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Teacher Education at Stone Laboratory: Program description, literature setting, and impact on educators

Ohio Sea Grant Technical Report

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Abstract:
Since the implementation of courses for educators at F. T. Stone Laboratory, there has been little beyond anecdotal study of the effects these learning experiences have had on the methods and subject matter teachers use in their classrooms. Based on the objectives of the teacher education program, the Ohio Sea Grant Education office has assembled descriptive and analytical data about teachers' responses to the one-week summer courses. The report includes a list of courses taught over several summers, a review of literature related to environmental learning in experiential modes, and two research efforts designed to identify teachers' perceptions of course outcomes and impacts.

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Teacher Education at Stone Laboratory: Program description, literature setting, and impact on educators

I. Overview

Rosanne W. Fortner

In an analysis of the outcomes of NSF-supported teacher enhancement programs, Supovitz & Turner (2000) found that teachers who have participated in the greatest amount of inservice professional development are far more likely to have both inquiry-based teaching practices and a classroom culture that encourages investigation. At the individual level, the researchers found that "teachers' content preparation also has a powerful influence on teaching practice and classroom culture" (p. 974). The factors that are critical to high quality professional development are the ability of programs to offer

- Models of inquiry forms of teaching
- both intensive development and sustained efforts
- engagement of teachers in concrete teaching tasks
- recognition and use of teachers' experiences with students
- a focus on subject matter knowledge and ways to deepen content skills
- specific ways to connect work to standards for student performance
- connections to other aspects of school change. (Supovitz & Turner, 2000, 964-5)

Most professional development programs are designed with the idea that high quality training will translate into superior teaching, and then improve student achievement. The National Science Foundation took great stock in the sequence with years of funding for State, Local and Rural Systemic Initiatives. Ohio's Statewide Systemic Initiative was able to statistically link their professional development with gains in student achievement (Kahle & Rogg, 1996). Regionally, the Ohio Sea Grant and Eisenhower programs for professional development of Cleveland area teachers also demonstrated cognitive gains among the students of participating teachers (Fortner, Corney & Mayer, 2004). Relatively few studies have reported such changes at the classroom level.

Teacher education at F. T. Stone Laboratory

Teachers have always been welcomed into graduate courses on the campus of Franz Theodore Stone Laboratory (Stone Lab) on Gibraltar Island in Lake Erie, but each summer since 1984 the Lab has focused on providing University courses specifically for educators (Table I-1). The courses may be taken for either undergraduate credit for preservice teachers, or graduate credit for practicing classroom teachers or nonformal educators. With small classes and intensive interactions with both the faculty and the learning environment, educators have an opportunity to study and learn new instructional methods and current science information. The courses have a reputation for excellence and for attention to the varied backgrounds and needs of educators. Many teachers return annually to enroll in new offerings, and the Laboratory continues to adjust scheduling and topics to meet teacher needs.

Table I-1
Timeline of the development of educators' courses at F.T. Stone Laboratory (adapted from F.T. Stone Laboratory Annual Report, 2002, J.M. Reutter, editor)

Year	Program development
1984	First courses taught for educators: Marine and Aquatic Education and Great Lakes Education Workshop. Used curriculum materials developed through Ohio Sea Grant
1993	Began offering Principles of Oceanography for Science Teachers, 1-week course
1995	First offering of Global Change Education, using materials from Ohio Sea Grant
1996	First offering of Geologic Setting of Lake Erie, week-long trip from Gibraltar to Niagara Falls, begun with support of Lake Erie Protection Fund and Ohio Sea Grant; First offering of Insect Biology for Teachers
1999	New courses: Ornithology for Teachers and Lake Erie Shipboard Research for Teachers on USEPA's 180-ft research vessel, the *Lake Guardian*
2000	Three new courses for educators, two with experimental schedules and venues: National Curricula for Water Education (2-credit course taught on three Sundays), Marine and Aquatic Education: Tropical Studies (10-day course at a marine lab in Jamaica offered jointly with SUNY, Buffalo), and Biological Oceanography for Educators (1-week on Gibraltar); Instituted Project Exploration course for proposed MNR program development.
2001	Stream Ecology for Teachers course begun (one week at Old Woman Creek); Natural History of Ohio attempted for 5-week term (cancelled: low enrollment)
2002	Great Lakes Limnology, one-week course aboard the *Lake Guardian* (teachers and grad students); new course Curriculum Development for Environmental Decision Making supported by Ohio Sea Grant Education project
2004	New courses from old: Aquatic Environmental Science for Teachers split into new course of same title, and Fisheries Science for Teachers Marine & Aquatic Education revamped to contribute to other marine courses; New 1-week courses: Alien Species Education, Local Flora for Teachers, Field Ecology

