

Ocean and Great Lakes Awareness Among Fifth and Ninth Grade Ohio Students: A Continuing Study¹

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ABSTRACT. The Ohio Sea Grant Education Program conducted a baseline study of ocean and Great Lakes awareness among Ohio's fifth and ninth grade students in 1979, and repeated it with some curriculum-specific additions as a longitudinal study in 1983. This report of the 1983 data indicates that over the 4-year period the ninth graders, cohort of the 1979 fifth graders, increased over 10% in ocean and Great Lakes knowledge scores. However, information considered critical to responsible decision-making is still lacking. Attitudes toward Lake Erie and the oceans, while remaining slightly positive for the group, did not change commensurate with knowledge. A new set of test items dealing specifically with information from Ohio Sea Grant curriculum materials was added to the survey in 1983 to provide a new baseline for future testing. The main self-reported source of student information about these topics changed over the period, so that in 1983 students in both grades were relying more on the classroom than on media sources for aquatic information. The survey will be repeated at regular intervals, continuing a longitudinal study unique to marine and aquatic education in North America.

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INTRODUCTION

In 1979, the Ohio Sea Grant Education Program conducted a baseline study of the knowledge and attitudes of Ohio students about the oceans and Great Lakes (Fortner and Mayer 1983). The study revealed a low level of knowledge, with fifth graders answering 37.6% and ninth graders 48.3% of questions correctly. Attitudes about the oceans and Great Lakes were related to knowledge, with high scorers having more positive attitudes. Students indicated that most of their information about oceans and Great Lakes was obtained through movies and television.

Results of that study were used to structure a program of curriculum development and dissemination. The Oceanic Education Activities for Great Lakes Schools (OEAGLS) were developed for infusion into the curriculum of grades 5-9, in part to address information needs identified through the 1979 survey. Dissemination of these materials through teacher training was done statewide, since Lake Erie is a statewide resource and regional differences in knowledge were identified in the study.

In 1983, a second survey was conducted, offering a longitudinal study of awareness changes among Ohio students with regard to major water resources. Questions from the original test were administered in fifth and ninth grades, and a new body of information about Great Lakes concepts was also tested at both levels. The new knowledge items were drawn specifically from OEAGLS, providing a test of the materials themselves and developing a new baseline for future studies.

This study was designed to answer the following questions:

- (1) How had Ohio students' knowledge about the oceans and Great Lakes changed over the previous 4 years?
- (2) How had the attitudes of Ohio students toward the oceans and Great Lakes changed over the previous 4 years?

(3) What did Ohio students know about specific Great Lakes topics being presented in new curriculum materials?

(4) Had the source of student knowledge about ocean and Great Lakes topics changed since the baseline study?

METHODS

RESEARCH DESIGN. This was a longitudinal study with a comparison group. Students in grade 5, 1979 and grade 9, 1983 were the same cohort whose knowledge and attitudes over the period were subject to maturational and historical influences, possibly including exposure to the first Sea Grant curriculum materials for teaching about the Great Lakes. Students in grade 9, 1979 served as a comparison group to determine if knowledge and attitude changes that appear among the age cohort reflected changes in general awareness or were related to specific happenings within the 4-year period. Finally, scores of students in both grades in 1983 provided a new baseline for future studies.

SURVEY DEVELOPMENT. The survey instrument consisted of the original 1979 instrument with some modifications. The final instrument contained the following:

- (1) A test of knowledge—25 multiple choice questions about the oceans and Great Lakes on each of three test forms. Six items common to all forms served as a means of assessing equivalence of groups responding to the forms. Other items were classified as either science, social studies, or humanities, and were equally divided among the three forms.
- (2) An attitude assessment—two sets of 10 semantic differential items with adjectival pairs describing the dimensions of potency, evaluation, and activity of two referents, "The Ocean" and "Lake Erie." This portion was the same for all test forms.
- (3) One item identifying the media source from which information was obtained relating to the content measured on the test of knowledge.
- (4) Test of knowledge from OEAGLS—multiple choice items specific to the content of OEAGLS. These items sought information about important economic, scientific, historic, and geographic aspects of Lake Erie and the Great Lakes. The items were distributed 10 to a test form, with science and social studies represented equally across forms.

Information about the participating schools' economic and geographic settings and about the classes' characteristics was obtained through a questionnaire sent to the cooperating teachers. These data were used for comparison of respondents in the two surveys, and to ascertain whether instructions were followed in the selection of classes

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for survey participation. Teachers also indicated whether they had participated in an Ohio Sea Grant workshop, and whether they were using OEAGLS in their teaching.

