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ABSTRACT

This program, developed for the primary grades, was started in September 1972 with the ultimate goal being the development (sixth-grade students) of citizens knowledgeable and conscientious about environmental concerns. A cadre of specially trained teachers utilized the adapted SCIS materials with emphasis on student planning and involvement, independent projects, and outdoor activities. In September 1973 the project was expanded horizontally. The final evaluation made assessments of cognitive developments, affective improvements and overall project success as perceived by teachers in the project. At all grade levels cognitive achievement, as measured by criterion referenced tests, surpassed expected levels. Acquisition of scientific attitudes was judged by individual teachers by means of a rating scale; in all grades the percentages of those who received higher than average ratings surpassed the expected level of 60 percent when the ratings on all factors were averaged. Using Semantic Differential scales, graduates of the program were appraised on the development of a positive attitude toward conservation of the environment; more than 60 percent were found to be in the ideal quadrant of the semantic space; it was inferred that the majority of the program participants developed desired levels of favorable attitudes. (Author/BT)

ENVIRONMENTAL AWARENESS
IN
GUAM ELEMENTARY SCHOOLS

AN EVALUATION OF
THE ENVIRONMENTAL EDUCATION FOR GUAM SCHOOLS PROJECT
1973-74

by

ANTHONY KALLINGAL

AUGUST 1974

THIS EVALUATION WAS PREPARED WITH THE ASSISTANCE
OF
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AUGUST 1974
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1.0 ABSTRACT

The Environmental Education for Guam Schools Project (EEGSP) was first launched in September 1972 at Mongmong Toto Elementary (now San Miguel Elementary) and Tamuning Elementary on an experimental basis. The ultimate goal of graduating citizens knowledgeable and conscientious about environmental concerns shaped the layout of the project components and implementation details. A cadre of specially trained teachers utilized the adapted SCIS* materials in the instruction of pupils in grades one to six with emphasis on student planning and involvement, independent projects and outdoor activities. Evaluation of the project showed that the cognitive and affective accomplishments of pilot students were significantly higher than those of comparable control groups. Student accomplishments and general satisfaction of teachers with the curriculum materials and instructional strategies encouraged continuation of the project on an expanded scale. In September 1973, the project was expanded horizontally to serve approximately 1214 students in forty-seven classes of the same two schools.

Curriculum materials and instructional strategies during the academic year 1973-74 were somewhat improved over the previous year's. Instruction attempted to capitalize on young people's innate appreciation for and curiosity about plants and animals. Formal and informal reactions of teachers revealed that the instructional approach was in general satisfactory. Very few teachers were able to cover the entire curriculum and suggested activities for each grade level. Student reactions from

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* - SCIS = Science Curriculum Improvement Study developed at the University of California, Berkeley.

fourth, fifth and sixth graders by means of student report cards showed that they were satisfied with the project. There was fairly high correlation between student preference for activities and the amount of time spent on those activities. Students were able to spend a lot of time on the activities they liked and little time on activities they did not like. (Primary students--grades 1-3--were not so canvassed.)

The final evaluation made assessments of 1. cognitive developments; 2. affective improvements and 3. overall project success as perceived by teachers in the project. At all grade levels cognitive achievements as measured by criterion referenced tests surpassed expected levels. Acquisition of scientific attitude was judged by individual teachers by means of a rating scale, and in all grades the percentages of those who received higher than average (2.5) rating surpassed the expected level of sixty percent when the ratings on all factors were averaged. The same was true when the four factors were considered separately except for first graders on Inventiveness and Persistence and for second graders on Inventiveness. The graduates of the program, namely the sixth graders, were additionally appraised on the development of positive attitude towards conservation of environment by means of Semantic Differential scales. More than sixty percent were found to be in the ideal quadrant of the semantic space, the inference being that the majority of the program participants in sixth grade developed desired levels of favorable attitude towards conservation of our environment. Teacher perceptions of project success culled from structured and open ended responses supplied additional evidence on successful implementation of the project.

The cognitive and affective accomplishments of the project participants, the general satisfaction of teachers with curricular materials and instructional strategies, and the overall impression of the teachers that the program was successfully implemented indicate the desirability of systemwide adoption of environmental education on the Island so that this Island remains for the generations to come the natural haven that it is today.

2.0 INTRODUCTION

The purpose of this report is to provide a brief description of the Environmental Education for Guam Schools Project (EEGSP) as implemented during the academic year 1973-74 and to present assessment data on student achievements in cognitive and affective realms that resulted from the implementation of the project. The report contains useful data for educational decision makers relative to continuation of the project and/or systemwide adoption. It also serves as feedback to the project staff on their activities during the year of project implementation and as a source of suggestions for further improvement of the project in case its implementation is continued. In addition, the report serves as a vehicle for dissemination of information regarding the Environmental Education Project on Guam to interested audiences.

In addition to this introduction the report contains three sections: Program Description, Assessment, and Summary and Recommendations.

Program Description seeks to provide the reader with information on who did what and how. This type of information is useful in determining the exact nature of the intervention variable (research purpose) and as a source for ideas for replication and/or modification (development purpose). Here attention will be focussed on developmental history of the project, its scope, personnel, procedures such as curriculum development, teacher training, instruction, community involvement, and finally a brief layout of expenditures.

The Assessment section is the core of the report. Informational elements in the previous sections lead up to and provide a background which facilitates understanding of assessment data. Here attention will be focussed on objectives, data collection, analyses and results, and a brief summary of the findings.

The last section of the report brings together the findings of the evaluation study and offers recommendations for further implementing of the project in the event of its being continued either as it is or in an expanded fashion.

3.0 PROGRAM DESCRIPTION

This section of the report is a brief account of the developments and happenings which occurred before and during this year's project implementation. It outlines the developmental history of the project and its implementation during academic year 1973-74 in terms of scope, personnel involved, curriculum, teacher preparation, classroom instruction, community involvement and expenditure.

3.1 Project History

In recent years a sense of personal responsibility for Earth's deteriorating environment has received growing attention. Man's abuse of his little spaceship's resources--green plants, animals, air, water, energy, and minerals--has placed his own survival in jeopardy. His behavior must change if life is to continue, and the changing of behavior is the job of education at whatever level.

Guam, a moderately-sized tropical high island, has its own environmental problems as well as those foisted upon it from the outside. Its natural beauty, tropical climate, and clean, warm waters have made the island increasingly a haven for tourists. This growth in tourism has triggered an unprecedented economic boom and population influx. Construction projects have proliferated and new industries have been established. These changes, though good in themselves, have brought with them an increase in environmental problems on the island.

In recognition of the existence of the environmental problems on the island the Department of Education conducted a Needs Assessment

Study in 1963 when it published the <u>Handbook for Elementary Teachers For A Conservation Education</u>. This handbook received very limited use, if any. In 1969 three independent studies indicated a need for education relevant to Guam, two specifically meaning environmental education.

1. April - Needs Assessment Study of the Students and Schools of Guam, conducted by the University of Guam, discussed "The need for development, improvement, evaluation and expansion of the current curricula, with special concern for its relevancy to Guam".

2. June - Management-oriented Survey conducted by Mr. Gerald Perez, then Acting Director, Department of Agriculture. Mr. Perez lists public education as the first priority in overcoming Guam's conservation ills, making the two following points:

   1. Integrated conservation education programs should be based primarily on Guam's problems and local needs. The understanding of local problems should then be used as a lever in developing and understanding of regional, national and world conservation problems.

   2. Conservation education should be integrated with all appropriate school subjects (science, social studies, etc.), and should emphasize the relationships of natural resources to the economic, social, and biological welfare of human beings.

3. November - Mr. Dan Saults, Fish and Wildlife Official, U.S. Department of Interior, Washington D.C. visited Guam to assess

the Island's conservation needs. His report to the Governor points out, "....Guam seems an ideal spot for environmental education; it is, in a sense, a little world, an ecosystem, and a living laboratory. This island offers small rivers and their estuaries--and a river basin study is almost a history of the natural world: rainfall, watershed, soil types and condition, botanical development, wild life, aquatic life, vegetational and biological changes, and the effect of fresh water entering lagoons. There are mountains, many plants, marine studies.....almost everything but tundra."

In July 1971, the proposal 'Environmental Education for Guam Schools", written by James Branch, revised and resubmitted by Dave Hotaling, was approved by the Department of Education and implemented in August of that year to meet the needs validated in the above studies. The first year of the project operation was devoted to planning project activities, developing curriculum, and training teachers.

In September 1972, the Environmental Education for Guam Schools Project (EEGSP) was launched on an experimental basis with funds available from ESEA Title III in two Guam schools - Tamuning Elementary and Mongmong/Toto Elementary. Approximately six hundred students in grades one to six participated in the project.

The ultimate goal of graduating citizens knowledgeable and conscientious about environmental concerns shaped the layout of the project components and implementation details. Teachers who had received training on Guam's ecology the previous year provided instruction in the two schools mentioned above utilizing a curriculum adapted from the Science Curriculum Improvement Study (SCIS), University of California at Berkeley.

Instructional strategy was underlined by the principles of student planning and involvement, of independent activities - principles designed to promote not only growth in knowledge but also healthy conservation attitudes. Outdoor activities were continuously emphasized.

The Evaluation Design compared the intellectual achievements of pilot students with comparable control groups as measured by locally developed and validated tests. The comparability was established on the basis of performances on the pre-tests on which in every grade the average score of control students was higher than that of pilot students. On post-tests, the first, second, third and fifth graders in the pilot schools surpassed significantly the performance of control students while pilot fourth and sixth graders showed a slight increase over the control students in the average of test scores.

The attitudinal growth of pilot students was assessed on the basis of percentage of students reaching predetermined levels of acquisition. In every grade the expected outcome was that seventy-five percent would receive better than average ratings from teachers on the four attitude factors of curiosity, inventiveness, critical thinking and persistence. Three of the six grades reached the expected mark, while the other three fell slightly below. In addition, teacher remarks showed that the students in the pilot schools developed an awareness of the need for and interest in preserving our environment.