Table I-2 demonstrates the range of course offerings over several summers at Stone Lab. All focus on using the Lake Erie island setting to teach concepts and techniques for curriculum-appropriate disciplines or interdisciplinary subjects. In some cases the courses are supported by special grants [e.g., Curriculum Development for Environmental Decision Making], but in most instances the topics are offered based on the interest and availability of graduate faculty from OSU and other institutions, and the needs and interests of teacher participants. The Lab program strives to be current and relevant, responding to topical and sponsorship opportunities and to enrollment trends. The table clearly indicates expansion of course offerings over time, and reaction to levels of participant and faculty interest. Some courses are offered in alternate years, some annually, and occasionally one is attempted once and then dropped for various reasons.

Table I-2
Courses offered at F. T. Stone Laboratory for educators, 1997-2004

Title	Department	Level	Credit	1997	1998	1999	2000	2001	2002	2003	2004
Great Lakes Education Wkshop	Nat Res	T	3	X		X		X		X	
Marine & Aquatic Education	Nat Res	T	3	X				X			X
Marine & Aquatic Educ: Tropical	Nat Res	T	3				X	X			
Insect Biology for Teachers	Ent	T	3	X	X	X	X	X	X	X	X
Principles of Oceanogr for Tchers	GeoSci	T	3	X		X	X	X	X	X	X
Field Geology for Sci Teachers	GeoSci	T	3	X		X					
Geologic Setting of Lake Erie	GeoSci	T	3		X	X	X	X	X	X	X
Global Change Education	Nat Res	T	3		X		X	X		X	
Shipboard Research , USEPA	NR/EEOB	T/G	3			X			X		
Ornithology for Teachers	EEOB	T	3			X	X	X	X	X	X
National Water Educ Curricula	Nat Res	T	2				X	X			
Biological Oceanog for Educators	EEOB	T	3				X				
Natural History of Ohio	Nat Res	U,T,G	5					X			
Stream Ecology for Teachers	EEOB	T	3					X		X	X
Project Exploration Seminar	Nat Res	T	3				X	X	X		
Aquatic environment for teachers	Nat Res	T	3						X	X	X
Curric for Envir Decisionmaking	Nat Res	T	3						X		
Alien Species Education	Nat Res	T	3								X
Field Ecology	EEOB	T/G	3								X
Fisheries Science for Teachers	Nat Res	T	3								X
Local Flora for Teachers	EEOB	T	3								X

While all the courses for educators demonstrate effective teaching methods, some are more oriented toward instructional methods and some toward subject matter enhancement. Instruction in the courses tries to accommodate the needs of adult learners and the background training of the teacher participants. This means that faculty make themselves available to participants for additional assistance, and progress in the courses may be monitored by alternative assessment [projects, portfolios, applications, etc.] rather than by objective tests. Most classroom teachers are accustomed to providing precise directions to their students, and to varying the learning activities at fairly short intervals to account for attention spans. When the teachers are the learners, they expect this kind of approach as well. They find the Stone Lab instructors are interested in making their learning experience a positive one by responding to expressed needs.

Rationale for this Technical Report

Over the years the range of Stone Lab courses for educators has expanded and the number of teacher participants has increased. Evaluation of the courses has consisted primarily of a Lab-initiated assessment and the Student Evaluation of Instruction [SEI] required of courses taught by faculty of The Ohio State University. The Stone Lab assessment serves to signal student response to teaching styles and faculty interest in the subjects, and review of the forms may be used to recognize the quality of faculty. SEI forms go directly to OSU faculty and their departments and do not inform the Lab's choice of instructors.

For most purposes the existing evaluation methods for Stone Lab courses have been adequate, but the Lab's mission to enhance the quality of science education in Ohio demands that courses for educators be of the highest quality. Stone Lab expects that teacher enhancement courses not only benefit the teachers who enroll, but also result in a better education for the students of those teachers. No external funds were available for a rigorous formal assessment of the impacts of the courses, so graduate students in an Environmental Communications research course in late 2001 undertook an assessment as part of their research training. Their work is reported here.