SAMPLE SELECTION. The State of Ohio was divided into Lake, Central, and River regions as in the 1979 survey, since results from that project indicated that proximity to Lake Erie was related to higher knowledge scores (Fortner and Mayer 1983). Schools listed in the *Ohio Educational Directory* were numbered sequentially in two sets: one having schools that included grade 5 and the other that included ninth grade. A computer program randomly selected the numbers (5% of fifth grade schools; 10% of ninth grade schools) of schools that would be invited to participate in the study. The principal of each school identified a cooperating teacher by a specified random technique; the teacher was asked to present the survey to the class that he/she taught during the last period of the day.

ANALYSIS OF DATA. Seventy-two fifth grade schools and 69 ninth grade schools returned usable answer sheets. A total of 1753 fifth graders and 1591 ninth graders participated in the study. Although presumably none of the respondents were participants in the 1979 study, since none of the same schools were selected, the ninth graders in 1983 are the same cohort of the fifth graders in 1979. The ninth graders from 1979 serve as a comparison group, but this study does not indicate changes in its cohort for the same period. A comparison of demographics for these students and the 1979 sample indicates no major differences among the students sampled in the different years (Table 1).

Among the teachers whose classes answered the survey, 8% indicated that they had participated in a Sea Grant workshop (six, fifth grade; five, ninth grade). Eight percent (four, fifth grade; seven, ninth grade) also reported that OEAGLS were currently being used in their classrooms. Teachers were not questioned regarding which OEAGLS topics were in use, or to what extent.

An item analysis of each form of the knowledge test for each grade provided individual item frequencies and total test statistics. The Kuder-Richardson formula 20 (KR-20) reliabilities for the fifth grade on the three test forms ranged from 0.38 to 0.51. The KR-20 is a measure of internal consistency, with the ideal value being 1.0 (Ferguson 1976). Because of the low reliabilities, no analyses were attempted for fifth grade data beyond the determination of summary statistics. For the ninth grade, KR-20 ranged from 0.56 to 0.72. A chi-square (X^2) comparison of responses across forms for the six common items on the knowledge test revealed no significant differences at a chosen $P < 0.05$ between the groups that responded to test forms A, B, and C. For summary analysis of this portion of the survey, therefore, responses to all test forms are averaged to determine a single knowledge score.

For analyses done as comparisons with the 1979 data, the knowledge test was divided into baseline knowledge (i.e., that tested in the original 1979 test) and OEAGLS knowledge (i.e., 10 items per test form added in 1983). Another breakdown of knowledge items classified each as being related to science, social studies, or humanities. Separate scores for subtests of these subjects were generated for comparison with the baseline data.

Analysis of the attitude semantic differential portion of the instrument was based on the original 1979 instrument, for which a panel of experts identified the response that was most positive for each set of adjectives presented. Response frequencies were tabulated and summary statistics by grade level were prepared for each referent.

The single experience item, source of information about the oceans and Great Lakes, was analyzed for frequency of the responses and compared to knowledge and attitude scores. This was done to deter-

mine whether certain types of media use were related to knowledge and attitudes, or whether respondents simply perceived media to be related.

Other comparisons between variables consisted of analysis of variance of knowledge scores in relation to sex, race, and region of residence. These factors were related to oceanic knowledge in earlier studies (Fortner and Teates 1980, Fortner and Mayer 1983). Pearson's product-moment correlations (Ferguson 1976) were used to identify relationships between knowledge and attitudes for all students, and separately for high scorers ($\bar{X} \geq 67\%$) and low scorers ($\bar{X} \leq 33\%$).

RESULTS

In the 1983 survey, fifth graders answered 38.6% of the original questions about the oceans and Great Lakes correctly; ninth graders answered 48% correctly (Table 2). These figures are essentially the same as those for 1979 (37.6% and 48.3%, respectively). The percentages of correct responses for individual questions likewise remained the same for the 1983 survey, with a few exceptions. Scores of the 1979 fifth graders increased markedly over the 4-year period preceding 1983, culminating in a ninth grade cohort score of 48% correct.

Scores on the new items specific to OEAGLS were 27.3% in the fifth grade and 32.3% in the ninth. Highest individual item scores were on social studies concepts, notably canals (why they were built and why they declined; 60 and 61% correct among ninth graders) and the concept of cost efficiency in lake transport of cargo (61% correct). Lowest item scores were on items related to the lake effect (12% correct), type of goods shipped from the Port of Toledo (10% correct), and phosphates' responsibility for water quality problems in Lake Erie (8% correct).

