Abstracts of Research in Marine and Aquatic Education 1975-1990

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Abstracts of Research in Marine and Aquatic Education 1975-1990
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Research in Marine Education (to August of 1991) not in Report
Marine and aquatic education (M/AE) is defined as "that part of the total educational process which enables people to develop a sensitivity to and a general understanding of the role of the seas and fresh water in human affairs and the impact of society on the marine and aquatic environments." (Goodwin & Schaad, 1977) As an important component of environmental education (EE), M/AE involves thousands of formal and nonformal educators throughout the continent.

The following is a brief review of the topics addressed in M/AE research during the last 15 years. The definition of research is the same as that used by the NACEER. We exclude program descriptions except as accompanied by needs assessment substantive evaluation.

Interest in teaching about the world of water grew to noticeable proportions in the 1970s, and with it emerged a network of leading individuals and sponsored programs. Research among this group produced an interdisciplinary conceptual framework that has been refined for use in framing objectives, structuring programs, classifying curricula, and identifying gaps in existing resources. Based on the scope of this conceptual framework, a number of researchers in the U.S. and Canada have assessed student knowledge and attitudes about the oceans and Great Lakes, finding generally that knowledge increases with grade level, with exposure to television documentaries and specialty magazines, and with proximity to the coast. Knowledge of science concepts in M/AE slightly exceeds knowledge of related social studies concepts, and both are far greater than knowledge of humanities topics in the world of water. Specific instruction in water topics has been shown to increase knowledge scores. Attitudes are directly related to knowledge levels.

Teacher awareness of marine and aquatic concepts had been assessed in relation to what is being taught. For teachers, as well as students, more is known about marine topics than about the Great Lakes, even in the Great Lakes region. In general, teachers report spending time teaching about those marine topics that they know best, including primarily the basic concepts of marine biology, physical oceanography, and media-interest topics related to marine mammals and ocean pollution. Conclusions from such research are frequently used as justification for new teacher education programs.

Implementation of M/AE programs has been the subject of much research. The number and nature of marine education programs have been reported for British Columbia, California, and Ohio. Program success has been examined in relation to factors such as school organizational climate, inservice teacher characteristics, content test scores of teachers, teacher willingness to innovate, students' cultural values and spiritual beliefs, and teacher experience with aquatic environments. The effectiveness of various modes of curriculum dissemination has also been evaluated, demonstrating that teacher training is a must to assure the highest level of use of curriculum materials.

Additional M/AE research deals with issues important throughout the fields of formal EE and science education: computer applications, global understanding through telecommunications, characteristics of successful student projects, and defining and responding to issues. The "pipeline" issue of educating more marine scientists to fill positions in the future may be addressed more effectively, using some 1987 research on learning styles of marine scientists.

As for nonformal M/AE, recent works include design and testing of multimedia interactive displays, evaluation of an estuarine sanctuary's outreach program for school groups, and multiphased evaluation of a museum program with an aquatic theme. Entire issues of CURRENT: The Journal of Marine Education have been devoted to action research on marine debris and program developments in NOAA's National Estuarine Research Reserve Program.
Finally, M/AE research includes studies of adults’ knowledge and attitudes about the oceans and Great Lakes. In most cases, adult information levels do not exceed those of high school students. Intensive studies using Piagetian development levels, concept mapping, interviews, and VEE diagrams have extended our knowledge of adults’ marine learning beyond what can be assessed in standard multiple-choice tests. Experimental studies have also indicated that a single television documentary or a series of brief TV news programs can influence knowledge levels on marine and Great Lakes issues. Given the generally low level of adult knowledge of marine and Great Lakes topics (frequently reported at 50-60 percent of items correct), marine and aquatic educators are cautiously rejoicing in the new higher levels of media interest in environmental topics.

Based on research in M/AE, an action agenda for increased implementation and more effective dissemination of information has been proposed in a chapter of NABT’s 1990 monograph on “Oceanography for Landlocked Classrooms.” The same recommendations apply to the needs of EE in general:

1) a clearinghouse for centralized information about and access to curriculum materials;
2) a speaker's bureau of subject matter experts by region;
3) an educator’s network for ongoing contact;
4) coalitions of groups with similar aims;
5) creative funding arrangements; and
6) attention to publicity and promotion of marine education activities.

The National Marine Educators Association (NMEA) and others in the marine and aquatic education community are working on these ideas and others that apply the results of research in the field. Some NAAEE members are among this group, and more are encouraged to examine M/AE approaches for their applications to other EE topics. After all, good planets are hard to find, and 70 percent of this one is water!

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**DESCRIPTORS:**
attitudes, curriculum evaluation, knowledge, water conservation

**ABSTRACT:**
This study was designed to evaluate the effectiveness of a water conservation instructional unit in increasing students’ knowledge of water conservation practices and influencing their attitudes about efficient water use. A Solomon 4-Group Design with 843 seventh-grade Life Science students was used. Data analysis revealed significant differences between treatment and control groups regarding water conservation knowledge, attitudes toward water conservation, and knowledge and attitudes of water conservation practices of seventh-graders taught a unit of water conservation and their attitudes about water use.


**DESCRIPTORS:**
attitudes, knowledge, marine environment

**ABSTRACT:**
The relationship between the criterion variable of attitude toward the marine environment and the composite set of predictor variables of knowledge of the marine environment, childhood and adult marine activities, childhood and adult residential proximity to the coast, socioeconomic status during childhood, formal coursework in the marine sciences, educational level attained, college science major or emphasis, and the demographic variables of age, sex, and race of middle and secondary school science teachers in Mississippi and Alabama was determined in this study. The independent relationships between the criterion variable and each of the predictor variables were also assessed.

The stratified (coastal and inland) random sample of subjects responded to “The Survey of Oceanic Attitudes and Knowledge (SOAK)” and the “Marine Activities Profile (MAP)” during the fall of 1984. The statistical technique of multiple linear regression, using the Veldam 1967 REGRAN program, was used to test the hypothesis of the study.

Results revealed there was a significant relationship between marine attitude and the composite set of predictor variables ($F = 4.928$, $p < .0001$). Marine knowledge, race of the subject, a college science major or emphasis in biology, adult proximity to the coast, and courses in marine science were selected, in the order listed, as the five best combined predictors of marine attitude. Significant independent relationships between marine attitude and the predictor variables of marine knowledge ($p < .0001$) and race of the subject ($p < .0002$) were also determined. Post hoc analysis established that subjects who have taken two or more marine science courses or workshops have a significantly more positive attitude toward the marine environment ($p < .017$) and significantly more marine knowledge than subjects who have taken no marine science courses ($p < .009$).


**DESCRIPTORS:**
curriculum development, learning theory, marine trades, Sea Grant

**ABSTRACT:**
This study, in the broadest sense, answers the question, “How does a theory of educating come to bear on extension education?” It seeks to fulfill the need for the incorporation of scientific research (curriculum) to extension programming (teaching) for identified audiences (learners). A comprehensive theory of educating, based on modern learning theory and epistemology, is applied to an important N.Y. Sea
Grant Program area: the marine trades.

A total of thirty-eight individual interviews with charter captains and marina operators were conducted in the Lake Ontario, Hudson River, and Long Island regions of New York state. Sea Grant Institute research which applied to the marine trades was identified and then analyzed using Gowin's VEE and concept mapping to organize conceptually the various subject areas, construct interviews, and analyze data.

Interviews with upstate charter captains revealed a great number of concepts and propositions concerning the distribution of salmonids in Lake Ontario. These are combined with existing research knowledge to form an adult extension curriculum entitled, The Theory of Structure Fishing. Marina operators indicated a set of marina concepts and principles which they consider to be important for the success of their business. These were combined with research in The Marina VEE Analysis for the design of future marina extension events.

