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ABSTRACT

The importance of experiential aspects of biological study is addressed using multi-dimensional classroom and field classroom approaches to student learning. This document includes a guide to setting up this style of field experience. Several teaching innovations are employed to introduce undergraduate students to the literature, techniques, and concepts of biology. These include: a primary emphasis on experiential learning, modifications in traditional course sequence, development of new instructional materials and new methodology in content delivery, individualization of instruction, development of new grading and criterion-referencing procedures, and changes in focus to allow for personal growth and maturation. The methodology employed to accomplish objectives includes the development of a database stored on computer disk and new search image slides for learning about common organisms. A summary of the estimated costs of implementation is included. (CW)

GUIDELINES FOR SETTING UP AN EXTENDED FIELD TRIP TO FLORIDA AND THE FLORIDA KEYS

An interactive experiential training field biology program consisting of pretrip instruction, search image training, field exercises, and observations of tropical habitats and coral reefs

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ABSTRACT

GUIDELINES FOR SETTING UP AN EXTENDED FIELD TRIP TO FLORIDA AND THE FLORIDA KEYS: AN INTERACTIVE EXPERIENTIAL TRAINING FIELD BIOLOGY PROGRAM CONSISTING OF PRETRIP INSTRUCTION, SEARCH IMAGE TRAINING, FIELD EXERCISES, AND OBSERVATIONS OF TROPICAL HABITATS AND CORAL REEFS.

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The importance of experiential aspects of biological study is addressed using multi-dimension classroom and field classroom approaches to student learning. Several teaching innovations are employed to introduce undergraduate students to the literature, techniques, and concepts of biology. These include: a primary emphasis on experiential learning, modifications in traditional course sequence, development of new instructional materials and new methodology in content delivery, individualization of instruction, development of new grading and criterion-referencing procedures, and changes in focus to allow for personal growth and maturation.

The methodology employed to accomplish objectives includes the development of a data base stored on computer disk (termed CORE + BOXES in proposal), and new "search image" slides for learning common organisms in the study area. Papers describing our grading procedure and some aspects of the study of fishes were presented at the Indiana Academy of Science. Based on our experience in teaching field classes of this type, we find that students are amazed at the quantity of biology they learn in a relatively short period of time. Finally, an intangible component may be operating in many cases with enhanced ecological sensitivity and a feeling of Man's place in the ecological system being desirable outcomes.

GUIDELINES FOR SETTING UP AN EXTENDED FIELD TRIP TO FLORIDA AND THE FLORIDA KEYS: AN INTERACTIVE EXPERIENTIAL TRAINING FIELD BIOLOGY PROGRAM CONSISTING OF PRETRIP INSTRUCTION, SEARCH IMAGE TRAINING, FIELD EXERCISES, AND OBSERVATIONS OF TROPICAL HABITATS AND CORAL REEFS.

1. Title of course: L303--Field Biology

2. Teaching- Learning problems

The importance of the existential and observational aspects of biological study is addressed in this set of guidelines. Our basic premise is that multi-dimension classroom and field classroom approaches to student learning are more productive than any single learning approach. Innovations explored include: a primary emphasis on experiential learning, modifications in traditional course sequence, development of new individualization of instruction, development of grading and criterion-referencing procedures, and changes in focus to allow for personal growth and maturation. The specific teaching-learning problems are described following a discussion of our teaching philosophy.

Philosophical Aspects

The science of Biology originally developed as an extension of Man's intrinsic curiosity about nature. Emerson in his essay on nature (1844) stated that on certain days we might literally walk onward into the open landscape absorbed by many succeeding pictures and recollections. We believe there is a basic grandeur in the science of life. Once educated regarding this grandeur and the scientific process, students will be able to ask questions of the biological universe. With questions and subsequent answers, we can add to the expanding wealth of knowledge and perhaps make life better for everyone as we advance into the next century.