Knowledge scores on baseline items were significantly ($P < 0.001$) related to attitudes (Table 3). High scorers had more positive attitudes than low scorers. As in 1979, the students' attitudes toward the ocean were more positive than those toward Lake Erie. Attitudes did not improve between the fifth and ninth grades for the cohorts.

Certain demographic variables were related to knowledge scores. Analyses of variance indicated main effects of race in grade 5, with white students outscoring non-whites. Main effects of region and race were noted in grade 9, with higher scores in the coastal area and among white students. A sex-race interaction was also detected in the ninth grade, with white males scoring higher.

Perhaps the most important difference between the responses to the 1979 and 1983 surveys lies in the students' responses to the question: "Which of the following was the most important in teaching you about the oceans and Great Lakes?" In 1979, 28% of the fifth graders and 37% of the ninth graders perceived movies and television to be the greatest influence. This media category out-

TABLE 1
Demographics of 1979 and 1983 survey respondents.

Characteristic	5th 1979	9th 1979	5th 1983	9th 1983
Sex: Female (%)	52.7	49.1	50.5	51.0
Male (%)	47.3	50.9	49.5	49.0
Race: Non-white	7.6	9.9	10.8	17.6
White	92.4	90.1	88.2	82.4
Region: Lake counties (No. of schools)	30	28	31	30
Central counties	22	17	14	20
Ohio River counties	27	23	27	20
No. of students responding	1,887	1,750	1,944	1,579
No. of schools	79	68	72	69

TABLE 2

Knowledge scores by content area of ocean and Great Lakes items.

Content	5th 1979 (%)	9th 1979 (%)	5th 1983 (%)	9th 1983 (%)
Baseline items total	37.6	48.3	38.6	48.0
Science	41.0	50.6	40.5	49.9
Social Studies	36.8	50.0	40.5	50.6
Humanities	31.8	40.7	27.4	39.8
OEAGLS items total	NA	NA	27.3	32.3
Science			26.5	28.3
Social Studies			28.1	36.2

TABLE 3

Relationship of knowledge and attitudes* about the oceans and Lake Erie: attitude means by knowledge level.

Group	Oceans/ Lake Erie	All students	High scorers ($\bar{X} \geq 67\%$)	Low scorers ($\bar{X} \leq 33\%$)
5th 1979	Oceans	3.76 N = 1887	4.01 N = 20	3.73 N = 688
9th 1979	Oceans	3.97 N = 1786	4.15 N = 207	3.75 N = 289
5th 1983	Oceans	3.72 N = 1753	3.94 N = 15	3.65 N = 595
9th 1983	Oceans	3.82 N = 1591	3.94 N = 153	3.56 N = 269
5th 1979	Lake Erie	3.49 N = 1887	3.76 N = 20	3.49 N = 688
9th 1979	Lake Erie	3.29 N = 1786	3.34 N = 207	3.20 N = 289
5th 1983	Lake Erie	3.49 N = 1753	3.92 N = 15	3.45 N = 595
9th 1983	Lake Erie	3.45 N = 1591	3.60 N = 153	3.28 N = 269

*Maximum positive attitude = 5.00

ranked all others including classes in school, reading outside of school, coastal activities, and public nonformal education such as in aquaria and museums. Respondents to the 1983 survey, however, credited school classes as their major information source (Fig. 1), whereas movies and television ranked fourth and second for the fifth and ninth graders, respectively. Choice of information source was not significantly ($P < 0.05$) related to students' sex, race, or region of residence. In the ninth grade, however, those 1983 students who identified classes in school or reading newspapers and magazines as information sources scored 49% or higher on the original items. Those selecting television, coastal activities, and nonformal education institutions scored 47.6, 47.2, and 45.4%, respectively.

DISCUSSION

Over a 4-year period, Ohio students in the age cohort beginning as fifth graders in 1979 and ending as ninth graders in 1983 exhibited an increase in knowledge about the oceans and Great Lakes, scoring almost 10% more on an interdisciplinary test in 1983 than on the same test in 1979. More information was gained in social studies than in science or humanities related to the aquatic environment. However, ninth grade scores in 1979 were almost identical to those in 1983, an indication that no progress was made during the period in increasing general awareness of the oceans and Great Lakes. Attitudes toward