Governance, in the context of educating, led this research to investigate how Sea Grant extension can design events to secure cooperation among people to achieve common goals and feedback information to guide future programming. An exemplary case of functional Program Advisory Committee (PAC) was analyzed to determine those criteria PAC members should exhibit. Mapping techniques were used to trace lines of influence and communication in the extension program. In the broader social context, the Lake Ontario lake trout creel limit controversy was VEE analyzed to indicate the role of policy, evaluation, management, and science in determining mutually agreed upon natural resource decisions. This analysis, together with interviews of Long Island captains, forms the basis for the design of extension events to help resolve natural resource conflicts.

This research indicates that a theory of educating forms an integrated and comprehensive conceptual framework for the Sea Grant Marine Advisory Service. The new educational techniques described provide agents with tools that better enable them to design and evaluate extension education programs.


DESCRIPTORS: marine education, video-assisted instruction

ABSTRACT:
In this study a half hour marine education video program about the fishing industry in the Gulf of Maine was produced. A pretest and posttest were designed to test for concepts presented in the video program. The video program was field tested with three student groups in central Maine: a junior high school group (n = 99), a high school group (n = 117), and a college group (n = 41). Each student responded to a pretest, a test of Piagetian development level, a posttest, and received the video program as treatment.

This study examined the following research questions. What is the effect of the video program on the posttest scores of the subjects in the study? What is the effect of the video program on posttest scores when the subjects are classified by grades? What is the effect of the video program when the subjects are grouped by developmental levels? What specific items presented by the video program were learned best by the subjects in the study?

There was a significant difference between pretest and posttest scores for the entire sample. No significant difference was found on posttest scores by gender. A significant difference was found between posttest scores of concrete operational students, transitional students, and formal operational students. The video program was found to be conceptually too rich for concrete operational students. Abstract concepts presented with no visual representation in the video program were learned best by formal operational thinkers.

**DESCRIPTORS:**
curriculum evaluation, curriculum implementation, elementary education, marine education

**ABSTRACT:**
This study attempted to identify any differences which might exist in a number of variables among schools which accepted, rejected, or made exploratory use of an introduced innovative marine education curriculum. The innovative curriculum material consisted of one instructional unit each for grades K-8. Each of the units had an aquatic, or marine focus, and each was an infusion unit. That is, it was intended to provide classroom teachers with exercises and activities related to marine, or aquatic topics for use in teaching in their standard grade-level disciplines.

The selected variables for this study were percentage of male teachers on a school staff; percentage of teachers by age categories on a school staff; percentage of teachers with academic preparation in mathematics, science, and social studies on a school staff; school pupil to teacher ration; school total number of professional staff members; community per pupil expenditure; community socioeconomic status; and the number of highway miles from the community to the marine environment. Organizational Climate Description Questionnaire (OCDQ) (Halpin, 1969) openness scores, the eight subtest scores, and school climate type by Halpin and Croft's prototypic categories were also considered.

Principals of 64 Maine elementary schools provided some of the necessary demographic data, and administered the OCDQ to their teachers following prescribed guidelines to insure anonymity. At the same time, marine education infusion units produced by the directors and staff of the Northern New England Marine Education Project were distributed through the principals to the teachers of the schools. At the end of a six-week study period, the principals provided data on the use made of the marine education infusion units by the teachers in their schools. From this reported use, the schools were categorized into accepting schools, rejecting schools, and schools which made exploratory use of the introduced innovative material.

The variables of teacher preparation in mathematics, and teacher preparation in science were found to be significant variables at, or beyond the .05 level of significance by a one-way analysis of variance. Schools with higher percentages of teachers with academic preparation in mathematics and science were more likely to explore, or accept the innovative marine education material that were schools with lower percentages of such teachers.

T-tests showed highway miles from the marine environment and percentage of upper white collar workers in the community to be significant variables among accepting, rejecting, and exploring schools.

The data clearly showed that teachers perceived the introduced marine education material was math/science oriented and as addressing saltwater topics, only. Neither of these perceptions is congruent with the design intent of the marine education infusion units.

The findings clearly show that if marine educators wish to address both aquatic and marine topics in a multidisciplinary manner, they will have to make their intentions clear to the educators they hope to serve.


**DESCRIPTORS:**
learning styles, marine scientists

**ABSTRACT:**
This multipurpose study of marine scientists in the United States was conducted during the summer of 1987. The primary objective was to determine the learning style of the marine scientists. The second objective was to ascertain whether a relationship exists among the subdisciplines of marine science, i.e., biology, chemistry, geology, and physics, with regard to learning style. Other objectives addressed whether relationships exist between the sex, age, or education of the scientists and their preferred learning styles. In addition, the study was to determine if
there was a relationship between learning style and a preferred time of day to learn. Lastly, the study was intended to ascertain the preference for instructional methods by each learning style type.

There were 182 subjects, representing five government agencies and two major state marine research institutions. The Gregorc Style Delineator and an accompanying demographic questionnaire were completed by each subject.

Marine scientists were found to be primarily concrete sequential learners with a second mode of concrete random learners. Abstract sequential learners were the third most frequent learner type. Few marine scientists were abstract random learners. An insufficient number of female subjects precluded the test for learning style differences attributable to sex. Neither age nor subdiscipline relationships with learning styles were found. A relationship was found between educational level and learning style. There was no relationship between learning style type and preference for time of day to learn. The majority of the subjects preferred the morning, i.e., 8:00 a.m. to noon. The preference for instructional methods largely agreed with Gregorc's assessment of the preferences of the learner types. The discrepancies can be explained, in part, by the type of information that is characteristic of marine science.


**DESCRIPTORS:**
elementary education, environmental education, marine education, secondary education

**ABSTRACT:**
Marine education, originally linked to the century-old discipline of marine science, is becoming increasingly popular in the area of environmental education. Although marine science has existed for many years as specialties in a few schools, marine education at this time is not limited to this discipline. By using oceanic or aquatic examples of a concept, marine education can become a topic for nearly every discipline including home economics, physical education, and physics. Marine education is also taught informally outside the school. Existing organizations and corporations offer educational/recreational marine related activities, while television and news media offer us excellent exposure to the unknown wonders of the sea. Yet despite the variety of available marine education experiences, our knowledge of the sea is minimal. Marine awareness assessments have been designed to determine marine knowledge, and the combination of marine attitudes and marine knowledge. All tests have indicated a lack of marine knowledge, yet participants expressed positive and improving attitudes towards environmental education.


**DESCRIPTORS:**
attitudes, knowledge, marine education, secondary education

**ABSTRACT:**
The Survey of Oceanic Attitudes and Knowledge (SOAK) was conducted to assess the current level of marine knowledge and attitudes among Virginian tenth graders. The rationale of the survey was to determine whether certain experiences among participants influenced both positive and negative attitudes toward marine related issues. And, if so, could these experiences be manipulated to improve overall awareness and attitudes? The survey was broken down into three categories, measuring students' individual attitudes, students' personal marine experiences, and a section asking students to rate the importance of those experiences. The mean knowledge score for coastal states was about 52 percent correct, while inland students scored about 48 percent. No significant attitude differences were detected between inland and coastal states, and participants felt most strongly about potential hazards to the marine environment. The survey also assessed the possibility of a relationship between knowledge about the environment and environmental attitudes. The results suggested high scoring students having more positive attitudes than students with lower scores.

**DESCRIPTORS:**
attitudes, elementary education, knowledge, marine education, secondary education

**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 three 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 Great Lakes and oceans from fifth and ninth grade students in randomly selected schools with three 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 two 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.


