupils and is not tied to specific instructional methods and materials in any area. (6)

Thus the tests are designed to measure how well students can apply education in expression, quantitative thinking, social studies, natural sciences, literature, vocabulary and the use of sources. The abilities assessed are the product of both academic and out-of-school experiences. The strength and applicability of the test battery lies in its ability to provide measures of educational achievement appropriate for all high school students, regardless of the particular curriculum they are taking.

According to ITED test results, significant fluctuations in science achievement have occurred in Iowa high schools for years 1962-77, inclusive. (Fig. 1) It is apparent that achievement peaked in the mid 1960's and has since been declining. The greatest retrogrades have occurred in grade 10. Performance declines have been approximately -2.2% , -5.6% , -7.4% , and -3.6% for grades 12, 11, 10, and 9, respectively. For the same period (1962-77) the overall (grades 9-12) decline in ITED science scores for Iowa was -4.7% .

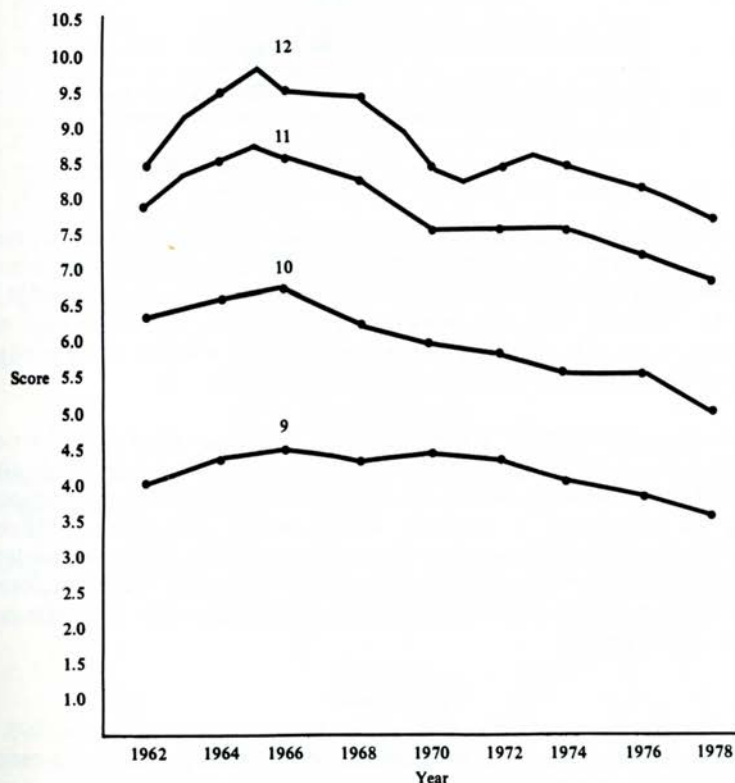


Fig.1. Mean ITED Scores of Natural Science Test for Grades 9, 10, 11, 12.

In comparison to the NAEP reported "slump" of 4.7% in science achievement scores nationally for 17 year olds, the ITED downgrade for the same period (1969-77) for Iowa was 5.7%.

Decreases in science achievement may be partially attributed to the low-emphasis placed on science education after the post-sputnik, golden decade (1960-70 approximately) of high-emphasis. In addition, the effect of elective courses in science, beyond grade 10, may be a factor in establishing such trends.

Summary

America is a highly technological society. Decline in knowledge of scientific concepts and processes should be viewed with concern. Science does not create problems; technology does. Science, however, can solve the problems created by technology.

Science as a Basic

"If a nation expects to be ignorant and free in a state of civilization, it expects what never was and never will be. There is no safe deposit for the functions of government but with the people themselves, nor can they be safe without information." (8)

— Thomas Jefferson

Education is a cyclical profession. Emphases shift with societal pressure and reactions. Schools are often placed in the tenuous position of being neither reflections of what society is, or trend setters in what it should be. "Science is an attempt to help explain the world of which we are a part. It is both an investigatory process and a body of knowledge readily subjected to investigation and verification." (9)

The Iowa Council of Science Supervisors (CS²) has identified Science Education as a basic curriculum component in developing a scientifically literate society. America, today, is a highly technological society, based heavily on knowledge of scientific concepts and principles. Without knowledge in basic science, and its processes, living with, and understanding technology cannot be accomplished. More specifically, alienation of the lay public from the scientific community and scientific endeavors may result.

Conclusion

Though, in many ways, science education in Iowa appears to be more successful than nationally, complacency must be averted. Constant effort must be exerted to keep science a viable and essential component of *all* levels of instruction. Accordingly, CS² has recommended that all students receive an appropriate education in science in order to develop

intellectual skills that are basic to critical thinking, problem-solving, and decision-making.

Education is responsible for increasing student awareness, and comprehension of his/her environment. As that environment becomes more scientific and technological, education must develop methods for increasing cognizance of science and technology. (10) Science instruction must become so personally applicable to students, as members of a technological society, that they should demand more.

Citations

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4. Actual enrollments for 1971-72 through 1976-77 and Projections for 1977-78 through 1981-82, Iowa Department of Public Instruction, Des Moines, Iowa.
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8. Ikenberry, O.S., *American Education Foundations*, 1974, Charles E. Merrill Publishing Company, Ohio, p. 114.
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10. Anderson, H.O., *Readings in Science Education for the Secondary School*, 1970: The MacMillan Company, New York.

* * *

Iowa Springs

Largest Hailstone: Dubuque — June 16, 1882 — 17" circumference; weight 1.75 lb.

Barometric Pressure: Lowest: 28.66" — Sioux City — March 26, 1950

From *Iowa's Weather* by Paul Waite.

Eclipses

Eclipses, the latest publication in a series of observe manuals, is now in preparation by the Astronomical League and will be available at \$2.00 per copy from the Astronomical League Book Service % Mrs. Sheran Brettman, 13 Meadowlark, Carpentersville, Illinois 60610.