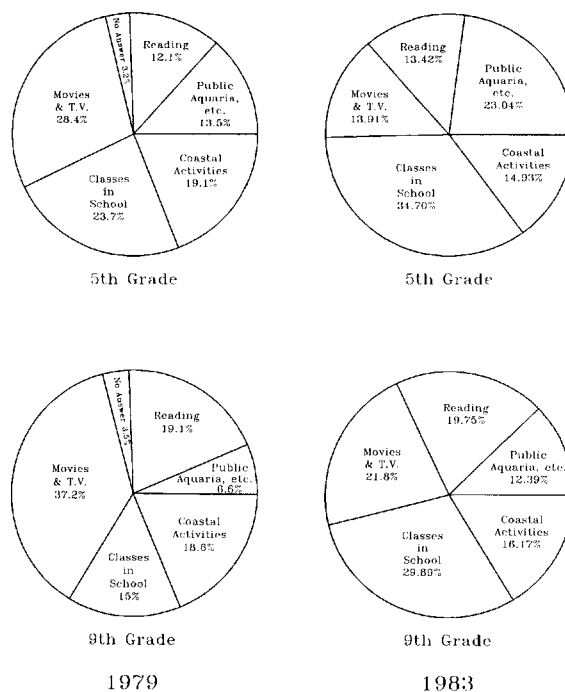


FIGURE 1. Perceived sources of information about the oceans and Great Lakes for Ohio students in grades 5 and 9, 1979 and 1983.

Lake Erie and the oceans, while remaining slightly positive, did not change commensurate with knowledge.

Immediate interpretation of these results would indicate that the teacher-training efforts of the Ohio Sea Grant Education Program were not successful in reaching the target students, those who were fifth graders in 1979 and would-be ninth graders in the follow-up of 1983. This may indeed be the case. However, several aspects of the study need to be considered before conclusions are drawn.

First, the magnitude of the Sea Grant effort, although great in terms of the outreach per dollar, was still small in relation to the size of the population, reaching only 8% of the state's teachers. Changes in the knowledge and attitudes of those teachers' classes would not be likely to affect state averages markedly. Such changes should be documentable, however, in a subsample consisting of only the responses of classes in which the teacher had been in a workshop or was using OEAGLS. Those subsamples in 1983 were not large enough to use as a basis for judgement.

This leads to a second aspect of the study that warrants consideration in interpreting the results. The only demographic characteristics examined in the survey were race, sex, region of residence (proximity to bodies of water), and some macro-demographics of entire schools. In 1983, there were 3% more fifth grade, non-white students and 8% more ninth grade, non-whites responding than in 1979. The fact that non-white students scored lower as a group may have influenced the averages. It is likely, however, that there are other unmeasured demographic variables that could account for a lack of change over the period. For example, a 1982 study of ninth grade knowledge of marine mammals (Fortner 1985) indicated a relationship of this attribute to language IQ. The potential threat to privacy that is involved with collection of such data as IQ scores makes their use in a statewide survey unmanageable. Yet these characteristics may indeed be the limiting factor in assessing the success of

teacher-training efforts by this repeated-survey method. Teachers themselves acknowledge notable differences in ability between entire classes of students that they teach from year to year. If 1983 was a "low" for ninth graders, this alone could cancel the effects of additional training in marine and aquatic topics for that group.

The main self-reported source of student information about the oceans and Great Lakes changed during the interim between tests, so that in 1983 the students were relying more on the classroom than on mass media sources. Changes in both classrooms and the media may be responsible for this. New curriculum materials for marine and aquatic education, such as OEAGLS, have become available, and teacher interest in inservice training programs is high. At the same time, the number of natural history programs on television has declined, and fewer new programs are being developed (Steinhart 1980). The popularity of media information sources will be an important factor to monitor in future administrations of this survey, as it will help aquatic educators target their efforts effectively.

The new items relating to the Great Lakes on the 1983 survey established an additional baseline against which to compare the effects of educational programs over the next few years. Low numbers of correct answers on some very basic questions regarding Lake Erie provide an impetus for increased efforts in this direction. The ninth graders of 1983 are the voters of 1987 and beyond. If only 8% know that phosphates have been responsible for Lake Erie's historic water problems, it is unlikely that they are

well prepared for making responsible decisions about the future of our water resources.

This study has provided the Ohio Sea Grant Education Program with a means of drawing attention to the need for aquatic education in the state. The student survey mechanism has indicated a need for further curriculum development in current topics related to Lake Erie and the oceans, and has established classrooms as a recognized source of information on these topics. The expanded survey can be administered in future years, continuing a longitudinal study unique to marine and aquatic education in North America.

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The 1987 Paper Of The Year Award

was presented at the 97th Annual Meeting
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for their paper

"Effects of Current Velocity on the Physical Structuring
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