**DESCRIPTORS:**
marine education, Sea Grant

**ABSTRACT:**
Different types of education programs about the aquatic environment and training for professions dealing with these environments have been supported by the National Sea Grant College Program throughout its history. This paper reports the preliminary results of two concurrent studies regarding that support. The first analyzes historical records of funding patterns by category of education. The second study reviews results of a survey of Sea Grant Directors regarding their programmatic education philosophies, their assessment of benefits derived from their program's education thrusts, and the anticipated future role of education in Sea Grant.


**DESCRIPTORS:**
attitudes, environmental education, knowledge, television

**ABSTRACT:**
Is television an effective medium for communicating environmental information to the general public? This study made use of a “two-way television” cable system to evaluate knowledge and attitude changes among viewers of a new Cousteau documentary. The experiment consisted of a televised pretest, posttest, and delayed posttest among randomly selected viewers and nonviewers of the documentary. Viewer knowledge increased significantly and remained high for two weeks. Viewer attitudes shifted toward the attitude goals of the producers, but within two weeks returned to pretreatment levels. No significant changes occurred among the control group.

**DESCRIPTORS:**
attitudes, environmental education, knowledge, marine education, television

**ABSTRACT:**
When questioned regarding their sources of environmental information, many people cite television as the major contributor. Recent research has in fact identified a relationship between scores on aquatic information tests and the reported number of Cousteau documentaries seen on television. This study assesses the knowledge and attitude changes resulting from home viewing of a Cousteau Society documentary on marine mammals and compares these changes with those resulting from a science teacher's presentation of the documentary's script. A pretest-posttest-delayed posttest comparison group design utilized an instrument based on specific program content. Results indicate that comparable presentations in either medium can result in increased and retainable knowledge. Attitude changes were apparent in the television treated group but not among those receiving classroom treatment.


**DESCRIPTORS:**
attitudes, Great Lakes, knowledge

**ABSTRACT:**
Since 1964 the Center of Science and Industry (COSI) in Columbus, Ohio has provided both recreational and educational experiences for 325,000 visitors annually. Part of COSI's mission in Ohio has been to bring science and technology to people in easily comprehensible forms, and through its extensive educational program offerings it provides real world contact with timely issues of high interest. One such effort was "The Great Lake Erie", an educational program to improve visitor knowledge and attitudes about the lake. Surveys have demonstrated that the importance of Lake Erie is not well understood throughout Ohio, and much evidence exists that attests to the measurable importance of formal and informal learning centers as settings for affective and cognitive learning.

An extensive portable exhibit and program package was generated at COSI with the assistance of the Ohio Sea Grant Education Program. Findlay, Ohio, was the site chosen to implement the portable program on a pilot basis. A two-day inservice workshop for teachers was conducted in the Findlay area as a means of maximizing the potential of the COSI program. Twenty-two teachers were provided with information and curriculum materials for teaching about Lake Erie in their classes.

From September 15-20, 1984, "The Great Lake Erie" visited Findlay. Weekdays were reserved for school groups, and on weekends and evenings the public was invited to attend. During this period the impact of the program was evaluated in five different ways. Results of the study have implications for other programs in informal educational settings.


**DESCRIPTORS:**
aquatic education, attitudes, knowledge

**ABSTRACT:**
Surveys of students and adults in Ohio reveal a lack of information about aquatic environments, including Lake Erie. A potential means of increasing citizen understanding of coastal environments and their importance is through nonformal classrooms. This research assessed the magnitude and nature of the educational impact of the Old Woman Creek National Estuarine Research Reserve visitor center and outreach programs for local schools.

Testing in the fourth and fifth grades indicated
that students gained significant amounts of knowledge with each part of the outreach program. Greatest gains accompanied the more structured in-school activities. Student attitudes toward estuaries also improved in comparison to those of students who did not receive the outreach experiences or visit the reserve.

Adults at the visitor center took a modification of the student test administered on Apple computers, and those exiting showed significantly more knowledge than those entering the center. Arrangement of display panels and readability of text on the panels appeared to be related to knowledge of different topics. The visitor center attracts a relatively young population. Visitors remain an average of 18.7 minutes. Given that 49.6% of the visitors came out of curiosity, the knowledge gains achieved are cause for optimism for the potential of the visitor center for public education.


**DESCRIPTORS:**
aquatic education, elementary education, Great Lakes, marine education, Sea Grant, secondary education

**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 four-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 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.


**DESCRIPTORS:**
attitudes, Great Lakes, knowledge, oceans

**ABSTRACT:**
The Ocean and Great Lakes Awareness Survey was developed by the Ohio Sea Grant Education Program in 1979. It has been used every four years as a repeated measure of Ohio students’ knowledge and attitudes about the oceans and Great Lakes, charting changes in those attributes as means of determining how well Ohio citizens are being prepared for decision-making about those bodies of water. Interest in the Survey by researchers in other regions has led to the inclusion of the material in ERIC. This will assure greater access to what we believe to be the only regularly repeated environmental awareness test in North America and perhaps the world.


**DESCRIPTORS:**
aquatic education, marine education, science education, Sea Grant

**ABSTRACT:**
This article attempts to bring marine and aquatic education to the attention of the science education community for the purpose of encouraging greater infusion of marine and aquatic education into the curriculum of the science community. Additionally, the Ohio Sea Grant Education Program conducted a study to determine the degree to which the national
goals for Sea Grant education were attained for the years 1976 - 1987. The greatest amount of Education funding seems to have gone to provide support for research assistants and internships. The greatest number of projects seems to have gone to the Courses category. K-12 curriculum development saw a dramatic reduction in both funding and number of projects.


DESCRIPTORS:
- aquatic education

ABSTRACT:
Discusses how aquatic education can be incorporated into standard classroom activities regardless of proximity to aquatic resources. Details the recommendations of the Great Lakes Commission.


DESCRIPTORS:
- aquatic education, attitudes, knowledge, marine education, television

ABSTRACT:
From Disney and National Geographic, the television viewers of the second half of this century learned about the mysteries of the deep. Cousteau’s divers admonished us to care about marine environments and led us to wonder at their diversity. NBC News asked us “Who Killed Lake Erie?” in 1969 and NOVA showed us troubled waters in the 1980s. This paper highlights the chronology of television presentations about marine and aquatic topics and present research documenting the impact of such presentations on viewer knowledge and attitudes.


DESCRIPTORS:
- environmental education, Great Lakes

ABSTRACT:
Baseline information about public knowledge of the Great Lakes was collected from two groups in an urban lakeshore area. Survey questionnaires were completed by 570 shoppers in two Cleveland, Ohio shopping malls during April, 1989. This “general public” study revealed that knowledge levels about the Great Lakes are low. In January, 1990, the survey was repeated at a regional boat show in Cleveland, with 425 respondents. Respondents who cited newspapers or lake experiences as their primary source of Great Lakes information were most knowledgeable. Boat show respondents (“recreational users”) outscored the general public on both knowledge and vocabulary related to Great Lakes issues. A review of the substance of the survey responses indicates areas of need for public information programs.


DESCRIPTORS:
- aquatic education, elementary education, environmental education, secondary education

ABSTRACT:
This study attempted to provide a perspective on Canadian efforts in marine education. Federal agencies with a functional area related to management of marine and aquatic resources were surveyed as to the type of K-12 involvement it had in formal education, nonformal and informal learning initiatives. Additionally, letters of inquiry were sent to Science, EE, or Social Studies consultants in the ten provincial
and two territorial Ministries of Education in an effort to determine the extent of their involvement in marine education. Finally, a selected population of teachers currently teaching marine or aquatic education were sampled using a modified Delphi process. Fisheries and Oceans, Inland Waters Directorate and the Environmental Management Services of Environment Canada were the only ‘agencies’ within the Federal Government developing materials for use in schools. Only Newfoundland and Labrador, Nova Scotia, and British Columbia and the Northwest Territories had developed marine education materials for some of the grades between K-12. Science, Environmental Studies, and Geography represented the top three curriculum areas represented in marine education according to the teachers surveyed. Other teachers with similar materials were the primary source for teaching materials.


