

# OHIO STUDENTS' KNOWLEDGE AND ATTITUDES ABOUT THE OCEANS AND GREAT LAKES<sup>1</sup>

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**ABSTRACT.** A program to develop instructional materials for implementing marine and aquatic education in Ohio middle schools was begun by Ohio Sea Grant in 1977. This was followed 3 years later by a grant to disseminate the materials to schools in Ohio. To determine the effectiveness of the dissemination process a baseline study was conducted in the autumn of 1980. The survey obtained information on attitudes and knowledge of the Great Lakes and oceans from fifth and ninth grade students in randomly selected schools within 3 arbitrarily determined zones: the lake region, the central region and the Ohio River region. In addition, students responded to items to determine their perceptions of the sources of their knowledge.

Students exhibited low levels of knowledge of marine and aquatic topics, with the poorest performance in those topics related to the humanities. The ninth graders scored significantly higher on all topics. Knowledge scores were related to attitudes and high scorers had more positive attitudes than low scorers. Students in the lake region did not have appreciably more water related experiences than those students in the other 2 regions. In both grades television was rated the most important source of aquatic information.

A similar survey was begun in September of 1983 upon completion of the dissemination project. Any changes in ninth graders' knowledge and attitudes can in part be attributed to the program, provided fifth graders' behaviors have not changed appreciably.

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## INTRODUCTION

The Office of Sea Grant, within the National Oceanic and Atmospheric Administration, supported a study resulting in a paper published in 1978 on the need for marine and aquatic education in the nation's schools (Goodwin and Schaaf 1978). The paper provided a definition of marine and aquatic education as a component of environmental education. The consensus of those contributing to the study was that since Earth Day, environmental concerns have resulted in an increased awareness of our air quality, mineral resources, drinking water and landscape, but too often the critical role of the oceans has been ignored.

What do our children know about the world's oceans? What are their attitudes toward them? These questions must be answered for educators to be able to support the need for programs in marine and aquatic education and to effectively design such programs. Fortner and Teates (1980) conducted a study of children in Virginia, a coastal state, and concluded that "... some improvement in the level of student knowledge about the ocean is desirable, and specific ocean study courses have not been shown to be significantly related to marine knowledge or attitudes. Given this information, it is recommended that subject matter dealing with the ocean be infused into existing curricula ..."

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The Office of Sea Grant funded Ohio Sea Grant in 1977 to develop teaching materi-

als for students in grades five through nine of Ohio's schools. The need for this development project was in part based on the results of a survey conducted by Howe and Price (1976). The survey was completed by about 30 students from each tenth and each twelfth grade class in 40 selected Ohio high schools. While results differed within and between schools, the data indicated that most students had positive attitudes regarding the oceans, recognized the importance of the oceans in the future of the United States, and were aware of related environmental problems. On the other hand, most lacked factual and conceptual knowledge about the oceans and other bodies of water.

In designing the development project, Ohio Sea Grant staff felt that high quality teaching materials, focusing on factual and conceptual information about the oceans and the Great Lakes, would be a first step in facilitating increased learning among Ohio's school children about the marine and aquatic environments. Consistent with the recommendations of Fortner and Teates (1980), the materials developed were to be supplementary, 2-5-day modules, and infused into existing curricula. Because of the structure of Ohio schools, it was felt this could best be accommodated at the middle school or junior high school level. The modules were collectively titled Oceanic Education Activities for Great Lakes Schools (OEAGLS).

None of the studies previously cited dealt with documenting student background in marine and aquatic education during the middle school years, nor did they attempt to determine changes in such knowledge and attitudes over a period of time.

The study was designed to answer the following questions: (1) What do Ohio fifth grade and ninth grade children know about the oceans and the Great Lakes? (2) How does their knowledge change over the intervening four years of schooling? (3) What are the attitudes of Ohio fifth and ninth graders toward the oceans and toward Lake Erie? (4) How do these attitudes

change over the intervening four years of schooling? (5) What do children perceive as their sources of knowledge regarding the oceans and the Great Lakes? (6) Do these perceptions change over the intervening four years? Fortner and Teates (1980) found that students who lived in close proximity to the coast had higher knowledge scores. A further question to be answered in the Ohio survey was whether this "proximity effect" was found also in relation to the Lake Erie shoreline.