References cited in this section:

Fortner, R.W., J.R. Corney & V.J. Mayer, in press for 2004. Student achievement as an outcome of inservice education using Standards-based infusion materials. NAAEE Monograph Series.

Kahle, J.B. & S.R. Rogg, 1996. A pocket panorama of the landscape study. Miami University, Oxford, OH.

Supovitz, J.A. & H.M. Turner, 2000. The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching* 37(9): 963-980.

II. Description of Study Sources

In the early part of the 21st Century, the School of Natural Resources at The Ohio State University enrolled students doing Master's degree coursework and non-thesis projects that led to this synthesis of research about how the teacher education courses at F.T. Stone Laboratory impact the teachers' professional goals and development. The following research components are presented in this Technical Report:

Preliminary study: Impact of Teacher Inservice Courses at Stone Lab and Elsewhere on the Instructional Practices of Participating Teachers.

This component was done as a collaborative team effort in the graduate course NAT RES 810: Case Studies and Evaluation of Environmental Communication, in autumn 2001. Dr. Rosanne Fortner, Associate Director of Stone Lab and Professor of Environmental Science Education, was the instructor for the course. Student teams elected to do research projects on either workshop student outcomes or teacher course outcomes from Stone Lab programs. Those class members studying teacher course outcomes were Lisa Bircher, Hongxia Duan, Paul Genzman, Becky Lippman, Melissa Simons and Sara White. From this group, a representative student report was adapted for inclusion in this Technical Report.

Literature Review: Evaluating Learning in an Experiential Setting in Environmental Education.

Based on the results of the class research in 2001, graduate student Lisa Bircher from Columbiana County Schools (OH) elected to expand on the teacher course study as her Master's project in the School of Natural Resources. Her review of the literature considerably expands that of the class effort and reflects the broad view of Stone Lab's efforts as a site for experiential, place-based learning.

Research on Program Impacts. Survey of In-service Teachers Who Have Taken F.T. Stone Laboratory Courses: Outcomes and Impacts

Dr. Fortner advised this research and assisted Lisa Bircher with her audience contacts, questionnaire development and data analyses. The results of the research offer insight into the unique opportunities in professional development to be achieved with teacher courses at Stone Laboratory. Suggestions made by teachers may be used by program planners to enhance future programs for educators.

III. Preliminary study: Impact of Teacher Inservice Courses at Stone Lab and Elsewhere on the Instructional Practices of Participating Teachers

Sara White, reporting graduate course research by Bircher, Duan, Genzman, Lippman, Simons and White.

Background

Franz Theodore Stone Laboratory (Stone Lab) is a research laboratory located on Gibraltar Island in the Western Basin of Lake Erie. Host to a wide range of students, Stone Lab offers great opportunities for participation in hands-on activities by utilizing equipment, recording and analyzing data, and interpreting results (Acosta, 1997). One of the student audiences targeted during the summer months is educators. Teachers from various grade levels travel to Stone Lab and take part in weeklong courses geared toward enhancing the teachers' content knowledge and teaching strategies.

Ornithology, oceanography, insect biology, stream ecology, geology of Lake Erie, Great Lakes education workshop, and global change education are examples of the courses Stone Lab hosts for educators. Offering a range of teaching styles, these courses focus on science content, teaching methodology, or a combination of both science content and teaching methodology.

Stone Lab Learning

A variety of educational terms describe the learning environment of Stone Lab. Nonformal education, experiential learning, and outdoor education overlap in their categorization of Stone Lab as a place where learning occurs with active participation of the audience. Heimlich (1993) would categorize Stone Lab as a nonformal learning setting. A nonformal classroom is one where the "learner controls the objectives but not the means" of the course. When a person chooses to participate in a given course, the learner is controlling the objectives; however, the institution offering the course is controlling the means by which those objectives will be met. Definitions of this term are compared to formal, informal, and self-directed educational settings in Table III-1.