The cognitive and affective accomplishments of the pilot students as well as the general satisfaction of teachers with curricular materials and instructional strategies of the adapted SCIS indicated the desirability of program expansion and of systemwide adoption of environmental education on the Island.

In September 1973, the Environmental Education Project was expanded horizontally to serve a larger number of students but at the same one to six grade levels and in the same schools.

3.2 Project Scope

During the 1973-74 academic year the EEGS Project expanded its scope to cover a larger number of students than the previous year at the same grade levels and in the same schools. The reader should note that Mongmong/Toto Elementary Elementary School is now called Juan San Miguel Elementary School. Approximately 1214 students in forty-seven classes of the two schools received environmental instruction. The distributions of students and teachers in the two schools are given in tables 1 and 2.

Table 1

Distribution of Students and
Teachers by grade level in
San Miguel Elementary

Grade	Number of Teachers	Number of Students
1	4	112
2	4	112
3	4	112
4	2	56
5	4	112
6	1	120
Total	19	624

Table 2

Distribution of Students and Teachers by grade level in Tamuning Elementary

Grade	Number of Teachers	Number of Students
1	3	84
2	2	56
3	5	140
4	6	168
5	4	112
6	4	112
Total	24	672

3.3 Personnel

In addition to the project director, Dave Hotaling, and the secretaries, Joy Camacho and Bertha Tanaka, several other dedicated people offered their services to the program.

A task force made up of people from several branches of the community assisted with ideas and time devoted to project productions. A list of these persons and their positions is herein presented:

1. Mrs. Pilar Lujan - Asst. Supt., Curriculum & Instruction
2. Mrs. Gloria Nelson - Assoc. Supt., Elementary
3. Mrs. Maria Roberto - Principal - Harry S. Truman Elementary School
4. Capt. Shelburn Coleman - Bioenvironmental Engineer (SGPM) USAF Dispensary
5. Mr. Bob Cruz - Department of Commerce, Bureau of Parks and Recreation
6. Dr. Donald Davis - Department of Biosciences, University of Guam
7. Mr. Nick Drahos - Wildlife Biologist, Department of Agriculture
8. Mr. Dave Hotaling - Director, Environmental Curriculum Development Project
9. Mr. Eric Liljestrand - Teacher, Yigo Elementary
10. Ens. Dean Leidholt - Asst. Force Civil Engineer ComNavMar
11. Mr. Jeff Shafer - Biology Teacher, John F. Kennedy High School
12. Mr. Richard Scrby - Acting Director, Learning Resources Center

With the cooperation of the principals, Jose Apuron, Bernadita Terre, and later Bill Harper, the following teachers and instructors agreed to participate in the second pilot year of the project:

GRADE	JUAN SAN MIGUEL ELEM.	TAMUNING ELEMENTARY	INSTRUCTORS
1	Lourdes Bamba Frances Cabrera *Pat Olsen Kathleen Ryan	Judy Bieze Anna Borja Myra VanderZee	Dorsee Bennett
2	*Lyn Hasselbring *Eleanor Main Terese Montoya Chandrika Phillips	Mary Steinke *Catherine Yoichi	Larry Behrens
3	Linda Boughan Gail Hammer *Mary Ravenscroft Agripina Soriano	*Margery Birkedal Dorothea Blas Julita Illarmo Dana Lawrence Kathleen Peterson	Margery Birkedal
4	Mary S.M. Borja Genovene Casem	Terry Evenson *Eunice Loots Jeanne Rickey *Jim Simmons Helen Valera Susan Word	Carl Mock
5.	Teresita Cruz *Chuck Mitchell *Connie Pabalinas Carmen San Agustin	Kay Carter Dorothy Miller *Agnes Rinehart *Linda Shidel	Jeff Shafer
6	*Ethel Willis (taught 5 separate classes in science).	*Paul Irvine Anna Leta *Carl Mock Abalina Pangelinan	Carl Mock

* - In Project 1972/1973

Additionally, several other teachers at these two and "outside" schools made use of project materials during part of the year.

Eric Liljestrand (August 1973 - January 1974) and Pam DeSoto (March - June 1974), with assistance generously donated by personnel at Department of Agriculture, were project technicians, collecting and culturing organisms for use in project classrooms.

3.4 Procedures - Instruction

The goal of the EEGS project has been stated as follows: "To graduate citizens who are knowledgeable and conscientious about environmental problems of our island and of the world." In order to achieve this goal, the personnel listed in Section 3.3 were involved in the implementation of the various project components. These components are briefly described below.

3.5 Curriculum Development

The Pacific islands share a number of characteristics which allow of interpreting the islands as a unit even though they are widely separated. Guam is naturally part of the Marianas chain and is ecologically similar in many respects, as could be expected.

Hawaii, insular, larger, with nearly ten times the population of Guam and consequently more "developed", has already crossed many of the bridges Guam is approaching.

Both Hawaii and the Trust Territory are using the same basic elementary science program as we are piloting (the Science Curriculum

Improvement Study - SCIS). Additionally, the University of Hawaii's laboratory school is developing a junior high science sequence (FAST - Foundational Approaches in Science Teaching) for tropical islands and tailored to follow SCIS.

For these reasons the EEGSP has established a rapport with the Trust Territory and State of Hawaii Departments of Education as well as the science education division of the laboratory school operated by the University of Hawaii.

The relationship with the Trust Territory has proven to be mutually beneficial in regard to curriculum development, and valuable to Guam, at least, with respect to Hawaii. Should Guam adopt part or all of the FAST program then Hawaii would be provided with another feedback source, making this relationship also one of mutual benefit.

Four teacher-naturalists began work in February 1972 to modify SCIS for Guam. The sequence and concepts of SCIS: 1- Organisms, 2- Life Cycles, 3- Populations, 4- Environments, 5- Communities, 6- Ecosystems. An overview of the curriculum as modified is presented in the appendix of "Impact of Environmental Education for Guam Schools - An Evaluation" July 1973 by Anthony Kallingal. The work was completed and copies xeroxed for the twenty-four teachers by August. (The only printed materials for students are manuals for the 4th, 5th, and 6th grades. It was decided to use the commercial ones rather than revise these, so copies were ordered from the Mainland.). During the year 1972-73 the Teachers' Guides were again revised, this time on the basis of feedback from the teachers using them, and these revisions were used in 1973-74.

Several thousand small plants and animals such as algae, Hydrella, duckweed, peas, beans, pondsnails, mosquito fish and guppies, pillbugs, chicken mash beetles, water fleas, brine shrimp, fruit flies (vinegar flies), grasshoppers, anoles, landsnails, praying mantises, and toads are required for student activities. The great bulk of these were collected and/or cultured by Eric Liljestrand and Pam DeSoto, project technicians, with space, equipment and expertise donated by the Department of Agriculture.

With assists from three advisors, four teacher-naturalists, in 1972-73, worked on nature trails, in the limestone forest, coral reefs, and adjacent to the two project schools. These trails were opened through the current year, not only to project students but to all teachers wishing to take classes on field trips to the areas. Lists of organisms likely to be found along the trails were developed and distributed to project teachers.

3.6 Teacher Training

A two-day workshop for new pilot teachers was run by the instructors and project director before the opening of school in August 1973. During the year grade-level fortnightly inservice meetings were attended by teachers, instructors and project director. At these meetings upcoming activities and potential difficulties were discussed, (and feedback from past or ongoing activities was obtained, as a basis for further revision of Teachers' Guides).

3.7 Instruction

Instruction is the heart of the EEGS Project. All other project components such as curriculum development, teacher training, community involvement and management represent supportive services to instruction in the classroom. Here the general approach to instruction in the project is delineated, critical student activities are sketched, student achievement monitoring scheme is pointed out, and finally student reactions to the project are summarized.

General Approach: The approach to teaching placed emphasis on:

1. Doing activities
2. Having students observe, interpret, describe, compare, classify, measure and experiment.
3. Having the teacher provide materials and guidance but not lecture.
4. Giving the students opportunities to make discoveries for themselves.
5. Encouraging students to talk about their experiences in their environment.
6. Having the teacher provide the students with time for inquiry, experimentation and discussion.

Basically, instruction in the project attempted to capitalize on young people's innate appreciation for and curiosity about the plants and animals around them. Small organisms were used to demonstrate such biological concepts as life cycles, population increases and decreases, responses to environmental factors such as light-dark and cold-hot and wet-dry, organisms' inter-relationships in food chains, food webs and in ecosystems. Aquaria and terraria were supplied to small teams of students and were furnished with organisms. During field trips some teams made collections to be placed in their containers in the classroom. The students raised.seedlings and animals and in so doing developed a sense of competition in these activities.

The approach in general was satisfactory to both teachers and students. "Really great", - "Children like it and I like it" were sample illustrative comments made by project teachers.

Instructional Activities for Each Grade Level: A Checklist of Performance Process Objectives was developed for each grade level and distributed to appropriate classroom teachers. They were asked to mark 'Yes' or 'No' to the activities. The checklists represented what are considered important and critical activities for effective learning according to SCIS curriculum guidelines. One hundred percent 'Yes' on any checklist would be an indication that the SCIS guidelines have been followed and that the entire curriculum for a particular grade level has been covered. Here the results from the checklists are summarized.

One should, however, note that teachers in the project enjoyed great flexibility with respect to the activities that would lead the students to effective learning. The activities in the checklists, though important, are not the only ones a teacher could initiate and guide in the classroom. Hence the fact that some of the activities were not carried out would not necessarily indicate lack of quality instruction in the classroom.

Table 3 depicts the results from the Activity Checklists. (See Appendix I, Pages 68-75, for checklists).

