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ABSTRACT

This study attempted to identify differences among schools which accepted, rejected, or made exploratory use of a proposed marine education curriculum. The selected variables for this study included: (1) percentage of teachers by age; (2) percentage of teachers by area of academic preparation: (3) pupil teacher ratio: (4) per pupil expenditure: and (5) distance from marine environment. Significant relationships (following ANOVA and T-tests) were detected among acceptance/rejection and teacher academic field of preparation, percentage of white-collar workers in the community, and distance from the marine environment. (Author/RE)

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An Investigation of the Effects of Selected Variables on the Implementation of a Marine Infusion Curriculum

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SE 030 710

An Investigation of the Effects of Selected Variables on the Implementation of a Marine Infusion Curriculum

Introduction

As curriculum developers continue to produce innovative educational material, such as marine infusion units, the need increases for an improved understanding of the variables which show differences among schools that tend to accept such material and those that tend to reject it.

The purpose of this study was to attempt to identify any differences which might exist in a number of variables among schools which accepted, rejected, or made exploratory use of an innovative marine education curriculum. This material was produced by the Northern New England Marine Education Project at the College of Education at the University of Maine, Orono*. The material consisted of one instructional unit for each of the elementary grades, K-8. Each of the units had an aquatic, or marine focus, and each was an infusion unit. That is, units were intended to provide classroom teachers with exercises and activities related to marine, or aquatic topics for use in their teaching in their standard grade-levels or disciplines. Goodwin (1978) proposed the teaching of marine topics by these means. The following are brief descriptions of the units used in this study:

Clams and Other Critters** (Ed 164 439) was introduced for lower elementary school youngsters in kindergarten and grade 1. Unit activities are based on marine invertebrates and plants of the shore. Exercises in art include mural and bulletin board making, crayon resist techniques, prints of seashells, and others. Tips on keeping very inexpensive aquaria are given, and language arts activities are suggested. These include listening to poetry, dramatics, music and writing experiences.

*A listing of the project materials may be obtained by writing the project director at the University of Maine.
**These units are available as ERIC documents on microfiche or as printed pamphlets from project headquarters.

The Marine Art (Ed 164 351) which was introduced for second grade use, stresses elementary school arts and crafts exercises. Each of the art activities described focuses on the marine, or the aquatic environment. Finger painting, sand painting, and watercolor painting are all recommended student exercises. Each of these exercises suggests the use of bits of seaweed, shells, and other shoreside findings to enhance the design. Gyotaku, printing designs with a fresh fish, is described.

The Aquarium (Ed 164 347) was intended for use in grade 3, although with modifications, it should be useful for all elementary grades. The teacher is first given instructions for the establishment of a simple, inexpensive freshwater aquarium. The students then perform language arts, math, music, art, and science activities related to the aquarium. For example, spelling words are suggested which are parts and occupants of the aquarium. These spelling words are reinforced using simple crossword puzzles. The unit provides "story starters" to help the student begin fictitious stories pretending they are part of the aquarium environment.

The Beaver (ED 164 348) was introduced for grade 4. This unit presents the teacher with ample background information on the beaver, a slideshow with script, and a tape recording of a folksong about beavers adapted from Longfellow's Tales of Hiawatha. Various subject matter skills are practiced while considering the beaver and its habitat. Vocabulary, sentence structure, and parts of speech are practiced in the language arts section. Arithmetic word problems relating to beavers are provided.

The Lobster (ED 164 350) was introduced for use in grade 5. This unit provides a considerable amount of teacher background information on the habitat, life cycle, harvesting, and economics of the Maine lobster. Reading, writing and vocabulary exercises are suggested which relate to lobsters and lobstering. New vocabulary is reinforced with crossword puzzles. Several art activities are presented, including the construction of a scale model lobster boat hull. The establishment of an aquarium for keeping crayfish is recommended. Activities and observations are described for use with the crayfish. Diagrams available for teacher duplication include lobster boat drawings, the lobstering process, the aquarium set-up, lobster internal and external anatomy. Mathematics problems are provided.