Table III-1
Definitive characteristics of environmental learning types [Heimlich, 1993]

Type of Learning	Characteristics
Formal Learning	Institution controls objectives and means
Nonformal Learning	Learner controls objectives, but not the means
Informal Learning	Learners control the means, but not the objectives
Self-Directed Learning	Learners control both objectives and means

Nonformal education, which usually consists of workshops or seminars, contains characteristics of activities that are "learner centered, community oriented, local resources utilized, present-time focused, and equal relationship of teacher and learner" (Heimlich, 1993). As teachers choose which class they want to participate in at Stone Lab, they are choosing the objectives that they want to achieve. However, it is the faculty of Stone Lab who decide how those objectives will be met. Stone Lab must consider course supply-and-demand as Lab coordinators study where the interests of their audience, teachers, lie and then align those interests in the objectives of their offered courses.

Experiential education describes the hands-on approach to learning employed by Stone Lab. The wide definition of experiential education includes "team-building adventures in the wilderness" (Fenwick, 2000), "learning by doing" (Connors, 2001), and promoting "learning through participation, reflection, and application to situations of consequence" (Hendricks, 1994). Through the use of a variety of teaching techniques that promote active learning and reflecting, experiential learning helps to emphasize the value of authentic science, real-life science, and outside-the-classroom-science. Many of the courses offered at Stone Lab integrate lectures with hands-on labs and connect content topics with real-life situations while allowing time for the participants to reflect on how their classroom embodies these applications. Courses that focus on methodology compared to content tend to propose more questions or situations that cause the teacher participants to reflect on how the workshop fits into their continuum of teaching styles. By writing journal entries, creating portfolios, and observing weeklong learning, these science methods courses challenge the teacher participant to adapt experiential learning to their classroom.

Outdoor education is promoted easily at Stone Lab. With the beautiful real-life lab of Lake Erie, students at Stone Lab are given opportunities to interact with the outdoor environment through measuring, observing, and data collecting. As students are able to participate in outdoor education, they apply science education to their life (Boss, 1999). The "community rather than the classroom" becomes a place where learning is occurring (Boss, 1999). Knapp (1992) defines outdoor education as the utilization of nature "beyond the school to expand and enrich learning." Fostering a sense of place within the students, outdoor education surfaced as a needed alternative to the traditional classroom where students are not actively learning (Knapp, 1992). As teachers face many new obstacles in the classroom, they must find a way to meet the needs of every individual student. Outdoor education meets the needs of numerous individuals as nature becomes the focus of the lesson rather than lecture notes on nature. Students who have attention problems in the classroom can immerse themselves in the outdoors and focus on realistic situations. The student's attention problem is redirected to applying science content to reality.

The reason for teachers to take graduate coursework or inservices/workshops anywhere varies from person to person. Most school districts encourage their teachers to continue their education post-degree. With new teacher licensure in the state of Ohio, teachers graduating with undergraduate degrees have a period of time in which they need to complete a master's degree. Those graduating with a teaching license must continue their education to maintain a license status. Incentives such as pay-scale increases and tuition reimbursement factor into the decision of what type of graduate class to take. Also, the logistics of when, where, and how long may play a key role in obtaining continuing education credits. Wood (2000), a graduate school educator, asked a few teachers their reasons for taking extra graduate courses. With the increased step on the pay scale as the only motive, some teachers decided to choose the easiest route possible; others felt that they wanted another degree to mean something to them and to "make them a better teacher" (Wood, 2000). While these responses reflect a long continuum of reasons, teachers generally choose a program of graduate work or an inservice workshop that best fits their needs and objectives.

When an educator decides to participate in an inservice or graduate course, characteristics of the workshop play a role in its reputation among teachers. Reputation is part of the reason why teachers decide to spend a week of their summer taking a class at Stone Lab. Excellent reviews of Stone Lab spread among teachers and motivate teachers to become a part of the learning experience on Lake Erie. Vukelich & Wrenn (1999) developed a list of qualities, illustrated in Table III-2, which enhance teacher workshops. They emphasize that meaningful, active involvement enhances professional development greatly. Participants are not necessarily actively involved with just hands-on activities, especially if those activities do not personally relate to the participant. Stone Lab, which utilizes interdisciplinary Lake Erie information, caters to many teachers who are land-locked and do not have easy access to the lake for first hand experiences with their students. Therefore, the faculty of Stone Lab must attempt to adapt these experiences to authenticate the hands-on participation. Vukelich & Wrenn (1999) also described the ability of the professional development to help teachers network with each other to generate lessons and ideas. On a tiny island teacher participants are forced to be interactive with each other as they eat, sleep, and learn together. This generates great connections back in the classroom and lasting friendships that are renewed at the lake each summer.