Table 3

Completed Activities by Frequency of Teachers

	Frequency of Teachers	Activities Listed	Activities Completed
First Grade	2	17	15
	1	17	13
	2	17	12
	1	17	7
Second Grade	1	17	16
	1	17	14
	1	17	12
	1	17	10
	1	17	8
	1	17	7
Third Grade	1	19	17
	2	19	16
	1	19	15
	2	19	14
	3	19	12
Fourth Grade	1	21	21
	1	21	19
	1	21	18
	1	21	16
	1	21	13
	1	21	12
	1	21	11
	1	21	7
Fifth Grade	1	23	21
	2	23	19
	1	23	17
	1	23	15
	1	23	13
	1	23	8
Sixth Grade	1	31	29
	2	31	25
	4	31	20
	1	31	19

Student Progress Monitoring Scheme: No instructional program is successful unless student progress is continuously assessed and appropriate feedback and/or remedial action is rendered. The how of this formative assessment was left to the ingenuity of the project teachers. Some of them made up unit tests, administered them and provided feedback to students. Some others judged student progress on the basis of student participation in the classroom and by other unobtrusive measures. Teachers were encouraged to use the original SCIS Evaluation Materials. Owing to delays in receiving materials, only a few teachers were able to use them. In brief there was no systematic scheme outlined for monitoring student achievements in formative stages.

A systematic summative evaluation design was developed and used in final assessment. The evaluation activities and the findings are narrated in Section 4.0 of this report.

Student Reaction: Student reactions in terms of interest and satisfaction in various activities of the project were gathered using student report cards. Use of the cards was limited to fourth, fifth and sixth grades. (Environments Report Card, Communities Report Card, and Ecosystems Report Card respectively. See Appendix II, Pages 76-78). These cards were designed by the developers of the original SCIS curriculum. A few minor modifications in the format were made to enable students to respond more easily.

In the fourth grade 180 responded. As the analyses of all responses would consume an enormous amount of time, it was decided to select a twenty five percent sample in a 'random systematic' fashion. The results of sample analyses are given in the following tables.

Table 4

Frequency of Responses to Item 1.
"What do you think of these Activities?
(Most interesting-A, good-B, fair-C, boring-D)"

Activity	A	B	C	D	No Response	Total
Building a Terrarium	25	12	3	3	2	45
Observing environmental changes	14	15	10	0	4	45
Going on a field trip	35	8	1	0	1	45
Investigating isopod responses	12	11	11	7	4	45
Investigating snail responses	11	11	11	11	1	45
Investigating plant responses to temperature	14	17	5	3	6	45
Investigating plant responses to light	13	15	6	5	6	45

A good deal of individual difference is apparent with respect to the ratings of each activity. However, based on the highest frequency of ratings for each activity, the following is the order of preference:

Going on a field trip
Building a terrarium
Investigating plant responses to temperature
Observing Environmental Changes
Investigating plant responses to light
Investigating isopod's responses to temperature, heat, water.
Investigating snail responses.

Going on a field trip is the most preferred activity and investigating snail responses is the least preferred activity, with all other activities falling within the two extremes of the continuum.

Table 5

Time spent by fourth graders in
various activities.
(Item 2: How much of your time in science did you spend on each of these?)

Activity	Much	Some	Little	None	No Responses
Experimenting	25	9	10	1	0
Writing	19	13	11	2	0
Listening to teacher	28	12	4	1	0
Discussing	17	15	11	2	0
Reading	21	13	8	3	0

The Table once again brings out the ever present phenomenon of individual differences. Experimenting has consumed the largest amount of student time and discussing is the activity that received the least amount of time. The other three activities - Listening to teacher, Reading and Writing - fall between the two extremes in that order.

Table 6

Frequency of 'most liked
and least liked activity'

(Item 3: Circle the activity in Question 2 that describes what you like most. Put an "X" on the activity you like least.)

Activity	Most liked	Least liked
Experimenting	21	6
Writing	1	19
Listening to teacher	10	3
Discussing	3	10
Reading	7	8

Students have indicated that experimenting is by far the most liked activity on the list. Listening comes next. Writing is the least liked activity. There is almost an equal distribution for reading. Almost the same number of students chose reading for most liked and least liked activity.

The fifth graders expressed their reactions using 'Communities Report Card'. There were 165 respondents altogether. Here again a twenty-five percent sample was selected and their responses were analyzed. The results are given in the following tables.

Table 7

Frequency of Responses to Item 1.
What do you think of these? (1. liked it a lot, 2. liked a little, and 3. didn't like it.)

Activity	Liked a lot	Liked a little	Didn't like it
Examining parts of seeds	12	26	4
Measuring growth of seed parts	10	20	12
Growing grass in light and dark	8	23	11
Experimenting with cotyledons	8	20	14
Planting seeds	17	22	3

The distribution of frequencies is about the same for all activities except examining parts of seeds and planting seeds. These two received very few negative responses. Students were not very enthusiastic about the other three activities; however, the majority did not object to doing them. The fact that there were very few who did not like examining seeds and planting seeds is an indication that the project had succeeded in inducing a 'back to nature' attitude in fifth graders.

The reader should note that some of the students in the selected sample responded in an open ended manner and as a result the evaluator has to interpret students' statements in terms of the three categories provided.

Table 8

Time spent by fifth graders in various activities

Activity	Much	Some	Little	None
Experimenting	20	15	6	1
Writing	13	11	18	0
Listening to teacher	23	16	3	0
Discussing	22	14	4	2
Reading	12	5	22	3

The amount of time spent on various activities differs widely with individuals. Experimenting and listening to teacher have taken up most of their time, while reading and writing required a relatively small amount of time. Discussing falls somewhere in between.

The fact that most of the selected students felt that they spent a lot of time listening to teacher might indicate that some of the teachers have fallen back to the traditional lecture mode of instruction rather than the intended guidance and facilitation approach. The proportion of time spent in experimenting is in consonance with the intended emphasis of the project.

Table 9

Frequency and Percentage of
Best liked activity

Activity	Frequency	Percentage
Experimenting	16	38.10
Writing	4	9.52
Listening to teacher	7	16.67
Discussing	3	7.14
Reading	4	9.52
No response	8	19.05
Total	42	100.00

Thirty-eight percent of the selected sample liked experimenting most. This agrees with the information contained in the previous table. Approximately nineteen percent chose listening to teacher as the most liked activity. The other activities of reading, writing and discussing were liked by only a small percent of students.

There are a couple of things readers should note here. First of all there appears a fairly high correlation between the preference for an activity and the time spent on that activity. Students spent a lot of time in experimenting and they liked it much. Similarly they spent little time on reading and writing and very few liked those activities. This correlation can be taken as an index of student satisfaction. Surely they will be happy if they spend most of their time in an activity they like most and very little time in least-liked activities.

Secondly, there is a possibility that student responses to the activity of listening to teacher do not reflect their true feeling; instead they may have been influenced by their desire to please teachers.

In general, fifth graders' reactions are favorable and the respective times spent on various activities reflect the intent of the project except in the case of lecture from the part of the teacher and listening from the part of the students.

A total of 196 sixth graders expressed their reactions using "Ecosystems Report Card". Here again a twenty-five percent sample (49 students) was selected using random systematic design. The results are presented in the following tables.

Table 10

Activity Ratings by Sixth Graders

Activity	Most Interesting(A)	Good(B)	Fair(C)	Boring(D)	No Response
Building Aquarium-terrarium systems	31	14	3	0	1
Observing organisms	22	19	7	1	0
Testing for CO_2 with BTB	23	8	8	1	9
Experimenting with pollutants	3	12	3	3	28

The first three of the activities listed received fairly high ratings. There was a conspicuous lack of response for the fourth activity, namely, experimenting with pollutants. This lack of response makes it impossible to make any evaluative judgement one way or the other.

Upon research into the reason why the responses to the fourth activity were scarce, it was found that there were two contributive factors. One was that the section on pollution and pollutants happened to be the last in Ecosystem curriculum. (See Appendix III, Page 79). The other was that majority of teachers were not able to complete all activities suggested for Ecosystems (See Table 3 of Completed Activities on Page 19). It seems natural to assume that in a curriculum with as many activities possible as in the sixth grade unit, if any activities are to be left out, they would most likely be those toward the end of the unit.

Table 11

Time spent on various activities
by sixth graders

Activity	Much	Some	Little	None
Experimenting	17	25	4	3
Writing	15	16	14	4
Listening to teacher	20	23	6	0
Discussing	17	17	15	0
Reading	9	16	20	4

The data in the above table indicate that the sixth graders distributed their time somewhat equally in all five activities. This is more apparent in the chart below depicting superimposed frequency polygons for all activities.