Whales and Whaling (ED 164 354) was introduced for the 6th grade. The lists of suggested activities in the unit are lengthy, as are the catalogues of available resources. Exercises and activities are available for language arts, music, math, art, history and social studies, science, dance, and wood-working. Activities in this unit range from arithmetic comparisons of the speed of sound in air and water, to the scale drawing of a 92 foot Great Blue Whale on the school playground. Sea shanteys of the whaling era provide musical and historical exercises, and authentic arithmetic problems are provided in the form of whaler's pay and expense computations and shops expense tabulations.

Our Heritage of Ships (ED 164 352) was introduced for use by the 7th grade. This unit provides background information on the history of watercraft featuring some of the more important types with descriptions and drawings. Arithmetic and science activities appear in the form of navigational exercises. Sundials and water barometers are described for student construction and use. Songs, poems, crossword puzzles, field trips, and written activities provide opportunities for students to use ships as a medium for studying science, social studies, art, music, and language arts.

Coastal Indians of Northern New England (no longer available) was introduced for 8th grade use. The Indians unit provided teacher background information on the tribes of the Abenaki kingdom. Crafts activities allow the students to make models of the tools and bark objects used by the indians. Field trips for foraging and visiting dig sites and shell heaps are suggested, but many in-school activities are also recommended for those unable to travel. Teacher reproducible drawings show the indians in common hunting, fishing, and playing situations. Home economics activities involve the preparation of some indian foods, most of which center around foraged plants. Science in the unit is an astronomy lesson including the mythology the indians attached to the constellation.

Eight additional units hve been developed in this series since the study herein reported was conducted. The grade level span provided is now K-12.

The independent variables considered in 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 ratio; total number of professional staff members; per school community per pupil expenditure; community socio-economic 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.

Marcum's research (1968) found teacher age to be a signficant variable among schools with different tendentices to adopt innovations. Hinman (1966), Lawrence (1967), and Rogers (1965) found no relationship between innovative tendencies and teacher age, however. Ochitwa (1973) found no relationship between age or sex of teachers and innovative adoption.

Marcum (1968) also found number of teachers in a school, and per pupil expenditure to be significant variables among schools in Utah with different tendencies to adopt innovation, while Ochitwa (1973) found no such significance in his study in Saskatchewan. Chesler and Barakat (1967) found there to be no relationship between innovation adoption and either specialized training, or general teaching experience.

A number of researchers have investigated the relationship between organizational climate, as measured by the OCDQ, and the tendency to adopt innovations. The results are by no means conclusive, however. Christian (1972), Hughes (1971), Marcum (1968), and Monasmith (1969) all found significant positive relationships between openness of climate and tendencies to adopt innovation, while Barfield (1972), Hill (1973), and Ochitwa (1973) found no such significance in similar studies.

Procedure of the Investigation

The principals of 200 randomly selected Maine elementary schools were mailed an explanation of the proposed study and an invitation for their schools to participate. Sixty-four of the schools chose to take part in the study.

The principals of those schools were asked to provide some of the demographic data, and they were asked to give the OCDQ to their teachers under the prescribed guidelines, which insured teacher anonymity. The completed CODQ forms were mailed directly to the University in pre-paid envelopes by the responding teachers. The remaining demographic data were collected from the Maine Department of Educational and Cultural Services.

As the principals of the participating schools were asked for the initial demographic data, the Northern New England Marine Education Project (NNMEP) marine education infusion units were sent to their schools

for teachers' use. Teachers were advised of the study and were asked to complete and return the 64-item OCDQ. Following the six-week period, the use made of the NNMEP marine education infusion units by the teachers in the sample schools was reported by the principals. From this reported use, schools were categorized into those which accepted the innovation, those which gave the innovative material exploratory use, and those which rejected the innovation.

Accepting schools were those in which two, or more, teachers made more than five hours of in-class use of the infusion units. Exploratory use was considered five, or fewer, hours of in-class utilization of the infusion units by any number of teachers in a school, and/or more than five hours of utilization by one teacher. Rejection of the introduced marine education infusion units was no reported use.