Early biological instruction may have involved the collection of organisms along the seashore with both students and instructor asking questions about the creatures observed and collected. With the development of research tools such as the microscope, a significant portion of biological science became confined to the laboratory where the techniques and machinery involved could be duplicated within many secondary school and college settings. Currently, however, using expensive, modern laboratory equipment, scientists are generating a biological data base at the organismal, cellular, and molecular level which can be duplicated only at schools and universities where adequate funds are available to purchase necessary equipment. As a result of this technological and informational explosion, much of today's biology can be referred to as "armchair biology"--the studying, reading, or lecturing about the accomplishments of others.

In an almost futile attempt to cope with the informational explosion, naive biology instructors, newspapers, and popular periodicals often present biological knowledge as a series of amazing facts. Clearly, innovative instructional programs are necessary if we are to rescue students who are being overwhelmed by information which may be out-of-date in a short period of time.

One method of injecting life into a biology program is to utilize methods which appeal to a student's innate curiosity. This procedure allows us to reawaken the naive wonder present in everyone. We recall some lines attributed to Rachel Carson. "A child's world is fresh and new and beautiful, full of wonder and excitement. It is our misfortune that for most adults that clear-eyed vision and true insight for what is beautiful and awe-inspiring, is dimmed and lost before we reach adulthood. I wish each child in the world could be given a sense of wonder so indestructible that it would last a lifetime." To accomplish the above task, selected departures from the basics in order to concentrate on experiential learning and **the biology of what is not known** may be appropriate.

Experiential learning and training involving field trips were an integral part of early biology. For example, the lives of some pioneer North American naturalists consisted of a life long field trip in which they recorded their impressions of a new environment, new species, and a wealth of biological information. Properly conceived and implemented, these types of activities can be used by modern biology teachers to provide students and teachers with a point of entry allowing study of the unknown, exploration of many biological concepts, and development of critical thinking.

A particularly useful experience is a field class trip to habitats different from those encountered locally. Students participating in the trips are exposed to totally new environments, organisms, and interpersonal reactions. Based on our ten year's experience in leading these types of trips and our experience with our recently developed course, we find that students are amazed at the quantity of biology they learn in a short period of time. In addition, an intangible component may be operating in many cases. We strongly suspect that these experiences may positively influence a student's thinking later in life with enhanced ecological sensitivity being a desirable outcome. Since we feel close to nature, we want students to gain from the course not only information but **a feeling of their place in the ecological system**. As a conclusion to this philosophical statement, we repeat a sentence from K. Yamamoto's 1972 article in "Teacher's College Record", "To teach is to touch someone's life in progress, and, in so doing, one hardly remains untouched."

Teaching Learning Problems

Teaching-Learning Problem 1--Learning through Experience

Some instructors feel that the passive nature of many classrooms is a great detriment to learning. Many argue that the active involvement of a learner provides a more worthwhile and substantial learning experience.

Teaching-Learning Problem 2--Modifications of a Traditional Course

In teaching intensive field class courses with pretrip materials, we want to find better ways to structure the content areas. Modifications of this type may be a general trend in biology where instructors are attempting to restructure old content areas. Hopefully, modification and rearrangement leads to the development of new perspectives.

Teaching-Learning Problem 3--Development of New Instructional Materials

Since we visit unfamiliar areas, new materials in the form of a new syllabus, search image slides, and other appropriate items have been generated. Users of various media claim that the involvement of different senses in receiving information leads to a more integrated understanding of a given topic.

Teaching-Learning Problem 4--Methodology in Content Delivery

Limitations of presenting information only in the lecture format have been noted for many years. Research on note-taking strategies indicates that students typically record only a small percentage of the verbal information delivered in a college lecture. Achievement appears highly correlated with the percentage of significant ideas appearing in a student's notes. In this course, other delivery modes and lectures modified to make them more interesting are used to supplement or replace the standard lecture format.

Teaching-Learning Problem 5--Individualization of Instruction

In our course, students differ greatly in terms of background and how fast they assimilate the information at the pretrip level. We developed a procedure using self-paced instruction (SPI) with the possibility of students being able to take tests more than once.