### SURVEY DEVELOPMENT

Each of the survey instruments consisted of 3 parts: a knowledge component, an attitude assessment, and an experience inventory. A pool of 86 knowledge items was developed from those used in the earlier Ohio study, the Fortner and Teates (1980) study in Virginia, and a study conducted by Delaware Sea Grant (Leek 1980). Additional items were developed by staff of the Ohio Sea Grant OEAGLS project. The entire pool was reviewed by a panel of 12 experts in marine history, fisheries, and geography. Items were revised based on the experts' suggestions. The pool was divided into 4 tests and administered to 55 fifth grade students and 80 ninth grade students from a suburban Columbus school system.

Students were asked to make comments on each item relating to the language used and its difficulty. In addition, a random sample of fifth graders was selected and interviewed about items. Teachers were also asked to comment on each item. These informal comments were used to modify items to make them understandable to fifth graders. In addition, item analyses were performed on each of the 4 pilot versions of the survey. A final item pool of 63 items survived the pilot procedures. These items were divided among 3 forms. Six items were selected as a core and were included on all 3 forms. These items were of a broad, general nature and appeared to be of greater significance than most of the other items. The remaining 57 were categorized by content area and then equally assigned from among the 3 areas of science, social studies, and humanities to each of the 3 forms, making a total of 25 knowledge items on each.

The semantic differential format was selected for the assessment of attitudes. Two referent concepts were used, "The Oceans" and "Lake Erie." Ten adjectival pairs were selected for use with the 2 concepts. The pairs represented the 3 dimensions of potency, evaluation, and activity. A panel of 6 individuals critiqued the scale, and minor revisions were made. The third component of the survey was a series of items to determine student perceptions of their sources of knowledge regarding the oceans and the Great Lakes. The items developed

by Fortner and Teates (1980) were slightly modified and used with this survey. The same attitude items and experience items were used on each of the 3 forms.

Additional information about each school's geographic and economic setting and about the class in which the survey was conducted was obtained through a questionnaire completed by the teacher. This information was used to verify whether instructions were followed in the selection of classes. It also provided data on the socio-economic status of the groups involved in this survey.

In identifying the sample for the study, the State of Ohio was split into 3 regions. Those counties located within 50 miles of the Lake Erie shore comprised the "lake region;" those within 50 miles of the Ohio River, the "river region;" and the remaining counties, the "central region." Two lists were compiled by region, one with schools having fifth grade classes, and one with schools having ninth grade classes. A 4% random sample of the fifth grade schools was selected in each region. Since there are fewer ninth grade schools because of their generally larger size, a 10% random sample was chosen from these schools. This resulted in a sample of 120 fifth grade schools and 110 ninth grade schools. A letter was sent to the principal of each of the selected schools explaining the nature of the study and offering an invitation to participate. Each principal was asked to list the teachers in the school at the fifth or ninth grade level in alphabetical order and to select the teacher at the middle of the list to be the administrator of the test. The teacher's name was then sent to the investigators. The survey materials were sent to that teacher with a request to use them in the teacher's last class of the day and on or before a certain date.

Each teacher received sufficient survey forms for a class of students. They were arranged sequentially by form within the set received by the teacher, so that a third of the students in each class received

form A, a third form B, and the remainder received form C.

ANALYSIS OF DATA

Results were received from 79 of the originally selected fifth grade schools, a 66% response, and from 68 of the originally selected ninth grade schools, a 62% response. Totals of 1,887 fifth grade students and 1,786 ninth grade students participated in the survey.

The proportion of non-responding schools was relatively high despite the fact that intensive efforts were mounted to obtain responses from the original sample. Original response rates varied between a low of 59.0% from ninth grade river schools to a high of 84.6% from fifth grade central schools. It appeared that respondents differed in some respects from non-respondents. For example, it was more likely that non-respondent schools were from urban areas. This was particularly true of the river region. One factor was the strike of Cincinnati teachers which occurred during the testing period. Some caution must be exercised, therefore, in generalizing the results of the study, especially those from the river region.