DESCRIPTORS:
instrument design, knowledge, Sea Grant

ABSTRACT:
This test instrument was developed in preparation for a project sponsored by National Sea Grant. It was designed to measure the general level of marine knowledge of adults of northern New England. The major research questions were: 1) Can a taxonomy of objectives for marine education be developed? 2) Can a valid and reliable instrument be developed to measure knowledge of the marine world? 3) Are there differences of marine knowledge on certain independent variables as age, sex, educational background, distance of residence from the sea, and experience?

Test questions were judged for content by a team of marine educators. The resulting 58 item multiple choice test was then administered to a volunteer sample of 479 adults in eighteen test centers selected from coastal and inland Maine. The split-half reliability was 0.882 and KR-20 was 0.883.

The nine independent variables were reported significantly different at the .05 level. Out of a maximum score of 58, Males (x = 40.78) outscored females (x = 35.88). Adults 25 to 35 years of age (x = 39.85) and those 35 years and older (x = 42.35) scored higher than adults of 18 to 25 years (x = 26.28). Significant t-tests were found for scores of adults having four years of college and beyond compared with those having three years of college or less. Analysis of variance revealed that adults working in a part-time, marine related occupation (x = 45.6956) scored significantly higher that adults in a part-time, non-marine related occupation (x = 36.9500), married homemakers whose spouses do not work in a marine occupation (x = 34.5806), and those adults currently unemployed (x = 35.8582). Unemployed adults scored significantly lower than adults employed in a non-marine occupation. Those adults with one or more marine or environmental courses scored higher that adults with no course work. Adults living within 25 miles scored higher than adults living greater than 25 miles from the coast. Teachers scored higher than non-teachers; science teachers scored significantly higher than other subject specialists.

Thirty percent of the variance was accounted for by education and distance from the coast. Other independent variables accounted for less than ten percent of the variance. Factor analysis disclosed three clusters of items: biological processes, environmental concepts, and general geographical information.


DESCRIPTORS:
elementary education, instrument design, knowledge, marine science, secondary education

ABSTRACT:
This 35-item, multiple-choice Marine Education Knowledge Inventory was developed for use in upper elementary/middle schools to measure a student’s knowledge of marine science. Content of test items is drawn from oceanography, ecology, earth science, navigation, and the biological sciences (focusing on marine animals). Steps in the construction of the inventory (KR-20 of 0.70) are also provided.

DESCRIPTORS:
curriculum development, marine science, secondary education

ABSTRACT:
Recent legislative concerns and the results of more than twenty independent studies have brought national attention to the decline in the status of science instruction in the public secondary schools across the United States. The multiple concerns voiced in the majority of the reports have resulted in demands for more laboratory-oriented, relevant, and innovative curricula in order to broaden the appeal of the natural sciences among the high school population from which will come future scientists, mathematicians, and science teachers.

This dissertation project was based on the hypothesis that a secondary, multidisciplinary elective curriculum in marine sciences for grades 9-12 could be developed with sufficient scholarship to address the range of educational concerns within the context of existing instructional programs in science. It was organized according to the parameters specified in the Tyler and Taba curriculum models and was based on the employment of inactive experiences built upon a learner interest-oriented rationale. Fundamental decisions involving learning constructs, content structure, and elucidation of concepts were based to a significant degree on practitioner experience.

The established goals and content for the marine science curriculum were determined by 1) the nature and scope of subject content, 2) adolescent development of the learner, and 3) societal needs and concerns.

The curriculum consisted of six broad units of study, each comprising a separate science discipline: 1) the ocean environment (ecology), 2) marine geology, 3) seawater chemistry, 4) the air-sea interface (marine meteorology, physical oceanography), 5) life in the sea, and 6) the ocean resource (historical explorations and discoveries, renewable and non-renewable harvested resources, and contemporary sociopolitical environmental concerns).

Validation of the goal and objective statements was determined by a consensus among U.C.L.A. professors who served as judges with experience practicing marine science teachers in the Los Angeles Unified School District. Learning experiences were organized for each goal statement and instructional lessons were developed to meet the behavioral objectives derived from them.

The implementation of the marine science curriculum in the secondary school required consideration in three areas: 1) teacher re-education, 2) investment in equipment and material, and 3) a reorganization of the traditional methodology employed in secondary science instruction.


DESCRIPTORS:
secondary education, student research

ABSTRACT:
A New York high school teacher and a team of selected science students carry out independent research programs that allow them to correlate their science studies with societal problems. Students studied changing beaches, currents, and wave patterns to determine variations in beach erosion. The research team has identified various importance of salt marsh preservation (including a case study on Manchasset Bay). The students also studied sludge leachate hazards, including flushed household chemical products, industrial and commercial wastes disposed of through sewers, gasoline and oil spills, and underground tank leakage.

**DESCRIPTORS:**
blue mussel, marine education

**ABSTRACT:**
Results of research into the content and quality of existing marine education materials pertaining to the blue mussel (*Mytilus edulis L.*) indicated that there was a critical need for additional resources on this topic. Materials available to the marine education community regarding mussels were either too brief or inaccurate. Suggested curriculum strategies were also lacking. A demand existed within the marine education community for accurate mussel information for marine education. The needs referred to above include resource material pertaining specifically to: 1) the biology, ecology, and natural history of the blue mussel (*Mytilus edulis L.*); 2) the history of commercial utilization of the mussel and its current status as an underutilized marine resource; 3) national and international techniques of mussel aquaculture; 4) educational activities pertaining to mussels and mussel aquaculture; 5) multi-media presentations on mussel aquaculture; 6) mussel aquaculture information derived directly from the experience of a mussel grower, and 7) consumer information regarding the storage, handling, and preparation of mussels.

The research addressed these issues by producing three marine education resources pertaining specifically to the blue mussel (*Mytilus edulis L.*) and mussel aquaculture: 1) the establishment of a representative mussel aquaculture site; 2) a resource document suitable for elementary and secondary education; and 3) a multi-media presentation on mussel aquaculture.

Information regarding the establishment of a mussel-culturing site is contained in a report entitled, "Establishing A Mussel-Culturing Site in Maine, 1978-81". The report addresses the following topics: 1) selecting and establishing the mussel-culturing site; 2) culturing techniques utilized at the site; 3) results of operating the site; 4) observations and conclusions; and 5) graphic illustration of the culturing system and techniques used.

The second resource is a paper entitled, "Information and Activities for the study of the Blue Mussel (*Mytilus edulis L.*)". An instructor background section is included as a resource with a before and after test. In addition, classroom, field, and laboratory activities are suggested. Photos and diagrams accompany the text, and lists of references and resource centers are also included.

The third resource is a multi-media presentation on mussel aquaculture and some of the factors present in the marine education environment which affect culturing. Slides are accompanied by a taped narration with musical interludes. Technical information is also provided for correct use of the two necessary slide projectors, the slide dissolve unit, the stereo tape recorder, and sound system.

The author’s goals was to provide marine educators with accurate and informative resources to use in marine education programs relative to the blue mussel (*Mytilus edulis L.*) and its culturing. To increase awareness of the mussel, stimulate interest in its use as a viable protein source, and provide insight into the nature of the mussel aquaculture fishery were the objectives.