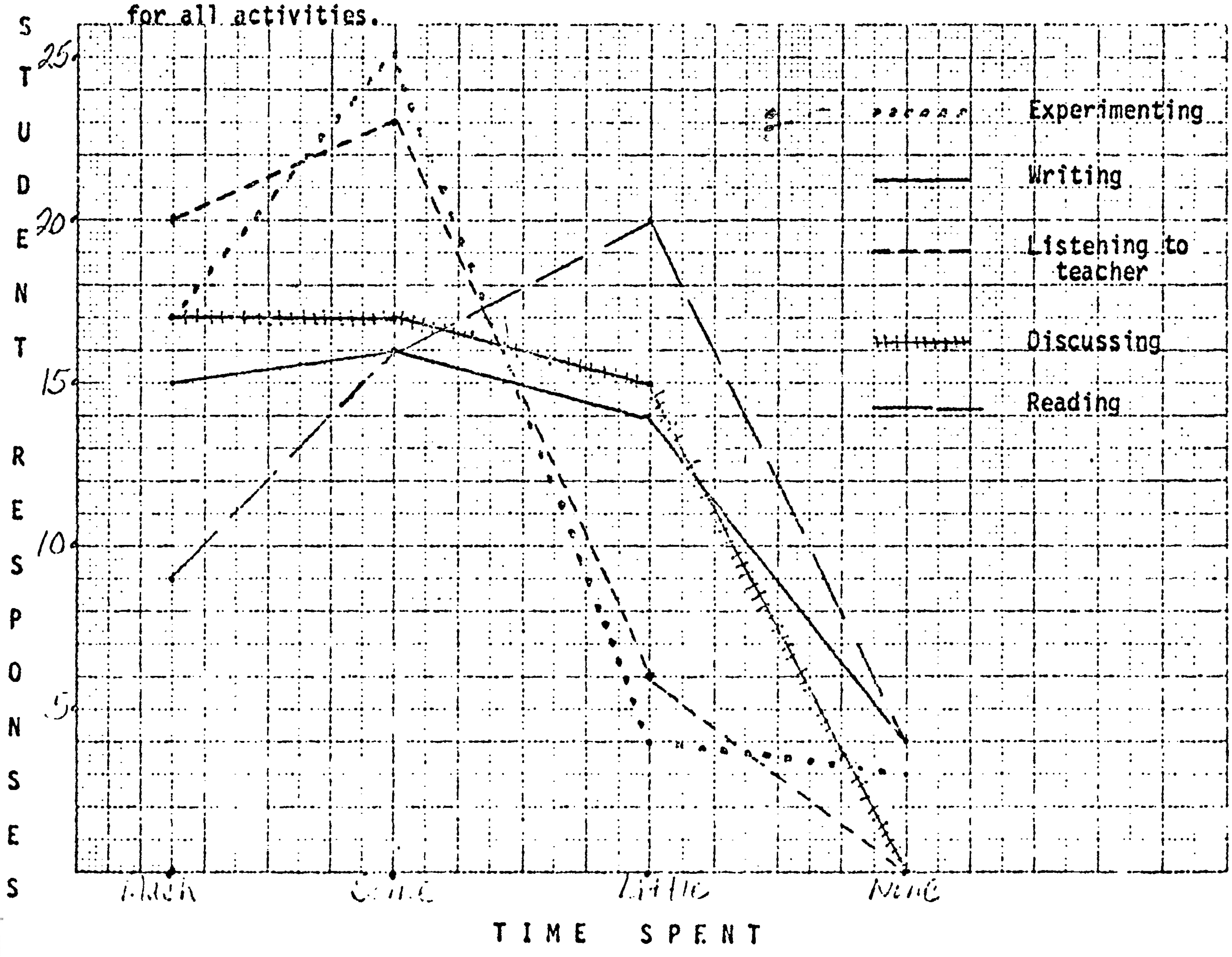

Table 12

Frequency and Percentage of best liked activity

Activity	Frequency	Percentage
Experimenting	35	71.43
Writing	4	8.16
Listening to teacher	3	6.12
Discussing	2	4.08
Reading	5	10.21
Total	49	100.00

The activity most preferred by sixth graders is experimenting. Only a few chose other activities as their most-liked activity. It should be noted that in the case of sixth graders there is a lack of correlation between the time spent in and student preference for an activity. In the absence of any other data this lack of correlation could be construed as indicative of lack of student satisfaction and happiness. However, the ratings given to the activities by the students on a five to one scale argue against such inferences. This will be apparent from an examination of the next table.

The data on 'most liked activity' provide evidence to show that the project has succeeded in instilling scientific attitude in students. This is clear from the students' expressed desire to engage in the activity of experimenting.

Table 13

Activity ratings on a 5 to 1 scale

Activity	5	4	3	2	1
Experimenting	36	8	4	1	0
Writing	4	3	10	14	18
Listening to teacher	3	10	12	11	13
Discussing	2	16	14	11	6
Reading	5	12	9	11	12

In general the sixth graders enjoyed most the activities of experimenting and discussing. The activities of reading, writing and listening to teacher were not highly regarded or liked by the students and therefore were not highly rated. This is in agreement with the emphasis the project wants to implement. Student perception that equal amounts of time were devoted for all activities suggests that there is a need for more feedback on how teachers carry out the instruction in the classroom. Perhaps teachers should be told to de-emphasize lecture in their instructional activities.

3.8 Community Involvement

From the inception of the project until its completion, attempts were made to involve the community wherever possible and to keep the community informed of the undertakings and developments in the project.

An Environmental Task Force was set up in September 1971 and consisted of members from various segments of the Island community including the military. Their principal task was to generate several different approaches to problems and then decide on the best solutions.

As the program developed, members were encouraged to pursue their own interests and concerns in developing materials to be placed in the hands of teachers and in-service programs. The committee held a total of nine meetings from September 1971 to June 1973. The critical comments of the Task Force were beneficial in steering the program and in general the group provided encouragement and moral support to the project staff in their activities. During the pilot years there was less and less need to rely on the Task Force, so fewer and fewer meetings were called.

Supportive groups like Department of Agriculture, Department of Public Health, Learning Resources Center, Public Broadcasting Station KGTF and the Pacific Daily News, have been actively involved in the development of instructional and/or promotional materials for the project.

The Guam Legislature manifested support for the project by adopting a resolution requesting that the University offer the course on

Environment of Guam on a permanent basis to island teachers. (See Appendix IV). The Guam Science Teachers Association and Biosciences Division of the University of Guam have rendered invaluable service to the project in the area of identifying and describing the island flora and fauna. The Naval Magazine opened for development of nature trails and study of Fena Lake.

The list of community involvement could go on and on. Suffice it to say that the project enjoyed inordinate support, encouragement and active participation from the community, including the Trust Territory and Hawaii.

3.9 Budget (expenditure)

Following is the budget breakdown of EEGSP 1973-74.

Personnel	01	-	$28,400.00
Travel	02	-	1,500.00
Contractual Services	03	-	13,300.00
Materials & Supplies	04	-	2,000.00
Equipment	05	-	1,000.00
Miscellaneous	09	-	3,000.00
TOTAL			$49,200.00

4.0 ASSESSMENT

The ultimate goal of the EEGSP is described as:

> "To graduate citizens who are knowledgeable and conscientious about the environmental concerns of Guam and the world".

Among the many traits and characteristics that make a person knowledgeable and conscientious about environmental problems, certain cognitive characteristics and affective traits constituted the immediate objectives of the project. This section lists these cognitive and affective objectives in behavioral terms, outlines the development, validation and administration of appropriate measuring devices, portrays the analyses and results, and summarizes the findings.

4.1 Performance Product Objectives

Performance product objectives, both for cognitive and affective domains, are included in this section. Since the affective objective is the same for all grade levels, it is stated first without distinguishing the grade level. Thus, the general statement of the affective objective applies to all grades. It is stated as follows:

More than 60 percent of the project students in each grade will acquire satisfactory level of scientific attitude as evidenced by higher than average rating on:

* 1. curiosity
2. inventiveness
3. critical thinking
4. persistence

*(See Pages 48, 49 for explanation of these terms.)

Cognitive objectives are stated for each grade level separately. Statement of each objective is comprised of two sections - one section specifies criterion level, and the second specifies the areas of competence. Since there are many areas of competence in each objective, each statement of objective with specification of criterion level and of competence areas can be considered as a conglomerate of as many sub-objectives as there are areas of competence.

GRADE 1: More than 60 percent of project students will acquire mastery* level in knowledge of:

1. names of certain organisms
2. requirement of life for organisms
3. habitat of organisms
4. natural events in an aquarium

GRADE 2: More than 60 percent of project students will acquire mastery level in knowledge of:

1. plant life cycles
2. animal life cycles
3. **3. meaning of biotic potential
4. categories of organisms

---

* - Mastery level is 100% correct responses for all items under one sub-objective.

**- Meaning of 'biotic potential' includes: (1) awareness that there would be a vast increase in number of organisms if certain limiting factors did not exist, and (2) understanding of the term 'generation'.

GRADE 3: More than 60 percent of project students will acquire mastery level in knowledge of:

1. aquatic populations
2. terrestrial populations
3. feeding relationships among organisms
4. the concept of community

GRADE 4: More than 60 percent of project students will acquire mastery level in knowledge of:

1. environmental factors
2. optimum range of environmental factors
3. effect of environmental factors on animals
4. effect of environmental factors on plants

GRADE 5: More than 60 percent of project students will acquire mastery level in knowledge of:

1. producers - the concept and growth
2. consumers - the concept and growth
3. decomposers - the concept and function
4. interrelation of all three in a given environment

GRADE 6: More than 60 percent of project students will acquire mastery level in knowledge of:

1. food chain, community and environmental factors as they relate to a classroom aquarium/terrarium system.
2. water cycle

3. oxygen-carbon dioxide cycle
4. cycles in an ecosystem
5. causes and effects of pollution in an ecosystem

In addition to the objectives stated above, another affective objective was developed for the sixth grade level. This objective was not included in the original evaluation design. It states:

> More than 60 percent of the project sixth graders would fall in the 'ideal' quadrant of the Semantic Differential Scales Space. (The space and scales will be explained in a later section pp. 54 ff.).

4.2 Data Collection

A variety of instruments was developed and used in connection with the evaluation of the EEGSP. Some of them were designed to determine the exact nature of the intervention variable as it occurred during the year. These instruments were explained in a previous section. Here attention is focussed on the instruments used in the summative evaluation of the project, namely to determine the extent to which participating students achieved the cognitive and affective objectives of the project. The purpose, method of development, validation and administration of instruments are briefly described here.

1. Criterion Referenced Tests: The purpose of criterion referenced tests is to assess achievement of the performance product objectives in the cognitive domain at all (1 to 6) grade levels.

Development of these tests was a cooperative effort of project teachers, the director and the evaluator. Teachers in all classes of the project constructed objective test items for assessing student achievement relative to the cognitive objective for their respective classes. These items were collected by the project director and reviewed by the project director and evaluator. From the pool of these tests the best ones were selected on the basis of item clarity and item appropriateness for the stated objectives. The selected items were then laid out in five to six equivalent subtests for each grade level so as to fit the matrix sampling procedure utilized in test administration.

The validity of concern in an achievement test is the content validity; namely, how well the items in the test are keyed to the stated objectives or how well the items in the test cover the subject matter area and the behavioral patterns such as recall, understanding and application. In the judgement of teachers, director and evaluator the items do possess the validity characteristics. However, there is room for improvement in the area of coverage. The apparent lack of coverage probably resulted from teachers' preoccupation with what has been taught rather than with what the students should know. This lack of coverage is not substantial so as to invalidate the test as far as measurement of achievement is concerned.

These tests were administered using a matrix sampling design. In matrix sampling students and items are laid out in column-row format so as to form a matrix of students and items. This matrix is then subdivided into a number of submatrices each with exactly the same dimensions. A subset of these submatrices is then selected for the purpose of test administration. Students in the selected submatrices respond only to the items in their submatrices. Thus in matrix sampling all students do not answer all items. Efficient statistical procedures exist which allow fairly accurate estimation of the population parameters.