Table 1 indicates the number of participating schools representing each community type and whether the funding source was public or private. Most of the schools in both grades were public

TABLE 1  
*Description of responding classes.*

	Grade 5			Grade 9		
	Lake	Central	River	Lake	Central	River
Number of schools	30	22	27	28	17	23
Setting						
Urban	20.0%	18.2	22.2	14.3%	17.7	4.3
Suburban	30.0	18.2	18.5	32.1	17.6	26.1
Town (pop. 100,000)	26.7	40.9	25.9	42.9	23.5	34.8
Rural	23.3	22.7	33.0	10.7	41.2	34.8
Funding						
Public	74%	83%	83%	81%	93%	91%
Private	26%	17%	17%	19%	7%	9%

schools. All types of community settings were well represented in the samples for each grade, although the proportions of schools in each setting varied between grade level and area.

Among the responding teachers, about 60% of the ninth grade teachers indicated that they complied with the request to give the survey in their last class period within the range of dates allowed. Determination of the time of day used by most of the fifth grade teachers could not be made since most had self-contained classes. In approximately 14% of ninth grade classes, teachers or principals noted that the survey was given in the class in which it could best serve as a learning experience to supplement the curriculum. Most apparently saw this experience to be related to science, and accordingly the most commonly reported subject area for survey administration was the science class (76% of ninth grade).

Five non-white racial categories were represented among students tested. Eighty-two percent of the non-white fifth graders and 90% of the non-white ninth graders were black. Because of the predominance of one race, the 5 categories were collapsed for analysis into a single non-white category.

Since response to the survey was divided over 3 forms of the knowledge test and therefore obtained from 3 different groups of students, it was necessary to assure the equivalence of the groups in order to combine results across test forms. The Crosstabs analysis of the Statistical Package for the Social Sciences (SPSS) was used to generate a chi-square analysis of response frequencies by grade on the 6 items common to forms A, B, and C. No significant differences occurred ( $p < .05$ ) between the means of the 6 items on the 3 forms, confirming the equivalence of the 3 groups.

The Item Analysis program of the Statistical Analysis System (SAS) was used to tabulate response frequencies for each knowledge item by grade by region, and to produce total test statistics. Since the

items varied greatly in their content, sub-test scores were calculated for the 3 subject areas of science, social studies, and humanities. The KR-20 reliabilities for the fifth grade respondents on the 3 versions of the test ranged from 0.35 to 0.47. Because of the low reliabilities, no analysis of the fifth grade data beyond means and standard deviations was performed. For ninth grade respondents the reliabilities ranged from 0.56 to 0.69.

To assist in analysis of attitudes a panel of reviewers was selected from among individuals involved in marine education in formal kindergarten through college settings and informal education programs. Panel members were asked to indicate what they considered to be the most positive response to each attitude item. The items were then recoded for analysis so that "positive" would always be at the high end of the scale of possible responses. Descriptive statistics were calculated for each item and for total attitudes about Lake Erie and the ocean.

The first 32 questions in the experience portion of the survey dealt with the wide range of experiences thought to influence knowledge or attitudes about water environments. Frequencies and means were calculated by region for the individual items to determine whether proximity to water was related to the frequency of each experience. A stepwise multiple regression analysis was conducted to determine whether any of the experience variables could serve as predictors for knowledge scores. For those that appeared to be related, Tukey's test of the mean was applied to assess the direction and strength of the relationship.

The final item in the experience profile asked for the type of information sources students felt was most important in teaching them about the oceans and Great Lakes. Student choices of information sources were compared by region, race, sex, knowledge score, and attitude mean using Pearson's correlation. This series of correlations was designed to indicate

first whether students with different demographic characteristics were utilizing different information sources, and second, which source was related to higher knowledge scores and more positive attitudes.

An analysis of variance indicated the significance of differences among knowledge scores according to region, race and sex of respondents. Pearson's product-moment correlation was used to determine whether there was a relationship between knowledge scores and attitudes. This process was repeated for high scorers ( $\bar{X} \geq 67\%$ ) and low scorers ( $\bar{X} \leq 33\%$ ).