Teaching-Learning Problem 6--Grading and Criterion-Referencing

Grading and evaluation are sometimes controversial topics. Since a great deal of learning takes place in a field classroom, new assessment systems have been devised to evaluate these experiences in an objective manner. Both formative and summative methods are utilized.

Teaching-Learning Problem 7--Changes in Focus

Education can play an important part in the development of emotional maturity. These types of experiences force both faculty and students to work closely together for a ten day period.

Teaching-Learning Problem 8--Course Management

As a better approach in "running" the program, we utilize team-teaching which enables us to provide more individual attention. In some areas, we utilize "peer teaching." Some argue that students are quite capable of teaching each other and that such procedures induce cooperation and interpersonal understanding.

3. Specific objectives

The overall objective of an extended field biology course is to address the importance of experiential training. The specific objectives are summarized below.

Objective 1--Field Biology L 303. Develop a field biology course consisting of pre trip instruction, search image training, field class exercises, and observations of several habitats. Although the field class destination may vary from year to year, the basic educational objectives remain constant--to introduce undergraduates to literature, techniques, and concepts in biology using the natural environment as the classroom and laboratory.

Objective 2--Develop pretrip instructional materials for an intensive field course experience.

Objective 3--Develop new instructional materials appropriate for experiential biology. An overall objective here is to develop a student's cognitive skills in recognition and identification.

Objective 4--Develop new methodology in content delivery.

Objective 5--Explore methods for individualization of instruction.

Objective 6--Develop an objective grading and criterion-referencing system for diverse aspects of a field biology course.

Objective 7--Study changes in course focus to account for development of emotional maturity and interpersonal relations.

Objective 8--Analyze course management methodologies.

Objective 9--Develop an appropriate set of field class exercises.

Objective 10--Study and formulate methods for evaluating student performance and the student's assessment of the overall quality of the course.

4. Methodology employed to accomplish objectives.

The field biology class involves the following components designed to satisfy Objective 1 listed above. Pretrip instruction begins about midsemester using the specially developed fact sheets. Students are given an examination following lecture summaries of the materials and the opportunity for individualized counseling. Those students receiving a B or better on the first examination have the opportunity to discuss their deficiencies and take an appropriate oral examination later. Students making a C or below on the objective examination are counseled regarding their deficiencies and then allowed to take a new examination on the pretest materials.

The pretrip classes are designed to provide a general background data base for the subsequent field studies (Objective 2) and an opportunity for students to learn identification characteristics of a variety of organisms (Objective 3). In preparation for our upcoming Florida trip, we have personally taken several teacher-oriented workshops and classes. In addition, information about the subtropical region has been summarized in the attached prepared syllabus which is organized into a CORE of information, specific information regarding some study sites, and an illustrated section on the various types of organisms we will likely to encounter in the Florida Keys.

The instructional method chosen (Objective 2) for presentation of the pretrip materials is a CORE and BOXES format using summaries of information ("fact sheets") programmed into a word processor and stored on disks. With the word processing format, both CORE and BOXES can be rapidly reorganized without destroying the integrity of the informational base. For example, future trips may be to different locations like the Atlantic Coast or Western Gulf Coast of Texas. In either of these examples, the CORE information would be married with local information.

New instructional materials have been developed so that students can gain pretrip expertise and familiarization with a number of plants and animals found in the study area. We term these materials which are presented in the 35 mm slide format--**"search images"**. We have noted in the past that students who have not been exposed to the characteristics and appearance of the species prior to actual experimental involvement usually are left with only fleeting memories of "pretty fish" and "big corals". For two pilot courses, we relied on the rather clumsy and lengthy procedure of using pictures in books and prepared slides for this aspect of the course. However, we received a $450 grant from our improvement of learning committee for the development of original materials. This year we successfully prepared search image slides on an individual or small group basis. For the identification test, students are required to positively identify several of the species.