The selection of submatrices was done on a systematic random basis. Each teacher at a given grade level alphabetically arranged all students in that class. The project director then listed all teachers for each grade level and asked the first teacher on the list to choose the first ten of her class for the administration of the first subtest for that grade. The second teacher chose the middle ten for the administration of the second subtest. The third teacher chose the last ten for the third test. The next teacher again chose the first ten. This procedure continued so that ten students from each class participated.

Based on the responses of students in selected matrices to the items in those matrices, estimates of mastery level for all students were made and this procedure is explained more at length in section 4.3.

2. Rating Scales for Assessment of Scientific Attitude: The purpose of this instrument is to assess teacher perceptions of students' growth in curiosity, inventiveness, critical thinking and persistence, factors which according to the SCIS curriculum developers constitute scientific attitude. (See Pages 48 and 49)

The instrument was also developed by the SCIS group, and logical validity of the instrument has been established by them.

All teachers completed this rating scale for each of their students. However, for economy of time and expense only a sample was used in the analyses.

3. Semantic Differential Scale: The purpose of this scale is to assess students' attitude toward prevention of pollution and conservation of environment.

The scale was developed by the evaluator in cooperation with the project director. A total of eight concepts essentially related to environment (four positive and four negative -- see page 54) were selected and for each concept a set of six bipolar adjectives was employed. (See Appendix V, Page 81). Adjectives were chosen to fit two attitudinal factors of potency and evaluation.

The validity of this type of instrument depends on the concepts chosen and the bipolar adjectives used. The project director and the evaluator agreed that the concepts chosen for the instrument are essentially related to conservation of environment. The bipolar adjectives are chosen from a list of already validated scales.

This scale was given only to sixth graders in the two pilot schools. The reason for this restriction was that the present sixth graders have been in the project two years and that they graduate from the project this year.

It should be noted that the use of Semantic Differential was not included in the original evaluation design. It was felt the assessment of the development of students' attitude towards conservation of environment would enhance the scope of the evaluation of the project.

4. Environmental Curriculum Project Feedback Report Forms: The purpose of these forms is to obtain feedback relative to teacher reactions concerning the relevance and success of various project activities (Page 60).

4.3 Analyses and Results

In this section the data generated from the use of various instruments in the course of summative evaluation are reduced into summary statistics. These statistics in most instances became immediate indicators of achievement objectives. This was true in the case of

1 - assessment of scientific attitude of students*
2 - assessment of attitude towards conservation
3 - teacher perception of project success.

In the case of assessing cognitive objectives sample statistics were further analysed for inference purposes.

This section on analyses and results is arranged into three subsections.

1 - assessment of cognitive objectives
2 - assessment of affective objectives
3 - teacher perception of project success

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* - Teachers rated all participants on the four factors of scientific attitude. However, only a twenty-five percent sample of the data was used for generating summary statistics.

4.31 Cognitive Objectives:

All the cognitive objectives of the project were stated in terms of 60% of the participants achieving mastery level. Mastery level was defined as 100% correct answers on the locally developed criterion referenced tests.

The reader should recall that a matrix sampling plan was employed in administering the criterion referenced tests. According to this plan no one took the entire set of items in the test. Therefore, the assessment of cognitive objectives could not be made in terms of individuals who reached mastery level.

Since the matrix sampling plan did not allow assessment of cognitive objectives in terms of percentage of participants achieving mastery level, the assessment was made in terms of percentage of correct responses. The focus of analysis is not the student himself, but the responses to individual items. From this analysis, inference was made as to the percentage of students accomplishing the objectives.

Four steps were involved in the analyses of responses in the matrix sampling context. First the total number of possible responses was calculated for each grade level, then the total number of correct responses was tabulated for the same grade, third a percentage of correct responses over possible responses was obtained. This percentage was used as summary statistics for assessment of cognitive objectives for that particular grade. Finally an overall index of project success was derived by dividing the total number of correct responses in all grade levels by the total number of possible correct responses in all grade levels.

1. Total number of possible responses for each grade level. Number of tests X number of items in each test X number of students taking each test.

Grade 1 7 x 4 x 10 = 280
2 6 x 5 x 10 = 300
3 9 x 6 x 10 = 540
4 7 x 6 x 10 = 420
5 8 x 6 x 10 = 480
6 7 x 10 x 10 = 700

2. Total number of correct responses for each grade level. For each grade this number was computed by multiplying the various numbers of possible correct responses with the corresponding actual frequencies. For example in grade 1, 4 was one of the possible numbers and there were 19 who scored all four correct. Therefore, 4 was multiplied by 19. Then the products were summed up to obtain the total number of correct responses for one grade level.

Grade 1: 19 x 4 = 76
33 x 3 = 99
12 x 2 = 24
6 x 1 = 6
205

Grade 2: 17 x 5 = 85
25 x 4 = 100
9 x 3 = 27
9 x 2 = 18
4 x 1 = 4
234

Grade 3: 20 x 6 = 120
44 x 5 = 220
21 x 4 = 84
4 x 3 = 12
3 x 2 = 6
442

Grade 4: 15 x 6 = 90
9 x 5 = 45
14 x 4 = 56
18 x 3 = 54
12 x 2 = 24
6 x 1 = 6
275

Grade 5: 18 x 6 = 108
21 x 5 = 105
20 x 4 = 80
15 x 3 = 45
7 x 2 = 14
6 x 1 = 6
358

Grade 6: 4 x 10 = 40
9 x 9 = 81
6 x 8 = 48
11 x 7 = 77
17 x 6 = 102
14 x 5 = 70
10 x 4 = 40
3 x 3 = 9
1 x 2 = 2
1 x 1 = 1
470

3. Percentage Success for each grade level --

$$\frac{\text{Total No. of Correct Responses}}{\text{Total No. of Possible Responses}} \times 100 = \%\ \text{Success}$$

Grade 1 = 73% Success $(\frac{205}{280} = 73\%)$
2 = 78% Success $(\frac{234}{300} = 78\%)$
3 = 82% Success $(\frac{442}{540} = 82\%)$

Grade 4 = 65% Success $(\frac{275}{420} = 65\%)$
5 = 75% Success $(\frac{358}{480} = 75\%)$
6 = 67% Success $(\frac{470}{700} = 67\%)$

4. Overall Index of Project Success

$$\frac{205 + 234 + 442 + 275 + 358 + 470}{280 + 300 + 540 + 420 + 480 + 700} = \frac{1984}{2720} = .73$$

Percentage success can be interpreted as percentage of sample participants achieving mastery level. For example 73% success can be interpreted as 73% of first graders in the sample achieving mastery level, similarily 78% in second grade and so on. However, these percentages represent only sample information. The question remains: given the sample information what can we say about the population of students who participated in the project?

The answer to the above inferential question is obtained by constructing 95% confidence intervals and looking at the lower limit of an interval.

If the lower limit is equal to or higher than 60%, then the probability that in the population the objective has been achieved is 95% or more. If the lower limit is less than 60%, then there is reason to suspect achievement of objectives in the population.

The formula for constructing the 95% interval is:

$$P \pm \left(1.96 \times \sqrt{\frac{PV}{n}}\right)$$

where P = Sample percentage

$V = 100 - P$

n = Total Number of responses

Table 14

Confidence intervals for percentage of correct responses for each grade level

Grade	Sample percentage of correct responses	Lower Limit	Upper Limit
1	73	67.81	78.19
2	78	72.92	83.08
3	82	78.77	85.23
4	65	60.44	69.56
5	75	71.12	78.88
6	67	64.10	69.90

In all grades the lower limit of confidence interval has been above 60% which means that the probability that cognitive objectives have been achieved in the population is higher than 95 percent. The actual percentage of those who achieved mastery level in the population could be as high as the figure shown in the "upper limit" column. The results therefore provide conclusive evidence that the project is successful as far as cognitive objectives are concerned.

4.32 Affective Objectives

Affective objectives were concerned with acquisition of scientific attitude at all grade levels and with development of positive attitude towards conservation (against pollution) at sixth grade level. The former was assessed by means of rating scales and the latter by means of Semantic Differential Scales. The data from these two instruments are summarized and analyzed in this section.

Assessment of scientific attitude involved rating scales on Curiosity, Inventiveness, Critical Thinking and Persistence. Rating was based on certain specified behaviors that a student exhibited during the course of the academic year. Each scale ranged from 1 to 5 depending on the frequency of specified behaviors (never, seldom, average amount, more than average and to an outstanding degree).

Curiosity was defined in terms of four behavioral patterns: a. using several senses to explore organisms; b. asking questions; c. observing organisms on first entering class; d. showing interest in experiment outcomes.

Inventiveness was defined in terms of three behavioral patterns: a. using equipment in new ways; b. suggesting new experiments; c. describing novel conclusions from observations.

Critical Thinking was defined in terms of the following three: a. using evidence to justify conclusions; b. pointing out weaknesses in others' reports; c. changing ideas in responses to evidence.

Finally the following behaviors were considered indicative of the trait of Persistence:

a. continuing investigations after the novelty has worn off; b. repeating an experiment to get "better" results; c. completing an activity even though classmates finished earlier.

Since the analysis of ratings of all students in all grades would be unduly time-consuming, it was decided to select a twenty-five percent sample in a 'random systematic fashion'. Summaries of sample ratings were computed. These are given in the following tables. No inferential analysis was done on the summary statistics chiefly because the size of sample in each class was small (average of less than 30). Small sample size usually has damaging effect on inferential analysis and is likely to present a somewhat distorted picture of the population. Therefore, instead of the summary statistics being inferentially analyzed, they were used as immediate indicators of success.

Table 15

Frequencies and Percentages of Higher Than Average Rating on Curiosity by grade level.