Table III-2
Qualities that enhance teacher workshops (Vukelich & Wrenn, 1999)

Workshop trait	Rationale
Clear focus on a subject	-gives participants a common purpose and a single identity -balance between the institutions' and the teachers' professional development initiatives
Focus on the need of participating teachers	-relevant to actual classroom work and to students' learning achievement needs
Ongoing and sustained	-need reflection time -teachers must unlearn as much as learn -need experimentation time
Views teachers as intellectuals, engaged in the pursuit of answers to genuine questions, problems, and curiosities	-allows opportunity to reconsider their assumption about best practice -debate new ideas -struggle with the notion of how to substitute old practices with new practices
Provides for participants' meaningful engagement	-materials and ideas must meet the teacher participants' interests -engage participants' in intellectual pursuit of solutions to real-life classrooms
Develops collegial relationships	-allow teachers to network with each other -learning in group settings for active participation
Encourages reflection	-time to analyze and reflect with opportunities to absorb new information and perspectives

The success of a professional development experience weighs heavily on the ability of the teacher to implement the knowledge and methods learned into his/her classroom. Rogers (1995) has studied the ability of people to adopt new ideas, and his diffusion theory illustrates "adopter categories" and "factors that influence the rate of adoption." In general, Rogers states that those who implement theories most readily are considered to be "innovators" while those who greatly delay in the implementation process are called "laggards." Factors that contribute to the rate of adoption are socioeconomic status, personality values, and communication behavior (Rogers, 1995). Teachers employed in a wealthy school district may have the necessary tools to implement change in their classroom more quickly compared to school districts with limited budgets. In a wealthy school district, personality may be liberal and open-minded to changes in the curriculum. Also, they may instigate change more readily and actively participate in the learning process along with their students.

If a teacher wants to implement a change into the classroom, then that change must be well suited for that particular teacher, curriculum, students, and school. Teachers are eager to develop improved teaching strategies; however, they also do not want to waste their time if the teaching strategy is not going to fit the mold of the circumstances. Rogers (1995) and Zaltman and Duncan (1977) propose characteristics influencing the speed of adoption (Table III-3).

Table III-3
Factors influencing rate of adoption of an innovation

Factor	Description
Relative advantage (Rogers, 1995)	-must be superior to what it is replacing
Compatibility (Rogers, 1995)	-consistent with past experiences and values of potential innovators
Complexity (Rogers, 1995)	-aim toward less complexity -doesn't need to be difficult to understand and use
Trialability (Rogers, 1995)	-should be able to experiment with on a limited basis
Observability (Rogers, 1995)	-demonstrated to the teacher before utilized in the classroom (helps to make the teacher feel comfortable with the activity)
Impact of social relations (Zaltman & Duncan, 1977)	-positive and negative impact
Reversibility (Zaltman & Duncan, 1977)	-how easily can it be discontinued without irreconcilable impacts
Time required for implementation (Zaltman & Duncan, 1977)	-the time of class periods and preparation for teachers

Risk involved in implementation (Zaltman & Duncan, 1977)	-teachers want low risk so that reversibility is not in jeopardy
Amount of commitment required for implementation (Zaltman & Duncan, 1977)	-depends on the teacher -most teachers do not want a heavy commitment with the implementation
Capacity for successive modification (Zaltman & Duncan, 1977)	-can this information be modified to fit the needs of the teacher, students, classroom, and school

Speaking as members of the target audience for inservice, writers of this section know that teachers are basically looking for a low risk, small time commitment, easy-to-modify, positive impact on change activity that allows the teacher high comfort with the knowledge and activity. If the knowledge or activity meets a curriculum need that is already met, then the teacher most likely will not implement the new activity. However, if the knowledge meets a need, then the teacher may favor the change (Doyle & Ponder, 1978). Stone Lab faculty must observe these criteria for diffusion if their objective is to help teachers implement new teaching strategies, new knowledge, and new activities into the everyday classroom. These criteria help to build the reputation of Stone Lab educator courses and facilitate the continuance of the teacher education program.

