

# ED309048 1988-00-00 The Second IEA Science Study: Data Related to Precollege Science in the U.S.A. ERIC/SMEAC Science Education Digest No. 1, 1988.

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This 1988 digest reports on some of the data gathered in the Second International Science Study (SISS). A total of 11 different populations involving more than 1,000 schools and more than 20,000 students was investigated as part of the study (Jacobson et al., 1987). Findings related to curricular patterns and student outcomes are discussed.

## CURRICULAR PATTERNS

In order to ensure that the achievement tests reflected the science curricula of the countries involved, science educators rated areas of science content and process as to their coverage in grades 5, 9, and 12 in schools with which the educators were familiar. At the fifth-grade level, earth science had the highest mean rating (coverage) of the four traditional science domains, with biology and physics tied for second, and chemistry rated the lowest. The emphasis on earth science in the fifth-grade curriculum was consistent with ratings in most other countries. In addition to receiving the lowest ratings, the pattern of ratings for chemistry topics was the least stable. The low level of coverage may be due to the abstract nature of chemistry. With respect to the Applied/Integrated Science Content, environmental science was rated highest in coverage at the fifth-grade level, ranking equal to earth science and ahead of topics in more traditional biology, physics, and chemistry. In descending order of ratings were health science, history and philosophy of science, technical and engineering science, and rural sciences. At grade 5, environmental science is most often integrated into the science curriculum of general science, life science, or physical science; this is also the case for most other science categories at this level.

The instructional objective that received the highest overall mean rating at the fifth-grade level was "Science Inquiry I - Observing and Measuring," followed by "Knowledge and Comprehension," "Manual Laboratory Skills," and "Attitudes." The order of ratings reported for the fifth grade was fairly consistent with other grade levels. This seems to suggest a "ripple effect" whereby curricular decisions at the high school or college levels filter down through the middle/junior high school and finally are absorbed at the elementary school level (Miller, 1986).

At the ninth-grade level, as at the fifth grade, earth science topics rated highest of the four traditional domains of science, followed by biology, physics, and chemistry. Again, in the Applied/Integrated Sciences, environmental science ranked first, followed by health sciences, history and philosophy of science, technical and engineering science, and rural sciences. Of the instructional objectives, the highest mean rating was for laboratory-related manual skills, but the highest mean scores for individual items were those for "specific facts and knowledge of scientific terminology." It appears from these data that learning science is still heavily dependent on the ability to recall specific pieces

of information (Miller, 1986:43).

The ratings for twelfth graders not taking science were based on their last year of science. Biology rated the highest of the four traditional domains of science, followed by earth science, chemistry, and physics. Environmental science rated first among the Applied/Integrated Sciences, followed by health sciences, history and philosophy of science, and rural sciences. Among the instructional objectives, manual laboratory skills rated first, followed by the basic science skills of observing and measuring, knowledge and comprehension, and attitudes. Among the instructional objectives for the specialized sciences, manual laboratory skills was rated first, followed by knowledge and comprehension, and basic science skills of observing and measuring.

It appears that there is great emphasis on acquisition of scientific facts, terminology, and concepts in the intended curriculum at all levels, although the emphasis tends to diminish as the level of knowledge grows more abstract. Basic inquiry skills are emphasized heavily at all levels (Miller, 1986).

## STUDENT OUTCOMES

One of the major interests underlying the SISS was to determine what changes had occurred since the First International Science Study conducted in 1970. By using a number of items from the first study (called "bridge items") in the second study, some comparisons were possible (Chang in Jacobson et al., 1987).