Grade	Frequency	Percentage
1	28	77.75
2	19	67.86
3	39	97.50
4	33	91.63
5	33	91.63
6	37	80.41

Table 16

Frequencies and Percentages of Higher Than Average Rating on Inventiveness by Grade Level

Grade	Frequency	Percentage
1	19	52.77 ⊗
2	16	57.13 ⊗
3	27	67.50
4	24	66.66
5	23	63.87
6	30	65.21

⊗=Below expected level

Table 17

Frequencies and Percentages of Higher Than Average Rating on Critical Thinking by grade level

Grade	Frequency	Percentage
1	23	63.88
2	17	60.70
3	28	70.00
4	27	74.99
5	26	72.20
6	32	69.56

Table 18

Frequencies and Percentages of Higher Than Average Rating on Persistence by grade level

Grade	Frequency	Percentage
1	20	55.55 ⓧ
2	18	64.71
3	30	75.00
4	23	63.88
5	28	77.76
6	32	69.56

ⓧ = Below expected level.

Table 19

Average percentages on all factors by grade level

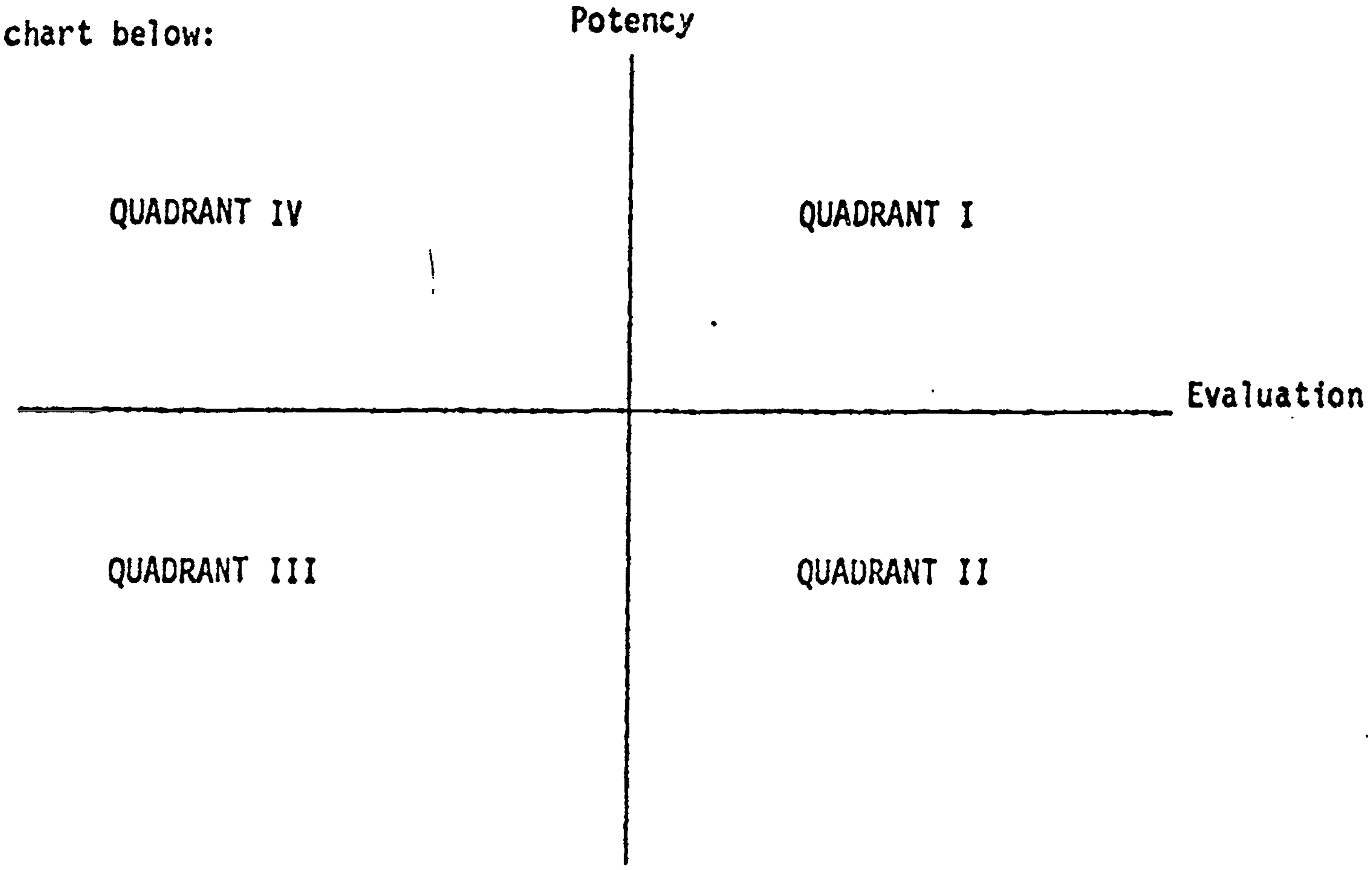
Grade	Percentage
1	62.49
2	62.60
3	77.50
4	74.29
5	76.36
6	71.18

Out of a total of 24 percentages in Tables 15 to 18 only three were below expected level and twenty-one surpassed the expected. On the factor of Curiosity all six grades reached beyond the sixty percent level. On Inventiveness grades 3 to 6 crossed the criterion mark of sixty percent, but the first and second graders were a little lower than expected. However, the average on all factors (see Table 19) was above the sixty percent level. On Critical Thinking again all six grades were higher than sixty percent level. Finally on Persistence all grades except the first grade accomplished higher than acceptable criterion levels. Here again the average for the first grade on all factors was higher than sixty percent. A logical inference one could draw from these sample summary statistics would be that all six grades have achieved satisfactory or higher levels of development in scientific attitude.

Semantic Differential Scales were used to assess attitude toward conservation of environment. Four concepts considered essential for conservation of environment on the Island and four concepts deemed destructive of the environment here made up topics for a set of six bipolar scales(See Appendix V, Page 81):

Positive concepts	Negative concepts
Nature trail	Bulldozing
Planting trees	Noisy airplanes
Clean beaches	Litter
Laws to preserve the environment	Pumping sewage onto the reef.

The phrases used in bipolar scales (Pages 56-57 & 81)spanned over two dimensions, called Potency and Evaluation. These two dimensions served as vertical and horizontal axes of a semantic space which generated four geometric quadrants. The space and quadrants are represented in the chart below:



The ratings given by respondents on the bipolar scales of each dimension were averaged. Thus each respondent received two averaged values on the dimensions of potency and evaluation respectively.

Corresponding to the values on the two dimensions, each individual was placed in one of the four quadrants. In the case of positive concepts all those who fell in the first quadrant would feel that the concept under consideration was both important for and effective in conservation of environment. Hence quadrant I was called the "ideal quadrant". Conversely those in quadrant III would feel that the concept is both unimportant and ineffective for conservation. Thus it was referred to as "undesirable quadrant". Quadrants II and IV contained individuals high on one dimension but low on another and therefore, these two quadrants were referred to as "tolerable quadrants".

In the case of negative concepts quadrant I happened to be the undesirable one and quadrant III the ideal one. The characteristics of quadrant II and IV remained the same.

If the project were to succeed in engendering positive attitude towards conservation, most of the respondents would fall in the ideal quadrant with respect to each of the eight concepts. The objective as stated called for more than 60% to fall in the ideal quadrant.

The data from the Semantic Differential Scales are summarized in the following two tables, which are laid out in the form of four quadrants. Each quadrant contains the names of the concepts, absolute frequency, and relative frequency of those who fell in the particular quadrant.

Table 20

Frequencies in each of the four quadrants relative to the four negative concepts.

POTENCY

5 4 3	Quadrant IV: TOLERABLE Bulldozing: 80 (43%) Noisy Airplanes: 77 (41%) Litter: 13 (7%) Pumping Sewage onto Reef: 25 (13%)	Quadrant I: UNDESIRABLE Bulldozing: 66 (36%) Noisy Airplanes: 20 (11%) Litter: 2 (1%) Pumping Sewage onto Reef: 11 (5.5%)
3 2 1	Quadrant III: IDEAL Bulldozing: 32 (18%) Noisy Airplanes: 84 (45%) Litter: 167 (91%) Pumping Sewage onto Reef: 154 (81%)	Quadrant II: TOLERABLE Bulldozing: 6 (3%) Noisy Airplanes: 5 (3%) Litter: 2 (1%) Pumping Sewage onto Reef: 1 (.5%)

1 2 3 4 5

EVALUATION

Table 21

Frequencies in each of the four quadrants relative to the four positive concepts

POTENCY

5 4 3	Quadrant IV: TOLERABLE Nature Trail: 9 (5%) Planting Trees: 9 (5%) Clean Beaches: 6 (6%) Laws to preserve the environment: 8 (4%)	Quadrant I: IDEAL Nature Trail: 148 (81% Planting Trees: 161 (89%) Clean Beaches: 83 (82%) Laws to preserve the environment: 163 (89%)
3 2 1	Quadrant III: UNDESIRABLE Nature Trail: 9 (5%) Planting Trees: 3 (2%) Clean Beaches: 5 (5%) Laws to preserve the environment: 7 (3.5%)	Quadrant II: TOLERABLE Nature Trail: 16 (9%) Planting Trees: 8 (4%) Clean Beaches: 7 (7%) Laws to preserve the environment: 7 (3.5%)

1 2 3 4 5

EVALUATION

Relative frequencies (percentages) for all four positive concepts were very high in the ideal quadrant. The concept of "nature" had 81% in the ideal quadrant; the concept of "planting trees" 89%; the concept "clean beaches" 82%; the concept of "laws to preserve environment" 89%. The percentages in all other quadrants were negligible for all concepts. The data from positive concepts evidences the fact that the project has succeeded in inculcating positive attitude toward conservation.