**DESCRIPTORS:**
marine education, secondary education, teacher training

**ABSTRACT:**
This is a study of relationships between characteristics of teachers participating in a High School Marine Science Studies (HMSS) Workshop and teacher scores in the HMSS Content Mastery Test. The combined Hawaii and Massachusetts workshop are the total population of HMSS Workshop participants during the summer of 1979.
Data were obtained using an HMSS Workshop registration form and results from the pre- and post-workshop administrations of the program-specific HMSS Content Mastery Test. The test has two components: "Subtest A. Physical Science" and "Subtest B. Biological Science." The pre-workshop test was administered in parts throughout the workshop just before each HMSS unit was introduced; the post-workshop test was administered in its entirety at the conclusion of the workshop.

Results from testing indicate no statistically significant relationship between either pre- or post-workshop HMSS Content Mastery Test scores and three of the teacher characteristics selected for the study: total years teaching experience, age, and sex. Disciplinary background, level of prior marine experience, and highest degree in science reached positive statistical significance on "Subtest B. Biological Science" scores. Level of prior marine experience also reached positive statistical significance on the pre-workshop administrations of "Subtest A. Physical Science." Two-way interactions reached statistical significance on post-workshop scores of "Subtest A. Physical Science" with total years teaching experience and disciplinary background.

In general, teacher characteristics had 1) a closer relationship to biological science scores than to physical science scores, and 2) a closer relationship to pre-workshop scores than to post-workshop scores. The study concluded that significant relationships exist between selected teacher characteristics and teacher scores on the HMSS Content Mastery Test.

As a result of this study, HMSS Workshop leaders can use preregistration data to predict scores of HMSS Workshop participants and to plan modification of workshop activities to better meet individual teacher needs.

ABSTRACT:
A modified three round Delphi survey was used to determine marine oriented knowledge, skill, and attitude objectives for precollege programs in Virginia. Respondents from five marine employment subfields, and one group of lay people were included. Thirty-eight knowledge, 29 skill, and 73 attitude objectives were selected as high priority.

Marine science respondents favored items dealing with food webs; the effect of large bodies of water on weather and climate; the power and inevitability of hurricanes and littoral drift; ecological balance; the balance between resource technology and the environment; the willingness to restrict development; the need for resource management; and the need for the enforcement of reasonable regulations.

The respondents other than those in the marine science group more highly favored objectives concerned with water pollution; the effects of a "dead" Chesapeake Bay; the impact of sewage discharges and chemicals; and administering first aid for burns, shock, and drowning.

In terms of broad categories, marine science respondents ranked the following as lower priority than did the other groups: 1) the influence of water on our history, 2) economics (knowledge), 3) defense (knowledge), and 4) safety (skills).


DESCRIPTORS:
curriculum evaluation, elementary education, marine environmental awareness, Project COAST, secondary education

ABSTRACT:
This investigation had two purposes: the validation of Project COAST's tests of marine environmental awareness and the examination of the test results as a possible indication of the need for curriculum revision. Dr. Robert W. Stegner realized the need to establish a baseline indicator of marine knowledge as that curriculum could be developed to meet the needs of students in acquiring a basic stock of ma-
rine concepts upon which rational decisions concerning the future of the coast and ocean resources could be made. The Project COAST tests are a product of this concern.

The Marine Environmental Awareness Tests for grades four, eight, and eleven are each composed of 30 multiple choice questions written to measure student understanding of the concepts presented in the Conceptual Scheme for Marine and Coastal Environmental Studies developed by Geens and Stegner in 1973. These tests were administered to over 8,000 students from public and private elementary and secondary schools throughout the United States. The study was divided into two parts: the 1976-1977 sample in which schools were selected jointly by representatives from the state departments of education from New Jersey, Delaware, Maryland, and Virginia and the director of Project COAST; the 1977-1978 sample in which teachers throughout the United States volunteered to take part in the testing program as a result of an invitation extended by the National Marine Education Association and Project COAST.

Using the data from these testing population hypotheses concerning test reliability, content validity, construct validity, item difficulty, and item discrimination were examined. Readability levels for each test were also estimated. Complementary studies including teacher interactions were conducted to assist in the assessment of hypotheses concerning teacher judgment of students' knowledge of marine concepts, the effects of instruction upon student test scores, and teacher attitudes toward revision of curriculum based upon their examination of test data.

KR-20 reliability coefficients ranged from .46 to .71 while the test-retest coefficients indicated reliabilities of between .58 to .68. Because the tests are relatively short measure, the Spearman-Brown prophecy formula was used to estimate reliability for tests of 60 to 90 items and yielded coefficients within the acceptable range of .80 to .95. The tests were determined to have a representative sample of questions which defined the content domain of interest and thus content validity was established. Construct validity of the tests was partially supported by the correlational studies which indicated that students' overall achievement in basic skills and educational ability accounted for 16% to 31% of the variance in the marine test scores.

Seven readability tests computed as part of the DELRAP program indicated that on the average the tests are at least two grade levels above the level for which they are designed. However, this is due in part to the technical, scientific vocabulary used in the tests. Limited studies indicated that marine instruction tended to significantly improve student scores on the tests and teachers did indicate a positive attitude toward incorporating a marine program into existing curricula.

Implications from the study findings indicate that the test results can and should be used by curriculum developers. Item analysis and groupings of the questions by the four major scheme concepts should show areas where emphasis is needed to improve student knowledge of the marine environment. This project is only the beginning of a movement to improve the United States citizens' knowledge of the marine ecosystem and its importance to our future existence.


DESCRIPTORS:
marine education, teacher characteristics, teaching innovations

ABSTRACT:
This study was developed to identify specific factors which affect a teacher's willingness to use innovations in education and marine education. Three hundred and thirty-two teachers attending thirteen marine education workshops responded to a questionnaire that had five sections. The sections were: demographic data, classroom activities, teacher's perspective, education innovations, and marine education innovations. Each participant attended one workshop. At three of the workshops, the participants' attendance was required; attendance at eight of the workshops was voluntary; and at two of the workshops attendance was mixed, voluntary for some and mandatory for others. Each participant completed the questionnaire prior to the actual initiation of the workshop activities.

The study showed a relationship between teacher willingness to use innovations in education
and marine education and the teacher's actual classroom activities and the teacher perspective variables. The teacher's perspective consisted of the five variables: change, teaching, institutional setting, change agent, and teacher role.

The differences between the voluntary and mandatory respondents existed only in regard to: (1) class activities used by the teachers-lecture, field trips, music, art and handicrafts; and (2) perception of a teacher's role.

Teachers who used more innovative activities in their classrooms were more open to using additional innovations. The teacher's class activities were related to their perspective on change, teaching, and teacher role.

A teacher's willingness to use innovations was related to the variables of change, teaching, and teacher role, and change agent but not institutional setting. The profile of a teacher who would be willing to use innovations in education and marine education is one who would use the class activities of guest speakers, contracts, field trips, and music, art and handicrafts more frequently and have a more positive perspective to change, teaching, teacher role and change agent.

The "best" predictor of the teacher perspective variables for willingness to use innovations in education was the teacher's perception of change; and the two "best" were the combination of change and change agent. For predicting willingness to use innovations in marine education, the "best" predictor variable was the teacher's perception of teaching.

If implementation of innovations in education is to be effective, this study indicates that during the initiation phase the teacher's perspective of change, teaching, change agent and teacher role need to be addressed.