Rationale for the research

Stone Lab provides the teacher participants with a brief chance to evaluate the course. This evaluation is presented to the teachers on the last day of the workshop and does not allow them time to implement what they have learn ed and give feedback to the faculty of their Stone Lab course. This study is intended to assist Stone Lab with enhancing its educator workshop programs.

Answers to the following research questions were sought:

1) How do teachers who have taken Stone Lab courses compare with those who have not taken Stone Lab courses, in terms of flexibility of teaching style, variety of subjects integrated, and variety of assessment strategies used?

2) Is there a correlation between certain teaching styles and participation in Stone Lab courses?

3) How do Stone Lab courses compare to other graduate courses/workshops taken by the same individual?

4) Have teacher workshops/courses influenced a teacher's teaching style?

5) Are Stone Lab or non-Stone Lab courses implemented more quickly?

6) Do teachers' goals match the choice of courses taken?

Methods
This evaluation of Stone Lab educator workshops was a group effort of graduate level students in an Environmental Education and Communication course offered by the School of Natural Resources at The Ohio State University. Over the course of about three weeks, the research team developed a survey. Each question was analyzed and evaluated concerning its connection to the research questions. Utilizing other members of the class, the survey was pilot tested for wording improvement and appropriateness for both Stone Lab and non-Stone Lab teachers. A copy of the script and interview questions is attached in the Appendix.

A partial list of teachers who had taken Stone Lab courses from 1999-2001 was provided to the team by Stone Lab. From this list, middle school teachers and high school teachers were contacted either by telephone or electronic mail. Some teachers did not respond to the emails while others declined to participate because of lack of time or burden. The teachers who accepted asked that the survey be administered by electronic mail or telephone. Also, at this time, the survey administrators asked if there would be a non-Stone Lab teacher who would be willing to participate in the survey as well. The non-Stone Lab teacher taught the same subject, grade, and in the same school as the Stone Lab teacher. The non-Stone Lab teachers were contacted either by telephone or electronic mail and were informed of the purpose of the survey.

Eleven interviews were completed. Of the eleven, seven were Stone Lab (SL) participants while four were non-Stone Lab (non-SL) participants. Each question response was analyzed by two members of the research team to avoid bias. Because of the small number of interviews, percentages are not used in the results and analysis section, and measures of significance were not applied. Only a comparison of group (SL versus non-SL) responses will be analyzed.

Results and Analysis
Participants in the survey ranged in teaching experience from 3-14 years and taught grades 4-12. The subjects taught by the interviewees were integrated science, earth systems, chemistry, physics, environmental issues, ecology, art, language arts, and health.

Course comparisons. Respondents rated the graduate courses taken at Stone Lab as slightly more valuable in methods and content compared to non-SL courses. When asked to categorize their inservice experiences, the majority of SL courses were said to be a combination of content and methods, while the non-SL courses were mostly methods. Also, the SL courses were more often recommended to other teachers. For the majority of courses, both SL and non-SL, methods and information were implemented in teachers' classrooms within 12 months; however, more people implemented SL courses than non-SL. The same ratio was present in the questions of implementation and recommendation for SL. The people who chose not to implement SL courses were also the ones who chose not to recommend the course to other teachers.

Current teaching preferences. To get an idea of typical teaching styles, the interviewees were asked to assign a percentage to the type of activities they use in the classroom in a given week or month. Some teachers gave percentages that totaled 100% while others did not. Those that did not total 100% were simplified to 100% to provide a better comparison. Once again, the number of interviews limited the ability to perform statistic tests. Participants in SL courses tended to favor hands-on activities, outdoor activities, and individual activities. An "other" category for activities was listed on the interview and SL teachers chose to provide additional teaching tactics in this column (non-SL teachers did not use the "other" column at all). SL teachers noted they also used "joint projects, portfolio assignments, exhibits," "working with living organisms," and "guided problem solving." The SL teacher that works with living organisms stated that she does this every day with her middle school students. The non-SL participating teachers favored lecture, group learning, discussion, technology activities, and projects.