Results

The major objective of the study was to identify significant differences in any of the selected variables among schools which accepted, rejected, or made exploratory use of the introduced innovative marine education material. Several significant differences were observed as the collected data were analyzed. Using a one-way analysis of variance, the percentage of teachers on a school's faculty with the equivalent of an undergraduate major in science was found to differ significantly among schools which accepted, rejected, or made exploratory use of the introduced innovation. This significance, as is shown in Table 1, was found beyond the .05 level. The analysis of variance also showed the percentage of teachers on a school's faculty with the equivalent of an undergraduate major in mathematics to differ significantly among schools which made differing amounts of the use of the introduced marine education units. This is reported as Table 2.

Table 1

Analysis of Variance - Teacher Preparation in Science

Use	Count	Mean	Standard Deviation	F Ratio	F Probability
Rejected	32	4.9063	7.1498	3.013	0.05
Exploratory Use	15	7.8667	8.5929		
Accepted	17	11.0588	10.3530		

Table 2

Analysis of Variance - Teacher Preparation in Mathematics

Use	Count	Mean	Standard Deviation	F Ratio	F Probability
Rejected	32	3.7813	5.9554	5.417	0.006
Exploratory Use	15	6.0867	9.6249		
Accepted	17	12.5882	12.4753		

Table 3

t-Test Results - Miles From the Marine Environment and Accepting and Rejecting Schools

School Use	n	Mean	Standard Deviation	T Value	df	2-tail Prob.
Rejected	32	31.6563	47.218	2.02	42.11	.05
Accepted	17	13.0588	16.072			

Table 4

t-Test - Community Percentage Upper White Collar Workers and School Exploratory Use and Acceptance of the Introduced Marine Education Infusion Units

School Use	n	Mean	Standard Deviation	T Value	df	2-tail Prob.
Explored	15	10.8000	5.427	-2.19	26.01	0.037
Accepted	17	16.7059	9.472			

T-tests reported as Table 3, showed distance from the marine environment to be a significant variable at the .05 level between schools accepting the marine education material and schools rejecting the material. Schools accepting the marine education infusion units were those closer to the coast. Those making exploratory use of the material before discontinuing its use were further from the coast.

The t-tests reported as Table 4 also showed the community's percentage of upper white collar workers to be a significant variable beyond the .05 level between schools making exploratory use of the material, and those accepting it. Those communities accepting the introduced innovation had higher percentages of upper white collar workers in their populations than did communities which tried the material and then discontinued its use.

The OCDQ openness score, the eight subtest scores, and the prototypic climate types did not prove to be significant variables among schools which accepted, rejected, or made exploratory use of the marine education material. The openness scores, and subtest scores were analyzed using a one-way analysis of variance, and the prototypic climate types were analyzed among schools which accepted, rejected, or made exploratory use of the material using a chi square analysis. These results should be interpreted

cautiously, however, since the OCDQ questionnaire return was limited. The lack of response resulted from a lack of cooperation from some of the principals and teachers on this particular facet of the study.

The following null hypotheses were supported by the findings of the study:

1. Among schools accepting, rejecting, or making exploratory use of the introduced marine education material, there is no significant difference on the openness scale of the ODCQ, or on the scores of any of the eight subtests.
2. Among schools accepting, rejecting, or making exploratory use of the introduced marine education material, there is no significant difference
    a. in proportions of male and female teachers
    b. in proportions of teachers in different age groups
    c. in proportions of teachers with subject matter concentrations in social studies
    d. in pupil to teacher ratios
    e. in number of professional staff members in the school.

Conclusions

The findings of this study support the findings of Hinman (1966), Lawrence (1967), and Rogers (1965) who found no relationship between teacher age and tendency to adopt innovations. The results also support Ochitwa's (1973) findings that teacher, teacher sex, and per pupil expenditure are not significant variables in innovation adoption. The organizational climate openness score was not found to be a significant variable by this study. This supports similar findings in studies by Barfield (1972), Hill (1973), and Ochitwa (1973).

Based on the findings of this study, marine infusion curricula introduced into Maine elementary schools would be most likely to be explored and/or accepted in schools with higher percentages of teachers with more academic preparation in mathematics and/or science. The likelihood of schools accepting the introduced marine education infusion units is also significantly greater among schools within 50 miles of the marine environment (seacoast). These distance findings were forecast by Schlenker and Crowell (1978) as part of a questionnaire study. They reported that K-12 marine instruction was significantly more likely to be reported by coastal rather than inland citizens and that coastal citizens were more concerned about the quality of the marine environment.