This course represents a deviation from the traditional instructor-centered teaching and lectures to one where the "experience" along with appropriate guidance provides the "model" for the learning process. Some changes in content delivery have been mentioned above (CORE + BOXES, "search image" slides). For the actual field classes, we developed the following practical, workable three step scheduling procedure for each activity: (1) pre-field class preparation and introductory material, (2) appropriate field class activities, and (3) followup and summary. As an example, in a previous study trip we considered the Florida seagrass meadows. Pre-field class preparation included tips on identification of organisms, energy flow and food web associated with the plants, and adaptations of the organisms living with the seagrasses. During the actual field class, organisms observed were reinforced using identification notes and keys. Later, field notebooks were brought up to date and questions answered. Sometimes the trips are so exciting that discussion is self generating.

During pre-field class instruction and the field experience, we seek the opportunity for one on one small group instruction (Objective 5). The class is, for example, limited to 9 to 15 students. In all phases of the class, we are able to meet with students on an individual basis to provide for individual instruction. In the CORE + BOXES format used in the pretrip instruction, the entire bundle of material in the syllabus is presented ahead of time so that students can proceed at their own pace. Basically, the material is summarized through short 30 minute minilectures. Tests are given fairly quickly to reduce procrastination. Previous innovation in this area suggests that it is desirable to spend time providing students with more information about their efforts in the process of the learning experience rather than after they are finished. The opportunity for taking the tests more than once involves "mastery-based learning" enabling all students immediate feedback and the possibility of working up to the same level. Mastery-based learning is assessed by a score of 90% or better on a fill-in test; these may be attempted three times.

Little information is available on grading a student's overall performance in field trip courses (Objective 6). Our library research and Dialog computer searches yielded no recent references on field trip achievement and testing procedures. Therefore, we developed the following system for measuring or criterion-referencing a student's performance using six major point assessment categories (See grading scale in front of syllabus). These categories are: pretrip class sessions (10 points), pretrip test on CORE + BOXES (10 points), "search image" test (10 points), field participation (30 points), field notebook and transcription (20 points), and a post-test covering field experience (20 points). A paper describing this grading system, "Experimental training: Evaluation and grading of extended field trip courses", was given in the Science Education section at the Fall (1986) meeting of the Indiana Academy of Science by C. Christenson, J. Christenson, and C.D. Baker. In the future, evaluation procedures will include the administration of diagnostic, criterion-referenced pretest-posttest instruments specifically designed for this course. In this way, we can generate a detailed analysis of students' strengths and weaknesses. Also, these test data are amenable to the determination of reliability and consistency which will be useful in indicating whether the tests are sufficiently reliable for use in empirical study.

Field participation is considered an important component of a field course. Working with students continuously for a 10-12 day period usually provides ample opportunity for determining activity level and observational skills. One problem has been that a hard working student may be deriving little benefit from the exercise.

Very simply, activity sometimes has no relationship to accomplishment. Therefore, we encourage students to ask questions. Substantive, relevant questions can create a snowball effect leading to significant accomplishment during the field experience. **[We believe that once a student has learned to ask proper questions, he/she has learned how to learn.]**

Despite the educational value of field trips, many biology instructors are reluctant to sponsor them primarily because they are unsure of trip organization methodologies (Objective 8). For each of our trips, a five step protocol is implemented--SCOPE. The acronym is taken from: Scheduling, Cost, Organization, Participation, and Evaluation. Organization and participation were discussed in previous sections.

Scheduling is a time consuming aspect of experiential studies. Careful planning (with a great deal of flexibility) in relation to course content are necessary to provide for maximal learning. Normally, our courses are designed to conform to natural breaks in the school calendar so that minimal overlap occurs. After determination of a time block and destination, some thought should be given to the development of a practical, flexible itinerary in conjunction with an appropriate curriculum. Since we now have the experience necessary to design our own programs, we incorporate a variety of learning experiences. First, we compiled a list of possible learning resources and field trip locations near the major destination. Locations easily accessible are included into the program. For example, in previous trips to Florida, we studied the following: north Florida springs, manatees, cypress swamps, high energy rocky shorelines, sandy beaches, coastal dune vegetation, estuaries, mangrove forests, seagrass meadows, tropical hammocks, reef geology, and coral reefs. In addition to the above, we provided a strong dose of "windshield ecology" in which common birds and vegetation were identified along the way.