ABSTRACT:
Four different methods for disseminating materials and activities used in a program to teach middle school students about aquatic environments were compared in Ohio. Six hundred teachers elected to attend one-and-a-half day workshops, 180 teachers attended workshops requiring 10 full days' participation, 200 teachers ordered materials by mail, and 400 teachers took advantage of a museum's sponsorship of selected program activities for groups of students. Questionnaires were sent to a sample of the teachers in each group. The responses indicated that those attending the short workshops used the material at a higher rate, and introduced them to others at a higher rate, than did teachers in other groups. Participants in the museum program showed the least use. Difference among the teachers making up the groups appeared to have greater impact on use than did the presentation format. Analysis showed that teachers selecting short workshops were less likely to have master's degrees and more likely to attend professional meetings and to participate in curriculum and textbook adoption committees. They appeared more interested in the professional benefits of the workshop than in the larger number of academic credits associated with the larger workshop.


DESCRIPTORS:
marine education, teacher preparation

ABSTRACT:
A survey of Alabama and Mississippi high school science teachers was conducted in the spring of 1979 as an initial step in the Man and the Gulf of Mexico (MGM) marine education project. Most teachers surveyed had little or no formal coursework pertaining to the marine sciences. The teachers felt they did not have adequate knowledge for teaching most marine-related topics. Most familiar topics were rated as highest in importance. A survey of teaching strategies and approaches were identified as suitable for presenting marine education concepts.


DESCRIPTORS:
aquatic education, secondary education, teaching innovations

DESCRIPTORS: attitudes, marine education

ABSTRACT:
An ESEA Title II marine studies program designed to improve high school students' attitudes toward the sea was implemented in American Samoa. A Likert-type attitude scale was developed to measure the students’ attitudes toward the sea. It was revised several times over a two year period and was tested for validity and reliability. A posttest only control group research design was utilized. One hundred students were given the program and then tested, and 112 students were tested without receiving the program. It was hypothesized that no significant difference would be found between treatment and control group scores.

The students receiving the program were shown to have significantly better attitudes toward the sea than the control group students. The students in both treatment and control group in one school were shown to have poorer attitudes toward the sea than students in two other schools. The variables of sex, age, district of residence and parents' vocations were shown to have no significant effect on attitudes toward the sea. It was recommended that the program be continued and expanded in the Samoan schools.


DESCRIPTORS: aquatic education, teaching innovations, secondary education

ABSTRACT:
This handbook is designed to meet the aquatic education needs of Minnesota secondary teachers and students (aquatic education referring of the study of freshwater systems). The handbook is divided into three parts. Part 1 (an introduction) provides an overview of aquatic education, a description of the use of the handbook, and two indices to curriculum materials (defined as instructional materials providing ideas or plans for water-related activities). These materials include either complete courses of study or short collections of activities. The first index lists curriculum materials by source, with full references for requesting them by mail. The second index lists the curriculum materials by their Minnesota water topic area. Topic areas include: water and society (water in daily lives, water in history and culture, water quality problem); water in nature (water cycle, properties of water, life in water); and attitudes about and experiences with water. Curriculum materials are listed alphabetically by title in the second part and student prerequisites, time required, and other information. The last part provides an annotated list of student/teacher references. These include trade books, bibliographies, pamphlets, and audio-visual material and their sources.


DESCRIPTORS: aquatic education, elementary education, Sea Grant, secondary education, teaching innovations

ABSTRACT:
The Minnesota Sea Grant Education Sub-program provided funds to the University of Minnesota in 1980 to develop aquatic education materials (dealing with freshwater systems) for grades 5-9. The project resulted in the development and classroom workshops to introduce Minnesota teachers to aquatic activities. The project also produced two sourcebooks cataloging these materials. A group of science educators then met to develop a set of objectives for aquatic education unique to Minnesota educational needs. These objectives, presented in the form of critical topic areas (water and society, water in nature, and attitudes/ experiences) provided the
focus for an assessment of Northern Minnesota teachers' knowledge and priority for selected aquatic education topics. Fifty-five teachers attending one of four workshops on environmental education completed a questionnaire (included in an appendix), assessing knowledge of and educational priorities for sixteen aquatic topics. Although teachers rated themselves as knowledgeable about aquatic topics, they rated aquatic topics low in educational priority when compared to teachers in Mississippi and Alabama. However, six topics appear to be prime areas for future curriculum development. These include aquatic ecology, water table, wetlands, toxic waste dumping, aquatic foodwebs, and influence of aquatic environment on man.


**DESCRIPTORS:**
attitudes, curriculum development, environmental education, marine education, secondary education

**ABSTRACT:**
Northern Minnesota secondary teachers (n=55) were surveyed on their knowledge of a priority for selected water topics. Teachers' assessment of these topic areas provide: 1) a suggested structure for marine education; 2) the evaluation of existing curricula; and 3) needs analysis to determine areas of future curriculum development.


**DESCRIPTORS:**
elementary education, marine education, secondary education

**ABSTRACT:**
This paper discusses the growth of precollege, academic marine science programs in American education. Both obstacles to measurement and exemplary programs are highlighted. The publication of a marine educators directory is also discussed.


**DESCRIPTORS:**
earth science, marine education, oceanography, secondary education

**ABSTRACT:**
A survey listing 21 major oceanography concepts and several sub-concepts was mailed to all Ohio earth science teachers. Respondents indicated that most of the oceanography topics taught were geologically-oriented. Oceanography concepts relating to ecology, chemical, physical, or life science are considered less important.


**DESCRIPTORS:**
attitudes, knowledge, marine education

**ABSTRACT:**
This study explored the relationship between students' orientations towards the seashore, their beliefs about specific seashore relationships, and their experiences during science instruction. An orientation referred to a tendency for an individual to understand and experience the world through an interpretive framework, embodying a coherent set of beliefs and values. The study involved the collection and analysis, by metaphor and literal interviews, of students' orientations and beliefs before and after instruction. By looking for patterns in the students' responses, six different orientations were identified (scientific, aesthetic, utilitarian, spiritual, recreational, and health and safety), as well as a diversity of beliefs
about specific seashore relationships (tidal cycle, habitat, food chain, community, conservation, etc.). Observations were made during classroom instruction and interviews were conducted with individuals in the school and the community to aid in the analysis of the students’ orientations and beliefs.

The primary focus of instruction was to introduce a basic set of ecological concepts focused around seashore relationships. In order to increase a student’s knowledge of beach ecology, the teacher used instructional metaphors which were sensitive to the student’s preferred orientation identified prior to instruction. A second purpose of instruction was to enhance the student’s willingness to view the seashore from a variety of orientations.

Prior to instruction all of the students used several orientations to describe the seashore, some students used one orientation predominantly. Only a few students held beliefs which were quite similar to accepted science ideas, most students held beliefs which were quite different. There was a reasonably strong relationship between the students’ orientations and their beliefs about specific seashore relationships.

After instruction all of the students showed an increase in knowledge about basic seashore relationships, and a decrease of beliefs inconsistent with accepted science ideas. This increased knowledge was accompanied by a willingness to use more frequently a scientific orientation. This new knowledge appeared to be relatively stable six months after instruction, implying that it was firmly integrated into the students’ cognitive system. Additionally, many students were willing and able to view the seashore from a variety of orientations.

ABSTRACT:
Marks the first step in a process of sustained, systematic collective study aimed at the creation of a marine and aquatic literate and sensitive Canadian populace.


DESCRIPTORS:
marine education, teacher preparation, teacher training

ABSTRACT:
A 42-item Marine Education Questionnaire was administered to all 92 school districts in British Columbia during the fall and winter of 1987-8. Results from 122 completed surveys revealed a normal distribution of respondents in primary, intermediate, and secondary education with an average age in the low 40s and over a decade of teaching experience. Almost half of the respondents had completed at least four biology courses.

Most respondents (85%) felt their pre-service training was inadequate in preparing them for teaching marine science. Fully 75 percent of the respondents indicated no in-service activities. Most respondents cited a “personal interest” and “love” of the sea and a childhood in a coastal environment as primary reasons for the development of an interest in marine education.