Implications

The significance of the variables relating to teacher preparation in mathematics and science, and relating to highway miles to the marine environment among accepting and rejecting schools lead to some interesting conclusions. The marine education units which were introduced were offered as multi-disciplinary adjuncts to curriculum already in place in the sample schools. Basically, the units were designed to supply exercises and activities with marine-related content to teachers for use in their standard teaching regimens. The innovativeness of these units stem from this very aspect of their intended use. The data would suggest that the nature of these units, that is their marine education focus, was one of the most significant factors in the school's decision to accept or reject.

Although data were not collected on which individual teachers within a school utilized the material, the significance of the percentage of teachers of a school who concentrated in science or mathematics would seem to imply that these marine education units were perceived as being

focused within these disciplines. While this is clearly not the case, teacher perception of the introduced material is important in several ways.

An understanding of how teachers perceive the marine education topic with no examination, or only cursory examination, of offered materials is important to those interested in encouraging further school-based study of the water environment. Such an understanding could lead marine educators to persist in their present curriculum dissemination schemes, or it could cause us to undertake projects aimed at enhancing teachers' understanding of the term marine education. The latter seems to be implicated here.

Further, the perception held by teachers of the nature of marine education will play a major role in determining the manner in which the topic is treated. The significance of teacher mathematics and science preparation in this study seems to imply that marine education will be treated as an adjunct to the math/science area. This sort of treatment is contradictory to that recommended by Goodwin (1977) and that supported by the Northern New England Marine Education Project in its unit development.

Similar concerns are raised by the significance of the distance between communities and the coast and acceptance and rejection of the introduced marine education material. As proposed by Goodwin (1977), marine education would address the entire water habitat of the world. This notion has been accepted by curriculum developers, including the Northern New England Marine Education Project. Hence, much of the marine education material available today is truly both aquatic and marine in focus. The significance of distance from the coast between schools which accepted or rejected the marine education innovative material in this study would seem to imply that marine education is being interpreted literally and distance from the sea is being considered a controlling factor in implementation.

The major implications of this study, then, seem to be that the public, in general, and teachers, in particular, are misinterpreting both the intent and the scope of marine education infusion curriculum offerings. This is perfectly understandable since in common, correct usage, the term marine refers to the saltwater of the world. That educators interested in increasing awareness of the world's water spread their interest over fresh- and salt-water alike is admirable; that they have chosen the word marine to express this area of interest is, perhaps, unfortunate.

The infusion format of the Northern New England Marine Education Project's units is truly innovative. It asks teachers to consider not only the concepts and processes they're teaching, but also the content of the examples and exercises they incorporate in their instruction. It is quite conceivable that students could increase their awareness of the marine environment while solving mathematics word problems, for example. Here again, however, the term infusion, which describes that process, is known to relatively few, and public explanation of the term has proven to be difficult to understand. The term infusion, in relation to marine instructional content was proposed in 1977, by the late Dr. Robert W. Stegner* and has received little exposure outside the marine and career education fields.

The implication, then, for marine education is clear. Either the term marine education must come to mean marine and aquatic education to the nation's teachers through a widespread national educational effort, or the term must be abandoned in favor of one with fewer existing connotations. Of equal importance, the infusion process that several marine educational curricula have so effectively used must be made clear to our classroom teachers.

*The late Dr. Stegner was the developer of project COAST at the University of Delaware and is considered by many to be the father of marine education

Several investigations are suggested by the results of this study. A sociological study using marine education infusion units would provide an opportunity to ascertain the level at which reject, or explore decisions are being made in the test schools. It would also permit verification of the discipline areas in which the marine education material is being used. Insights into teacher attitudes on the infusion process could be gained in the course of such a study. These questions represent a logical extension of those considered here.

A study of major importance to supporters of the infusion approach to curriculum innovation and enhancement should involve a validation of the assumption that students can, and will, assimilate information about both process and content at the same time. Lessons could be taught in virtually any discipline using marine education topics with post-testing determining the increase in understanding in both sought after skills and concepts, and the hoped for marine awareness.

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