At the fifth-grade level students scored, overall, about the same as their 1970 counterparts. Both the 1986 and 1970 students had higher scores on physical science items than on biological science items, but the gains from 1970 to 1986 were slightly greater in biology than in physical science. The scores of fifth graders in 1986 on process and nonprocess items remained essentially the same as in 1970, but the difference between scores on process and nonprocess items narrowed (Chang in Jacobson et al., 1987). The 1986 achievement scores also showed differences between males and females similar to those in 1970, with boys outscoring girls. However, on a manipulative process test, no significant difference in boys' and girls' scores was found (Humrich in Jacobson et al., 1987). Fifth-grade students' responses to the attitude inventory revealed that they enjoy school, find school challenging, and want to get as much education as they can. In summary, the science programs at the fifth grade level seem to have made a positive impact on both science achievement and attitudes toward science in particular and school in general (Doran and Jacobson, 1984:42).

Ninth grade students in 1986 performed significantly lower than students tested in 1970. Both 1970 and 1986 scores were higher on biology items than on physical science items, but the 1986 scores were lower than the 1970 scores for both the biological and physical sciences, with slightly smaller losses in the life sciences. The ninth graders also showed a narrowing of the process/nonprocess gap and, although the 1986 students scored lower on the process items compared with their 1970 counterparts, the

decline was less than for the nonprocess items (Chang in Jacobson et al., 1987). Again, boys continued to score better on achievement tests than did girls, with about the same difference in percentage correct as in the 1970 study. However, as was the case for fifth-grade students, there was essentially no difference in scores for boys and girls on a manipulative process test (Humrich in Jacobson et al., 1987). With respect to attitudes, the study showed that "liking science" is highly correlated with achievement in science. The 1986 ninth graders seemed to have a positive view of science. The majority of students found school challenging and wanted to get as much education as they could, findings that suggest a predisposition to study science. (Jacobson and Doran, 1986).

In comparing U.S. twelfth-grade students' achievement with that of students of other countries, the findings are not encouraging. A comparison of students in first-year and second-year courses in biology, chemistry, and physics and of twelfth-grade students not studying science shows lower scores for U.S. students in all areas. (Doran in Jacobson et al., 1987). However, both twelfth-grade students taking physics and those who were not taking any science outscored their 1970 counterparts. The twelfth-grade scores on process items also improved from the 1970 sample, for both physics and nonscience students (Chang in Jacobson et al., 1987). The sex difference in achievement continues to persist from Grade 5 to Grade 12 and from 1970 to 1986. Although the difference over time has not changed greatly, the gap between boys' and girls' scores tends to widen as students move from elementary to secondary school. With the exception of first-year biology, the gap continues for students in first-year chemistry and physics and increases by about two percent in each subject area for second-year courses (Humrich in Jacobson et al., 1987).

## SUMMARY

Student achievement scores indicate mixed results since the first study conducted in 1970, with fifth-grade scores essentially unchanged, ninth-grade scores declining, and twelfth-grade scores improving. However, students show progress in science achievement as they move to higher grade levels. Students are generally more competent at the higher levels of thinking or science processes. They tend to have fairly positive attitudes toward science and toward school and education. Sex differences in achievement, however, continue to persist and tend to increase slightly as students progress through the educational system. Comparisons of U.S. students' performance with that of students of other countries are not encouraging.

## SELECTED REFERENCES

Doran, Rodney L. and Willard J. Jacobson. "What Research Says: How Are Our Fifth Graders Doing?" *SCIENCE AND CHILDREN*, 22(1): 41-42, September, 1984.  
Jacobson, Willard. "The United States Science Curriculum Case Study." Paper presented at the United States-Japan Seminar on Science Education. Honolulu, HI, September, 14-20, 1986. ED 278 564.

Jacobson, Willard J. and Rodney L. Doran. "What Do Our Ninth Graders Think of Science and School?" THE SCIENCE TEACHER, 53(5): 59-61, May 1986.

Jacobson, Willard J., Rodney L. Doran, Edith Y.T. Chang, Eve Humrich, and John P. Reeves. THE IEA STUDY-U.S. SECOND IEA SCIENCE STUDY. Teachers College, Columbia University, New York, 1987.

Miller, June K. AN ANALYSIS OF SCIENCE CURRICULA THE UNITED STATES. SECOND IEA SCIENCE STUDY. Teachers College, Columbia University, New York, 1986. ED 275 534.

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