The financial aspects of the trip often tax one's patience. For example, students require advanced knowledge of trip costs. Price quotations can be obtained only by knowing the number of individuals in the group. This usually means that we plan our courses about nine months in advance so that numbers of students are known well in advance of the actual field classes.

Normally, we select a diverse group of field exercises for the extended field trip period (Objective 9). In a previous trip, we visited fossilized mangrove communities, seagrass meadows, sand dune vegetation, fossilized coral reefs, coral reefs, rocky shorelines, upside-down-jellyfish habitats, sandy shores, mangrove ecosystems, tropical hammocks, tide pools, and other areas as well. We had a four part observational study of fishes on coral reefs using SCUBA as an observational tool. Fish study items include: identification, locomotion methods, feeding ecology, coloration patterns, social life, and behavior. A paper covering some of the fish study items, "Friends with fins: Using fish as an educational tool", was presented by C.D. Baker at the 1986 Fall meeting of the Indiana Academy of Science.

We are constantly looking for ways to measure student's performance and their overall perception of the experience (Objective 10). We have always contended that teaching performance is best measured by the future success of one's students. From a previous crop of students, we now have three students accepted into the Bermuda Biological Station program this summer. Two have been accepted into Marine Biology programs in various universities. Another student now teaching in high school is developing a similar field course at the secondary level.

Finally, college faculty have begun to experiment with ways to motivate individuals and to influence their lifestyles in a positive way. For our course, active field classroom experiences hopefully provide a positive classroom experience leading to immediate reinforcement. We feel we nurture in students some keys to positive human development.

5. Evaluation process

We have considered carefully some of the mechanics of evaluating our success in this type of endeavor. For example, the student evaluations for our programs have all been glowing testimonials regarding the need for this type of experience. In addition, we have positively influenced students to seek additional training in this area. Some three students who completed field biology have received scholarships for this summer at the prestigious Bermuda Biological station. Other students are planning careers in field biology and ecology. It appears that experiential learning not only may have significant advantages for learning a discipline but also in learning **the practice of a discipline.** Thus, the field classes may provide a transition from the classroom to a career activity.

We recognized early on the need for monitoring of the various teaching-learning problems which we have identified earlier. Indeed some problems were identified in the pilot process. For the pretrip instruction, we use a standard evaluation form similar to one presented to standard lecture type classes at IUS. For the new instructional materials, the ultimate evaluation is the facility and ease with which the material is translated into the general vocabulary. In our case, the material has been easily digested by the students.

For the "search image" slides, we have used this instructional process for the first time this semester. All students have passed a test in which they identified the organisms. The final test is in the field where we see the organisms first hand. The use of this instructional modality has not been described adequately in the literature.

The actual field exercises is monitored according to level of participation and their usefulness as tools for conceptual development. Therefore, we carefully gage the amount of required pre-field class counseling and preparation. We have learned to restrict the times of all field trips to approximately 1/2 day periods so that ample time is available for development of field notes and appropriate summaries and feed back. In this way, evaluation is a continuing process.

As a part of our programs, students requested that a more concrete grading program be established. The grading system, described at the Indiana Academy of Science meeting mentioned above, was instituted to satisfy these requests.

In summary, we have an ongoing evaluation method which constantly improves upon an original product. One advantage we have is that students can take this course two times for credit. This has proven to be very helpful since over half of the preceding students have retaken the pilot course. This gives us needed feedback from seasoned veterans. These individuals can be used as a sounding board for potential trips, coursework and scheduling. In many cases, plans have been formulated with our veteran students acting as advisors.

6. Technologies to be utilized.

The following technologies currantly available on our campus or in the Metro area will be utilized in the project.

1. Utilization of available computer and word processor technology to organize pretrip materials into a CORE + BOXES format. This type of technology was used to organize the proposal.
2. Development of "search image" slides required the services of a graphic artist with expertise in generating educational materials.
   Several individuals in the Metro area have these skills available on a consulting basis.
3. We video taped previous field exercises and now utilize these as a data base for future pretrip materials.