**RESULTS**

Fifth graders answered 38% of the questions about the oceans and Great Lakes correctly, and ninth graders answered 48% correctly (table 2). When subtest scores were calculated, it was found that ninth graders' knowledge of aquatic concepts in social studies is about the same as that in science, about 50% correct. Knowledge of water-related humanities concepts, however, is considerably lower (41%). Among fifth graders, the highest scores were made on the science subtest (41%) and the lowest on humanities (32%).

Knowledge scores were shown to be significantly related to attitudes ( $p < .001$ ), and the data in table 3 illustrate that high scorers have more positive attitudes than low scorers.

When specific attitude items were examined in relation to knowledge scores, it was found that those who scored higher were also those who felt that Lake Erie and the oceans were important and valuable.

TABLE 2  
*Knowledge of oceans and Great Lakes for total test and by knowledge category.*

	Percent correct	
	5th	9th
Total knowledge test	37.6	48.3
Science	41.0	50.6
Social Studies	36.8	50.0
Humanities	31.8	40.7

TABLE 3  
*Relationship of marine and aquatic knowledge and attitudes.\* Attitude means by knowledge level.*

	Grade	All students	High scorers ( $\bar{x} \geq 67\%$ )	Low scorers ( $\bar{x} \leq 33\%$ )
Oceanic attitudes	5	3.76	4.01	3.73
		N = 708	20	688
	9	3.97	4.15	3.75
		N = 496	207	289
Lake Erie attitudes	5	3.49	3.76	3.49
		N = 708	20	688
	9	3.29	3.34	3.20
		N = 496	207	289

\*Maximum positive attitude = 5.

Overall, attitudes toward the oceans were more positive than those toward Lake Erie, even among residents of the lake region.

An analysis of variance was performed to identify relationships between demographic factors and knowledge scores. Main effects were significant ( $p < .001$ ) for region and race in grade five and for region, race and sex in grade nine. Specifically, white students in coastal areas scored higher in both grades. In the ninth grade, males outscored females. For the ninth grade there was also evidence of an interaction between region and sex ( $p < .05$ ) such that regional differences occurred primarily among males.

Students in the lake region did not appear to have appreciably more experience with water related activities than the river or central groups. Fifth graders generally reported lower frequencies of such activities except for those that involved reading books or magazines. The fifth graders also expressed a greater interest in learning more about the oceans and Great Lakes. Question 33 of the experience inventory collapsed the preceding items into 5 categories. Responses on this item by grade are reported as figure 1. In both grades the category of movies and television was selected most frequently as being the most important source of information about the oceans and Great Lakes. Classroom experi-

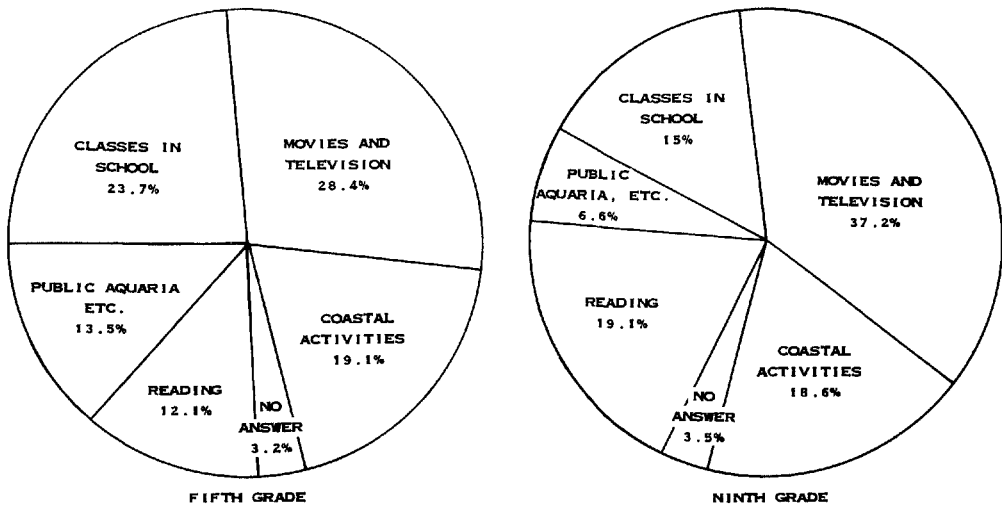


FIGURE 1. Perceived influence of experiences on ocean and Great Lakes awareness.

ences were more frequently chosen by fifth graders, as were non-formal institutions of learning such as museums. It is interesting to note that fifth graders, though they claimed to have been frequent readers of magazines, did not select that category as a major knowledge source.