Most respondents (68%) indicated that they are pretty much on their own to acquire teaching materials and that materials available are insufficient while 82 percent reported the absence of a marine science coordinator in their district.

Respondents cited distance from the seashore and lack of equipment as the main barriers to marine education in British Columbia. Actual time on marine education ranged from 1 hour to 5 hours per year. Most respondents (75%) indicated that student motivation and interest in marine education seems to be on the rise.
42. Snively, Gloria and John Sheppy. 1989. Students’ knowledge of marine science and resources, and opinions toward resource issues. Paper presented at the National Science Teachers Association Conference, Seattle, WA.

DESCRIPTORS:
attitudes, curriculum development, elementary education, marine education, marine science

ABSTRACT:
This study generated data on students’ knowledge of marine science and natural resource principles, and opinions towards specific marine resource issues. Questionnaires were administered to a representative sample of Grade 5 and Grade 9 students (n = 670) in three communities in British Columbia: Victoria (a small coastal city), Campbell River (a small coastal town), and Williams Lake (a small interior town). Similarities and differences between grade levels and among communities were analyzed and compared. The results of this research have implications for the assessment of students’ knowledge and opinions, and for the development of more comprehensive and responsive marine curricula.


DESCRIPTORS:
attitudes, knowledge, marine science, secondary education

ABSTRACT:
The primary purpose of the study was to determine the relationship between a marine science survey course and coastal proximity, and the levels of knowledge and attitudes of marine science of high school students. In order to determine the relationship between a marine science survey course, coastal proximity, and the levels of marine science knowledge and attitudes, test instruments were developed. The knowledge survey consisted of forty-two multiple choice questions and the attitude survey consisted of twenty-seven Likert type statements.

The test instruments measured the levels of marine science knowledge and attitudes of three selected groups of students. Group I, the coastal participants consisted of students who studied marine and lived in close proximity to the coast. Group II, the coastal nonparticipants, consisted of students who did not study marine science and lived in close proximity to the coast. Group III, the inland nonparticipants, consisted of students who did not study marine science and did not live near the coast. Students were pretested in September, 1983, and posttested in April 1984.

An analysis of variance (ANOVA) of the knowledge data indicated that significant differences did not occur between the means of the three groups from pre- to posttesting. Each of the three groups correctly answered approximately 46% of the posttest questions. This finding may be attributed to the fact that students acquire marine knowledge from sources other than formal marine science courses.

An analysis of variance (ANOVA) of the attitude data indicated that the coastal participants experienced a significant increase in positive attitudes. Coastal nonparticipants experienced a slight but insignificant increase, and the mean scores of the inland nonparticipants slightly decreased from pre- to posttesting. These findings suggest that a marine science course could possibly affect student attitudes toward marine science.

The implications of this study warranted the following recommendations: 1) examine the role of marine science in the secondary science curriculum; 2) identify those sources from which students acquire marine science knowledge; and 3) survey the sample to determine their strengths and weaknesses in science, which may have direct affect upon their levels of knowledge and attitudes in marine science.

**DESCRIPTORS:**
curriculum evaluation, elementary education, marine education, Sea Grant, secondary education

**ABSTRACTS:**
A general inventory and initial assessment of marine education activities in California elementary and secondary public schools based on data collected in 1980 are presented. The report includes: (1) a description of the procedures and findings of a series of surveys and questionnaires distributed to schools, individuals, and organizations; and (2) a set of conclusions derived from the findings. Section one briefly describes the history of Sea Grant and the objectives of the project. The second section sets forth the procedures employed in data acquisition. The third section presents the tabulated data concerning elementary and secondary school marine education expressed in terms of instructors, courses, instructional materials, and resources. The final section summarizes an analysis of the data and presents some recommendations received from junior high and high school educators about improving marine education in California public schools. Findings indicate a general lack of awareness, staff, courses and textbooks for marine education.


**DESCRIPTORS:**
curriculum development, fisheries science

**ABSTRACT:**
As a result of the increasing human impacts upon global marine and aquatic resources, there is an increasing need to produce fishery science experts who can contribute to management, planning, and research. The Food and Agricultural Organization of the United Nations and UNESCO cosponsored a workshop to examine the present status and problems in fisheries science at a university level. Based upon the consensus that curriculum should be adapted to the specific needs of a country and its students, participants examined various case studies of curricula in the present global context. This analysis resulted in the criteria and recommended curricula for undergraduate and advanced degrees outlined in Part I of this workshop report. Part II contains a discussion of the need for fishery science graduates based on analysis of the global situation and the six national case studies which guided the formulation of the recommended curricula in Part I.


**DESCRIPTORS:**
ocean engineering, university curricula

**ABSTRACT:**
This report contains recommendations on advanced university curricula in ocean engineering and related areas, emphasizing the needs of developing countries. A decision matrix is included to assist users in developing the necessary criteria for designing appropriate curricula to prepare university students for careers in different ocean engineering fields. Examples of curricula include: (1) offshore structural engineering; (2) coastal and nearshore engineering; (3) ocean instrumentation; and (4) fisheries engineering. Discussions on necessary and desirable requirements for introducing advanced ocean engineering curricula in terms of human resources, physical facilities, and teaching aids are also presented. In addition, recommendations for the strengthening of ocean engineering in general are provided.
ABSTRACT:
The purpose of this project was to develop a prototype general technology modular package in maintenance and repair of small mechanically powered marine craft. The project would include: 1) identification of modules to be instructed and included in the modular package design with criteria for recommendation and selection, 2) development of modular units and behavioral criteria, 3) field test of the modular units at the high school level, and 4) development of a modular package handbook for instructional personnel.

The modular package will be used as part of a general program of Industrial Arts at the high school level, and is further delimited to schools in the state of Connecticut. The evaluation of the project was limited to determining the viability of the modular units within the school system.

A topic rating sheet and a subtopic ranking sheet was developed from review of current publications and related marine literature.

The data were tabulated to identify the topics and the subtopics to be included in the modular package. Each subtopic unit includes behavior statements, tools/equipment and supply lists, general information activities and worksheets, self assessment, and selected bibliographies.

As a result of a field study the researcher found that the modular package in marine technology maintenance and repair of small mechanically powered marine craft is usable in the Industrial Arts laboratory in high schools in the state of Connecticut. There are activities involved with marine maintenance and repair that should not be attempted by students in the school environment and are best left to trained professionals who possess specific advanced skills and specialized equipment.

The varied specific requirements of each manufacturer's products made development of specific psychomotor objectives difficult and relied on instructors to ascertain completion of objectives for each unit.

The knowledge and skills have been drawn from other areas such as woodworking, metalworking, plastics, power, and electricity/electronics. This project was developed to consider basic skills within the marine area developed on a conceptual basis from other aspects of Industrial Arts.

DESCRIPTORS: knowledge, marine education, teacher training

ABSTRACT: The relationship between the criterion variable of cognitive achievement in marine education by participants in the 1979-1987 Marine Education Intensive Short courses for Teachers and the predictor variables of student involvement, residential proximity to the coast, socioeconomic status during childhood, educational background, and the participant's demographics was determined in this study. The same information was ascertained for the 1986 Intensive Short Course participants, excluding the predictor variable, student involvement. The independent relationships between the criterion variable and each of the predictor variables were also assessed for the 1979-1987 group. Additionally, the difference in pretest and posttest measures of cognitive achievement in marine education by only those participants in the 1986 Intensive Short Course was ascertained.