In the case of negative concepts the picture is slightly different. Relative to two concepts, namely, "litter" and "pumping sewage onto the reef", a very high percentage of respondents fell in the ideal quadrant. Relative to the other two concepts, namely, "bulldozing" and noisy airplanes", frequencies in the ideal quadrant were very low and the frequencies in the undesirable quadrant were unduly high. One explanation for the low frequencies in the ideal quadrant with respect to "bulldozing" and "noisy airplanes" is that respondents look at the good that might accrue from bulldozing and airplanes. Bulldozing is required for construction. Airplanes are needed for travel and quick transportation of perishable goods. Hence many respondents interpret them to be good. In other words, many students did not relate these two concepts to the damage they could bring about to conservation. Assuming this interpretation to be valid, a conclusion about the project success in creating a positive attitude to conservation could be made on the basis of the data obtained on the concepts of "litter" and "pumping sewage onto reef". In both instances frequencies were very high in the ideal quadrant and therefore it can be inferred that the project did succeed in developing positive attitude to conservation.

The conclusion that the project has been successful in developing positive attitude should be interpreted in a qualified manner. No information was available as to how the respondents felt relative to the eight concepts at the commencement of the project. It might be that they felt initially the same way. What is certain is that the respondents do have positive attitudes toward conservation at the end of the project. In order to establish causality between the project and attitude, a pre-post design would have to be utilized in the administration of the Semantic Differential Scales.

4.33 Teacher Perception of Project Success

Environmental Curriculum Project Feedback Report forms provided opportunity to teachers to express their reactions on various project activities. The forms allowed both structured response and open-ended answers. Out of seven items in the form, the following four have immediate relevance for success or failure of the project. These items are:

	Mostly	Moderately	Little or None
1. "Was the Activity a success in getting the objective(s) across?"	☐	☐	☐
2. "Were the suggested materials satisfactory?"	☐	☐	☐
3. "Did the students enjoy the activity?"	☐	☐	☐
4. "Would you recommend this activity to a fellow teacher seeking to present its objectives?"	☐	☐	☐

Table 22

Teachers' Reaction to Item 1

	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Mostly	22	76	28	85	12	71	xx	xx	5	72	xx	xx
Moderately	5	17	3	9	4	23	xx	xx	1	14	xx	xx
Little or None	2	7	2	6	1	6	xx	xx	1	14	xx	xx

Table 23

Teachers' Reaction to Item 2

	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Mostly	17	61	18	56	11	79	xx	xx	5	72	xx	xx
Moderately	10	36	5	16	3	21	xx	xx	1	14	xx	xx
Little or None	1	3	9	28	0	00	xx	xx	1	14	xx	xx

Table 24

Teachers' Reaction to Item 3

	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Mostly	21	78	22	67	13	81	xx	xx	5	72	xx	xx
Moderately	6	22	8	24	3	19	xx	xx	1	14	xx	xx
Little or None	0	00	3	9	0	00	xx	xx	1	14	xx	xx

Table 25

Teachers' Reaction to Item 4

	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Mostly	25	93	24	73	11	73	xx	xx	4	57	xx	xx
Moderately	2	7	8	24	3	20	xx	xx	2	29	xx	xx
Little or None	0	0	1	3	1	7	xx	xx	1	14	xx	xx

xx - Very few returns were received and therefore, no tabulation was carried out.

The tables indicate that the largest percentage of frequencies were in the category of 'Mostly', and the 'Little or None' category received very small percentages. This shows that most of the teachers felt that the project activities were successful and therefore that the project itself was a success. Open ended responses confirmed this conclusion.

In addition to tabulating the responses of the four items that have immediate bearing on the success or failure of the project, open ended comments of teachers were perused. The following representative examples are indicative of the success of the program as delivered to the students.

TEACHER COMMENTS

"High motivation and interest."

"The children enjoyed taking care of their fishes by feeding them regularly, watching their behavior, how they eat, die and move around."

"Many of the children are developing good observation techniques and are looking for details or organisms."

"Every child was very interested in watching the development of the tadpoles."

"Excellent source for students to learn life cycles."

"Children were very interested in this activity."

"The children liked looking at the pictures and easily told if they were plant or animal. They enjoyed identifying pictures as either plant or animal and also enjoyed pointing out characteristics of each."

"The children enjoyed finding out where seeds come from and the similiarities and differences among them."

"They enjoyed learning about the different parts of a plant and what the parts were called."

"The Environmental Curriculum Project is an excellent program to instill in the minds of the young boys and girls good ideas about environmental education."

"Fun! Student Manual difficult for low ability group."

> "Class did the experiments suggested on Page 6--soaking seeds in salt water before planting, heating seeds, and added the activity of freezing seeds. Class enjoyed 'forecasting' the results."

And finally, from a remedial reading teacher, "I used experiments as a reading exercise to develop the concept of sequence, and ability to follow directions."

Analysis of structured and open-ended responses showed that most of the teachers in the project perceived the project implementation as a success.

4.4 Findings

For convenience of readers, the findings from the descriptive and inferential procedures in the previous section 4.3 are specified in this section without any technical aspects. Final assessment of the program consisted of measurement and data analysis relative to

1 - Cognitive objectives
2 - Affective objectives
3 - Teacher perception of program success.

Results for analysis of Criterion Referenced Tests data revealed that all six grades achieved the objectives set out in the cognitive domain. More than sixty percent of the participants achieved mastery levels in all areas specified in adapted SCIS curriculum.

Results from analysis of Rating Scales provided evidence for achievement of affective objectives, namely that scientific attitude was achieved in all grade levels. Examination of the four factors of scientific attitude brought out that first graders did not reach the expected level of achievement on the factors of Inventiveness and Persistence and that the second graders fell short only on the factor of Inventiveness.

Analysis of data from Semantic Differential Scales disclosed that the project succeeded in developing positive attitudes to conservation of environment in the graduates of the program, namely the sixth graders. Most of them felt that there should be laws to preserve the environment, that nature trails and clean beaches are 'sine qua non' for a healthy environment on Gua and that planting trees would contribute to the maintenance of good environment. Most of the participants agreed that litter, pumping sewage onto reef, reckless bulldozing and noisy airplanes would be destructive to the kind of environment that should be preserved on the Island.

Results from the analyses of Environmental Curriculum Project Feedback Report Forms showed that the structured and open ended responses of teachers provide confirmative evidence about the success of the program as a whole.

The findings might therefore be summarized in the following statement: "Project students achieved the objectives set out for them and teachers felt that the project was successful".

5.0 SUMMARY AND RECOMMENDATIONS

This evaluation report has presented a brief description of the Environmental Education for Guam Schools Project (EEGSP) implemented during the 1973-74 academic year, summarized the reactions of student participants on instructional details, and outlined procedures and results of program assessment in terms of student achievements and teacher perception.

Program Description contained information on who did what and how, and outlined project history, project scope, personnel, procedures of curriculum development, teacher training, instruction and community involvement, and project expenditure. Student reactions to various project activities were summarized and included in the description of project instruction. In general students were happy in the activities they were involved in and differential emphases placed on various activities in general were in line with what was planned. A somewhat curious phenomenon emerged that, though contrary to guidelines, a lot of time was spent in lecturing and students indicated that they enjoyed listening to lectures.

Assessment centered around: 1. Student achievements in knowledge and attitudes. 2. Teacher perception of program success. Results indicated that student participants made significant advances in their knowledge of our environment in general, of the factors destructive of a healthy environment and of the factors contributive to the preservation of our environment. Results also revealed that a majority of the students at all grade levels developed satisfactory levels of scientific attitude and that the graduates of the program possessed a positive attitude toward conservation of our environment. Results from teacher responses disclosed that teachers in the project viewed the project implementation as a success.

Satisfactory levels of student achievements and teacher perceptions of program success argue for incorporation of both the philosophy and the curricular materials of the EEGSP into the regular instruction of the elementary school students on the Island. The evaluator therefore recommends that these aspects of the program be adopted for systemwide implementation.

APPENDIX Ia
ACTIVITIES CHECK LIST

ORGANISMS
GRADE 1

ACTIVITY	YES	NO
DID YOUR STUDENTS:		
Sort seeds into groups?		
Plant seeds in planter cups?		
Set up watering schedules?		
Discuss effect of light on plants?		
Set up aquaria?		
Identify organisms in aquaria by name?		
Observe birth, growth, & death of organisms in aquaria?		
Take schoolyard field trip to locate organisms' habitats?		
Listen to explanation of concept 'habitat'?		
Observe African snail & potted plant?		
Observe color change in aquaria?		
Experiment to find out reason for color change in aquaria?		
Identify organisms that eat other organisms?		
Use term 'food web' referring to feeding relation among organisms?		
Draw a food web?		
Observe 'dark' stuff on bottom of aquaria & call it detritus?		
Plant seeds in soil with detritus and without detritus to learn effect of detritus on plant growth?		

APPENDIX Ib

ACTIVITIES CHECK LIST

LIFE CYCLES
GRADE 2

ACTIVITY	YES	NO
DID YOUR STUDENTS:		
Find seeds in various fruits?		
Compare seeds to find similarities and differences?		
Plant seeds in flowerpots?		
Observe initial growth of root & stem in embryo plant?		
Experiment to answer questions such as: "Do roots always grow down?" "Do seeds drown in the water?" "Will parts of plants grow?"		
Arrange in sequence pictures of stages in plant life cycles?		
Observe vials of fruit flies?		
Identify stages of fruit fly development?		
Arrange in sequence pictures of fruit fly stages?		
Observe toad eggs develop into tadpoles and adult toads?		
Arrange in sequence pictures of toad life cycles?		
Observe cultures of beetles to find larval, pupal, & adult stages of the life cycle?		
Watch series of charts to see outcome if no offspring died?		
Do activity to find out possible increase in bean plants if no deaths occurred?		
Identify unnamed plants by comparing them with labeled plants and plant seeds?		
List ways living objects differ from non-living objects?		
List ways in which plants and animals differ?		

APPENDIX Ic

ACTIVITIES CHECK LIST

POPULATIONS
GRADE 3

ACTIVITY	YES	NO
DID YOUR STUDENTS:		
Build freshwater aquaria?		
Observe freshwater aquaria?		
Build saltwater aquaria?		
Observe saltwater aquaria?		
Take field trip to observe various groups of organisms?		
Relate in class, after field trip, a group of organisms to the term 'population'?		
Observe water fleas in aquaria over period of time to see change in population?		
Experiment to find causes of growth of duckweed populations?		
Build terraria?		
Observe terraria?		
Observe changes in plant population of terraria when they introduced grasshoppers and/or snails?		
Place aphids on plants about 2" high and observe their increase in number twice a week for three weeks?		
Observe populations of fruit flies in containers?		
Discuss plant-eater, animal-eater, and plant-and-animal-eater using beach lagoon pictures?		
Add a lizard to each terrarium & watch lizards catch and eat grasshoppers?		
Sort common food items according to origination from plant or animal?		
Draw various food chains?		
Put together several food chains to make a food web?		
Relate organisms represented in a food web to a system known as community?		