Because Fortner and Teates (1980) reported that 3 experiences were shown to have a particularly strong positive relationship to marine knowledge, the same 3 experiences, the number of Cousteau programs seen on television, frequency of reading *National Geographic*, and ability to swim, were examined in this study. For the ninth grade data a stepwise multiple regression analysis identified nearly the same variables, substituting *National Wildlife* as the magazine, as accounting collectively for 13% of the variance in knowledge scores. Using Tukey's test it was found that knowledge scores were significantly higher with more experience in each of the activities.

## DISCUSSION

The students tested had low levels of knowledge regarding marine and aquatic topics. The magnitude of this problem is illustrated by the responses of students when asked to identify Lake Erie on an outline map of the Great Lakes. Only 60%

of the ninth graders and 46% of the fifth graders correctly identified Lake Erie. Other questions indicated a lack of knowledge about the presence of PCBs in fish (29% correct in grade nine), how much of the world's food comes from the ocean (40% correct), and where energy comes from for life in the sea (45% correct). These topics are among the basic concepts that Picker (1982) compiled as the experts' consensus on a "Conceptual Scheme for Aquatic Studies."

Others of those concepts fared well. In the ninth grade, 54% knew what plankton are, 65% chose ships as the cheapest transport method for certain routes, 75% were aware of reasons why marine fossils are found on some mountaintops, and 60% could identify the binding interest of OPEC countries. Such information is important as a basis for responsible decisions, and the levels of knowledge indicated are encouraging.

The poorest performance occurred on items related to humanities, indicating that students are not encountering, or at least not remembering, information on the seas' and lakes' importance in our culture. While such information is perhaps not as important in the building of informed decision-makers as is the scientific, historic and economic value of waterways, ex-

posure to the cultural aspects can be a life-enriching experience. Exposure to this information also helps in informing students of the pervasive impact of the world of water in all aspects of human life and therefore can have implications in demonstrating the importance of decisions on water-related politics.

That ninth graders scored significantly higher on knowledge than fifth graders may be cause for optimism. This study has demonstrated a correlation between higher knowledge and more positive attitudes about the importance and value of water systems. Formal and informal experiences over the 4-year period between the grades are apparently producing desirable changes in the school population. If we can identify which of those experiences are the most effective information sources, then their use can be maximized to improve knowledge about the water world.

Thus, an important aspect of this report is a consideration of where the subjects' information might have originated. The largest percentage of the subjects felt they got their information from movies and television. The demographic factors shown to be related to knowledge scores were region and race in grade five, with sex also related in grade nine. An opportunity factor may be involved in the regional "proximity effect," with more aquatic experiences available in the coastal region, and a historic factor of dominance by white males in water-related careers may also be related. Combining these possibilities with the additional related factors of watching Cousteau programs, reading *National Wildlife* and being able to swim, it is not difficult to surmise the influence of socioeconomic factors on aquatic knowledge. Better clues to socioeconomic influences would be measures of family income and education level which were not collected in this study but should be included in future research.

This study has served the Ohio Sea Grant Education Office as a baseline of marine and aquatic knowledge and atti-

tudes and therefore as a guide to what information should be provided in curriculum materials and/or teacher training. It has shown that water-related knowledge, attitudes and experiences in a midwestern state are very similar to those in a coastal state such as Virginia. It has also suggested other mechanisms besides kindergarten through high school education as information vehicles and has thus served as justification for projects involving radio and museums as dissemination media. Finally, the survey will be treated as a pretest which preceded a 3-year program of teacher education in marine and Great Lakes education, grades five through nine. Repeating the survey in the 1983-84 school year, with a new sample chosen in the same way, should indicate whether this information has been passed on to the teachers' classes to the extent that ninth grade scores are substantially higher than the pretest scores. In the posttest the fifth grade will serve as a comparison group, since that grade level and below will be minimally impacted by the teacher education program and OEAGLS materials. In that regard, this study will serve as a summative evaluation for both projects.

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