A random sample of the 1979-1987 participants responded by mail to the "Marine Knowledge and Retention Survey" and "Marine Activity Profile" during the spring of 1987. The 1986 participants were surveyed during the Marine Education Intensive Short Course conducted July 9-14, 1986. The statistical technique of multiple linear regression, using the Statistical Package for the Social Sciences, was employed to test the hypotheses of this investigation.

Major findings revealed there were significant relationships between cognitive achievement in marine education for the 1979-1987 Intensive Short Course participants and the composite set of predictor variables ($F = 11.44, p = .0001$) and the 1986 Intensive Short Course participants and the composite set of predictor variables ($F = 7.11, p = .0002$). The best combined predictors of cognitive achievement in marine education for the 1979-1987 group were race and age. Childhood socioeconomic status and childhood proximity to the coast were the best combined predictors of cognitive achievement in marine education for the 1986 participants. Further, a significant difference did exist between the pretest and posttest scores of the 1986 group ($F = 154.29, p = .0001$). The only significant independent relationship that existed between cognitive achievement in marine education for the 1979-1987 group and the predictor variables was the participants' demographic of age, sex, and race ($F = 3.60, p = .006$). In addition to the participant's demographics, other predictor variables included student involvement, residential proximity to the coast, socioeconomic status during childhood, and educational background.


DESCRIPTORS: attitudes, knowledge, marine education

ABSTRACT: This document reports the results of a Canadian survey that questioned approximately 4,000 students and 200 teachers on marine related topics. The student population consisted of children from the fifth through ninth grades. Their questionnaire included items on: (1) attitudes toward the ocean, wildlife, and marine resource issues; (2) orientation toward marine management concepts; (3) knowledge about the marine environment and human impact on the oceans; and (4) personal experiences with the ocean, either direct or indirect. The accompanying teacher questionnaire questioned teachers about their views on marine and aquatic education in their schools. Student responses indicated that knowledge levels were surprisingly low. Replies to attitudinal items reflected a utilitarian orientation towards the ocean by coastal students. Many identified the school as the most important source of information about the marine environment. However, the students with the highest knowledge scores reported that they learned most about oceans from television and direct experiences with the sea. Teachers responded positively to the need for more marine education in the schools (89 percent) and 99 percent indicated that their stu-
...dents find the ocean interesting. Data results are graphically presented.


DESCRIPTORS: attitudes, marine education, marine science

ABSTRACT:
The purpose of this study was to determine whether secondary students exhibited significant changes in attitude toward science and the marine environment following their participation in a 4-week summer marine science course. The relationship between their participation in the course and selection of college major was also assessed. Student reactions to the course were used to identify perceived strengths and limitations of the established program.

This study involved 190 former participants in the Discovery Hall Project summer program at the Dauphin Island Sea Lab, the marine campus of Alabama's Marine Environmental Sciences Consortium. Since its beginning in 1975, the Discovery Hall program has been a strongly field-oriented marine science course for secondary students and has placed emphasis on awareness of the coastal environment. The former participants included in the study were the entire Discovery Hall Project populations during the summers of 1975, 1976, and 1977. Of the 190 members of the sample who were mailed questionnaires in March of 1980, 164, or 86.3 percent responded.

The questionnaire used in this study was developed from the available literature pertaining to development of science attitudes and student selection of major fields of study, from discussion with University of Alabama faculty and Dauphin Island Sea Lab staff, and from reactions by former Discovery Hall Project participants. Significant levels of .01 or .05 were used in the statistical comparisons of the data. Chi square techniques were used in comparisons of biographical data. Step-wise discriminant analysis was used in comparisons that involved attitudes toward science or the marine environment. A Likert-type scale was employed for questionnaire items that measured changes in attitude. A test of the additive reliability of the 22 attitude items produced an alpha coefficient value of .665.

The major findings and conclusions of the study were: 1) The respondents' attitudes toward science were significantly more positive following participation in the Discovery Hall Project summer program; 2) In comparison to the male participants, the female participants exhibited significantly greater positive changes in overall attitude toward science, interest in taking additional science courses, and confidence in their ability to do well in future science courses; 3) The respondents' attitudes toward the marine environment were significantly more positive following participation in the Discovery Hall Project summer program; 4) An "awareness of the marine environment" response was given by almost one third of the respondents as an important positive aspect of the Discovery Hall program. This served to reinforce the findings of positive changes in attitude toward the marine environment; and 5) Personal interest in a field was perceived by 91 percent of the respondents as having influenced their selection of college major. The 28 students who listed the Discovery Hall experience as a factor influencing their selection of college major were apparently not discouraged from science fields; as 25, or 89 percent of those students chose college majors in science.

In general, although almost 90 percent of the respondents had positive attitudes toward science before their participation in the Discovery Hall Project summer program, it appears that the Discovery Hall Project has been successful in affecting positive changes in attitude toward science and the marine environment.
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Oceanic Education Activities for Great Lakes Schools (OEAGLS)

Results of studies of student knowledge about the oceans and Great Lakes environments indicate a need for greater awareness of those environments and a greater understanding of the impact they have upon the lives of people. OEAGLS (pronounced "eagls") are designed to take a concept or idea from the existing school curriculum and develop it into an oceanic and Great Lakes context, using teaching approaches and materials appropriate for children in grades five through nine.

OEAGLS materials are designed to be easily integrated into existing curricula. Investigations are characterized by subject matter compatibility with existing curriculum topics; short activities lasting from one to three classes; minimal preparation time; minimal equipment needs; standard page size for easy duplication; student workbook plus teacher guide; suggested extension activities for further information or creative expression; teachability demonstrated by use in middle school classrooms; and content accuracy assured by critical reviewers. Each title consists of a student workbook and a teacher guide and costs $3.00 for the publication, postage, and handling. If ordering EP-026, add an additional $4.00 to cover the cost of the computer disk.

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THE EFFECT OF THE GREAT LAKES ON CLIMATE (EP-002)
ANCIENT SHORES OF LAKE ERIE (EP-003)
HOW TO PROTECT A RIVER (EP-004)
CHANGING LAKE LEVELS (EP-005)
EROSSION ALONG THE GREAT LAKES (EP-006)
COASTAL PROCESSES AND EROSION (EP-007)
POLLUTION IN LAKE ERIE: AN INTRODUCTION (EP-008)
YELLOW PERCH IN LAKE ERIE (EP-009)
EVIDENCE OF ANCIENT SEAS IN OHIO (EP-010)
TO HARVEST A WALLEYE (EP-011)
OIL SPILL! (EP-012)
SHIPPING ON THE GREAT LAKES (EP-013)
GEOGRAPHY OF THE GREAT LAKES (EP-014)
OHIO CANALS (EP-015)

THE ESTUARY: A SPECIAL PLACE (EP-016)
THE GREAT LAKES TRIANGLE (EP-017)
KNOWING THE ROPES (EP-018)
GETTING TO KNOW YOUR LOCAL FISH (EP-019)
SHIPPING: THE WORLD CONNECTION (EP-020)
WE HAVE MET THE ENEMY (EP-021)
IT'S EVERYONE'S SEA: OR IS IT? (EP-022)
PCBs IN FISH: A PROBLEM? (EP-023)
A GREAT LAKES VACATION (EP-024)
STORM SURGES (EP-025)
RIVER TREK with computer program (EP-026)
WAVES (EP-027)
LAKE LAYERS: STRATIFICATION (EP-028)
NUTRIENTS IN THE GREAT LAKES (EP-029)
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The Ohio State University
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Tel. 614/292-8949
Fax 614/292-4364
(Send all publication requests to this address.)

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(59 Ramseyer Hall, 29 W. Woodruff Avenue, Columbus, OH 43210-1077, 614/292-1078).

Dr. Jeffrey M. Reutter, Ohio Sea Grant Director