APPENDIX Id

ACTIVITIES CHECK LIST

ENVIRONMENTS
GRADE 4

ACTIVITY	YES	NO
DID YOUR STUDENTS:		
Identify environmental factors affecting organisms in terraria?		
Discuss causes of change in terraria?		
Compare a terrarium where population decline occurred with one in which the population increased?		
Practice methods of recording observations on a field trip?		
Make field trips to discover organisms living in the area?		
After field trip, record conditions under which organisms were found?		
Determine optimum range of an environmental factor?		
Test response of isopods to different intensities of light?		
Test response of isopods to different intensities of water?		
Experiment to find optimum range of light for snails?		
Experiment to find optimum range of water for snails?		
Experiment to find optimum range of temperature for snails?		
Experiment with brine shrimp eggs in different amounts of saltwater to determine salt concentration in which most eggs hatch?		
Experiment on responses of beetles to light?		
Experiment on responses of beetles to water?		
Experiment on responses of beetles to temperature?		
Experiment on plant responses to light by placing half the plants in the light and half in the dark?		
Attempt to germinate grass, millet (etc.) seeds at different temperatures?		
Experiment to determine optimum range of water for bean germination?		
Experiment to determine response of germinating beans to varying concentrations of chemical fertilizer?		
Construct terrarium providing optimum ranges of env. factors?		

APPENDIX Ie

ACTIVITIES CHECK LIST

COMMUNITIES
GRADE 5

ACTIVITY	YES	NO
DID YOUR STUDENTS:		
Examine seeds to identify parts?		
Predict parts of a seed that will grow into a plant?		
Observe growth of grass seeds in light and dark to determine that while light is not necessary for germination it is for continued growth?		
Experiment with cotyledons?		
Build terraria?		
Plant bean seeds in terraria?		
Observe plants until flowers, pods, and more seeds are produced?		
Dissect seeds to learn food in cotyledons was produced by photosynthesis and deposited there by parent plant?		
Add grasshoppers to terraria?		
Observe from experiments what the grasshoppers eat?		
Experiment to determine amount of food grasshoppers eat?		
Add a toad to their terraria?		
Observe that toad eats grasshoppers?		
Add isopods to their terraria?		
Discover that toads eat isopods?		
Observe dead organisms to identify molds and unpleasant odor as evidence of bacterial decay?		
Experiment the action of yeast on bananas?		
Discuss reproduction and its relationship to food supply?		
Draw arrows to represent transfer of food from organism to organism?		
Predict effect on food web if any population is removed?		

ACTIVITY	YES	NO
Take field trip to observe three groups in community (producers, consumers, decomposers)?		
Play 'Communities' game?		
Construct food web with man as central population to learn concept of 'competitors'?		

APPENDIX If

ACTIVITIES CHECK LIST

ECOSYSTEMS
GRADE 6

ACTIVITY	YES	NO
DID YOUR STUDENTS:		
Build a composite terrarium/aquarium?		
Plant pea seeds in terrarium section?		
Place aquatic animals in aquarium?		
Observe aquatic animals several days?		
Place aquatic plants in aquarium?		
Observe aquatic plants several days?		
Add mosquito fish to aquarium?		
Add grasshoppers to terrarium?		
Review concepts of food chain and decomposition?		
Discuss changes in aquarium/terrarium systems?		
Infer dependence of organisms on environment?		
Call a community interacting with its environment an 'ecosystem'?		
Observe moisture in their systems?		
Investigate source of the moisture in their systems?		
Discuss cause of condensation on outside of a container of cold beverage?		
Experiment to determine the cause of the condensation?		
Warm and cool liquid Freon-11 to infer that evaporation and condensation are related to change in temperature?		
Evaporate water at one end of a container and condense it at opposite end?		
Observe color change while blowing through BTB and attribute change to carbon dioxide?		
Experiment to find cause for reversal in color of BTB solution overnight?		
Perform experiment to identify seltzer gas as carbon dioxide?		

APPENDIX If

ACTIVITIES CHECK LIST ECOSYSTEMS - GRADE 6 Page 2

ACTIVITY	YES	NO
Observe demonstration experiment with soda water and BTB?		
Experiment with snails in solutions of BTB to determine how organisms interact with oxygen and carbon dioxide in the environment?		
Experiment with hydrella in solutions of BTB to determine how organisms interact with oxygen and carbon dioxide in the environment?		
Experiment to determine nature of gases given off by pea plants in light and in dark?		
Construct a diagram to illustrate cycling of minerals, water, oxygen, and carbon dioxide?		
* Investigate response of guppies to excess carbon dioxide?		
Investigate effects of large amounts of food in small aquatic systems on decomposition and excess carbon dioxide?		
Test the effect of commercial fertilizer on growth of algae?		
* Test soil samples to discover fertilizer in one area moves to another?		
Relate results of experiments (*'s above) to water pollution or reef ecosystem or lagoon areas?		

APPENDIX IIa

NAME: ______________________

DATE: ______________________

ENVIRONMENTS REPORT CARD

1. What do you think of these activities?:

(most interesting - A, good - B, fair - C, boring - D)

____ building a terrarium

____ observing environmental changes

____ going on a field trip

____ investigating isopods' response to temperature, heat, water.

____ investigating snail responses

____ investigating plant response to temperatures

____ investigating plant response to light

2. How much of your time in science did you spend on each of these? (circle word that best describes)

experimenting	much	some	a little	none
writing	much	some	a little	none
listening to teacher	much	some	a little	none
discussing	much	some	a little	none
reading	much	some	a little	none

3. Circle the activity in Question 2 that describes what you like best. Put an "X" on the activity you like the least.

NAME: ______________________

DATE: ______________________

COMMUNITIES REPORT CARD

1. What do you think of these?:

examining parts of seeds ______________________

measuring growth of seed parts ______________________

growing grass in light and dark ______________________

experimenting with cotyledons ______________________

planting seeds ______________________

2. How much of your time in science did you spend on each of these?:

experimenting	much	some	a little	none
writing	much	some	a little	none
listening to teacher	much	some	a little	none
discussing	much	some	a little	none
reading	much	some	a little	none

3. Circle the activity in Question 2 that describes what you like best.

APPENDIX IIc

NAME: ______________________

DATE: ______________________

ECOSYSTEMS REPORT CARD

1. Evaluate the following activities in which you participated in Environmental Science this year:

   (most interesting - A, good - B, fair - C, boring - D)

   What do you think of these?:

   ____ building aquarium-terrarium systems

   ____ observing organisms

   ____ testing for CO_2 with BTB

   ____ experimenting with pollutants

2. How much of your time did you spend on each of these? (circle word that best describes):

____	experimenting	much	some	a little	none
____	writing	much	some	a little	none
____	listening to teacher	much	some	a little	none
____	discussing	much	some	a little	none
____	reading	much	some	a little	none

3. Circle the activity in Question 2 that describes what you like best.

4. Rate the activities in Question 2, using the scale 5 to 1. 5 would be the activity you circled, 4 next best, 3 next, 2, and 1 you liked least. Place your numerals in blank provided.

APPENDIX III
Ecosystems (6th Grade)
Teacher's Guide

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APPENDIX IV

Introduced 4-18-72

Adopted 6-23-72

ELEVENTH GUAM LEGISLATURE
1972 (SECOND) Regular Session

Resolution No. 531

Introduced by G.M. Bamba

Relative to requesting the University of Guam to establish permanent in-service training program for elementary teachers in environmental problems on Guam.

BE IT RESOLVED BY THE LEGISLATURE OF THE TERRITORY OF GUAM:

WHEREAS, the limitations of the natural environment to adjust to pressures exerted by man has dictated that the people of Guam become increasingly aware of their surrounding environment and the ecological balances of nature; and

WHEREAS, the Department of Education of the government o Guam is the recipient of an E.S.E.A. Title III Grant which i intended to develop a curriculum in the public schools in environmental education; and

WHEREAS, a portion of the moneys allocated pursuant to E.S.E.A. Title III Grant is allocated to the in-service training of elementary teachers in environmental problems on Guam; and

WHEREAS, the University of Guam is presently conducting a pilot program of such in-service training and possessed the capability of and interest to provide such a training program on a permanent basis; now therefore be it

RESOLVED, that the Eleventh Guam Legislature does hereby respectfully request the Board of Regents of the University of Guam to establish a permanent in-service training program for elementary teachers in environmental problems on Guam; and be it further

RESOLVED, that the Speaker certify to and the Legislativ Secretary attest the adoption hereof and that copies of the same be thereafter transmitted to the Chairman of the Board of Regents of the University of Guam, to the President of th University of Guam, to the Director of Education, and to the Governor of Guam.

APPENDIX V

Your name: ______________________________

May 1974

		EVALUATION			POTENCY		
		A	B	C	D	E	F
a.	Bulldozing						
b.	Noisy airplanes						
c.	Litter						
d.	Pumping sewage onto the Reef						
e.	Nature trail						
f.	Planting trees						
g.	Clean beaches						
h.	Laws to preserve the environment						

A -	Hate it 1	Don't like it 2	Don't care 3	Like it 4	Love it 5
B -	Very bad 1	Bad 2	Don't care 3	Good 4	Very good 5
C -	Very ugly 1	Ugly 2	Don't care 3	Beautiful 4	Very beautiful 5
D -	Very unimportant 1	Unimportant 2	Don't care 3	Important 4	Very important 5
E -	Really useless 1	Useless 2	Don't care 3	Useful 4	Very useful 5
F -	Very harmful 1	Harmful 2	Don't care 3	Helpful 4	Very helpful 5