7. Cost of implementation, including budget details.

The cost of the program has been planned around our general budget in Biology.

1. The University supplies some $2,500 for the rental of transportation.
2. A $450 grant was received from the improvement of learning committee for the development of search image slides.
3. Slides and videocassettes were ordered using monies set aside for library materials.
4. For the actual trip, the cost per student was calculated in the semester preceding the trip, and the fees collected by the university in the following semester.
5. Students also pay for the three hours credit during the specified time.
6. The approximate $200-500 fee for the course covers fares, lodging, planned field activities like diving and visits to parks, museums and other areas.
7. Meals are not included into the budget primarily because of individual differences encountered. The additional cost for meals can be small or large depending upon one's individual tastes and money.

The overall sample budget summarized below compares favorably with courses offered by other educational institutions.

1.	Transportation	$2,500 (Supplied by IUS)
2.	Maximum approximate cost for 15 students $500 x 15=	$7,500 (Supplied by students)
3.	Cost for "search image" slides	$450 (Supplied by improvement of Learning)
4.	Approximate cost of syllabi	$225 (Supplied by Biology)
5.	Approximate cost of underwater fish books and other required materials	$350 (Supplied by students)
6.	Other incidental items like	

field notebooks	$500 (Supplied by Biology)
7. Approximate cost of tuition	$1500 (Supplied by students)
8. Salary of Three Faculty	$1800 (Supplied by IUS)
Total Cost of Field Course	$12,775

8. Additional details.

Long ago, we recognized the value of projects of this type. "Experiential training" and observational instruction are not confined to the biological sciences. For example, art classes sometimes visit museums to observe first hand the palettes of the Masters. Language classes travel to the country where the language is spoken. In our courses, students are exposed to environments different from our Metroversity Ohio River Valley ecosystems, learn to work in groups and as individuals, have an opportunity to observe different cultures and lifestyles, and are weaned somewhat from the provincial aspects of the local environs. As mentioned above, students are amazed at the amount of biological information they can assimilate in a short period of time.

In our department, we have been taking students on field trips for about 14 years. The initial development to an actual course has involved a gradual evolution in educational style and technique commonly known as "flying by the seat of the pants". Early on, we were fortunate that qualified individuals willingly provided materials and led field trips. Later, we developed a SCUBA diving program through the Division of Continuing Studies. Then Dr. Rosalie Kramer of Indiana University East proposed an extended field biology course about three years ago. Of course, we provided strong support so that we could use the course number for our own program. More recently, one of the authors (Baker) finished a sabbatical in Florida in which he studied first hand many of the environments which we visit. Based on his sabbbatical work, he proposed and is now teaching a new Marine Biology course, the first of its king in the IU system. These courses fit well into our goals of providing innovative, challenging instruction for IUS students.

The development of this course has had positive spillover in other areas. We mentioned above two papers which we presented to the Science Education section of the Indiana Academy of Science.

These papers resulted from our desire to share some of our experiences in developing the course. In addition, we contacted several universities with existing programs to determine how their programs were designed and implemented. Our senior seminar for the past two of three years involved presentations on marine biology. In developing the seminar course, we formalized "library research strategies" used by both students and faculty. At the present time, one student in education is developing a marine biology section which he will use at the secondary level.

For a number of years, we have searched for innovative ideas for possible use in our biology program at Indiana University Southeast. One reference which has proven particularly useful is a directory of innovative ideas entitled "Directory of Teaching Innovations in Biology", published in 1981 by Studies in Higher Education in cooperation with the American Institute of Biological Sciences. Many techniques noted in this proposal have been used by other biologists in their creative endeavors. Most of these, however, are restricted to a single innovative idea used in a single course. We have found no examples of biology courses where a multi-dimension approach was taken. Moreover, we believe the use of "search images" is widely employed in many courses; however, as mentioned above, the use of materials of this type may not be adequately described in the literature.