When the results of this same question were evaluated based on the order of preference for each teaching style, the orders were slightly different between SL and non-SL participating teachers. For example, SL and non-SL both ranked hands-on activities as the largest part of their teaching style and group learning as the second biggest part of their teaching style. SL teachers ranked individual learning and then group discussion as their third and fourth main teaching style respectively. Non-SL teachers ranked group discussion and then lecture as their third and fourth main teaching style respectively. Both groups of teachers ranked outdoor activities as the smallest part of their teaching style. This category may be more related to location of the school rather than SL versus non-SL. Since SL teacher interviews were accompanied by non-SL interviews from the same school, these comparisons of outdoor activities could be similar because of a lack of natural areas for activities near the school itself.

Another question pertained to teaching style concerning integration of subject areas in teaching. All teachers stated that they do integrate other subjects, including social sciences (history, geography, social studies), language arts (English, literature, writing), fine arts (music, art), math, and technology. One SL teacher also added an integration of "interconnectedness of human endeavors" citing it as one of his strengths as a science teacher while another SL teacher stated that he tried to "connect science to the real world." Part of the question related to how often teachers integrate other subjects. Most teachers (SL and non-SL) stated that once a month or every quarter they usually integrate topics through projects.

Teacher learning preferences. A question was asked as to whether the teacher preferred a content course, a methods course, or a combination of content and methods. Overall, both groups of teachers (SL and non-SL) stated that they prefer to participate in a graduate course with both content and methods. As a Stone Lab teacher herself, writer White felt that courses with both content and methods are "more exciting and interesting" and the courses have a "better flow."

Another question relating to preference concerned the type of learning environment in which teachers learn best. The interviewees were given the options of indoor, outdoor, lecture, hands-on, group and individual. The majority of all teachers preferred outdoor, hands-on, and both group and individual learning. One SL teacher chose all categories stating that she "liked variety." No consistent differences between SL and non-SL surfaced from this question.

Teaching style changes. Through adoption of ideas presented at an inservice or workshop, teachers may change their teaching style. Interviewees were asked if they have changed their teaching style over time and if they attributed that change to inservice/workshop experience. All non-SL teachers said that they have changed their teaching style over time; however, that change was not credited to inservices or workshops. Most SL teachers said that they have changed their teaching style over time and that it was mostly a result of inservices and workshops. When asked how they have changed their teaching style over time most SL teachers said that they have

- decreased their dependence on lecture
- increased hands-on activities
- improved their ability to relate to individual students
- make better connections of content to activity, and
- provide more realistic applications of science for their students.

Non-SL teachers said that they have increased their integration with technology and structured their classroom to fit proficiency time frames. The two teachers (both SL) who have not changed their teaching style over time stated that inservices have given them more confidence in the classroom and have contributed to their activity repertoire.

The study asked if teachers chose graduate courses/workshops that connected to the specific goals they have for their students. The majority of teachers, both SL and non-SL, did choose courses that related to their classroom goals and objectives. Searching for "useful ideas," "more creative ways to teach," and methods of "exciting students" were reasons cited. The general goals that teachers have for their students ranged from "appreciation for science" to "proficiency objectives" and from "pass the AP exam" to "make science fun." The goals of the SL teachers tended to promote authentic science, life applications, and a strong science content background while the goals and objectives of non-SL teachers promoted general organizational skills, science lab skills, and making science interesting.

All interviewed teachers claimed that they vary their forms of assessment throughout the school year. Overall, teachers varied their forms of the traditional test or quiz, using multiple choice, essay, true/false, and fill-in; they use both verbal and written tests. Both SL and non-SL teachers use projects, journals, and technology in their assessments. In general, SL teachers varied their forms of assessment with lab practicals, while non-SL teachers vary their assessment with concept mapping, powerpoint presentations, and demonstrations.

Depending on the enthusiasm of the interviewee to participate in the survey, we also asked some optional questions. Initially, these questions were part of the survey; however, after a discussion with the pilot test group, the team discovered that they really did not connect with the outlined objectives. Of the eleven respondents, seven offered feedback on the optional questions. These questions were more personal, asking if the teacher had responsibilities outside of school that would hinder their ability to take graduate courses/workshops. A second optional question asked about support from their school district. Overall, the teachers cited lack of time and financial support as reasons for not taking graduate courses. One SL teacher participant stated that he did not take classes that related to his curriculum; he took classes at Stone Lab because it was "extremely energizing." The teachers who did not take SL class said they were at the top of their pay scale and therefore did not have any reason to take more graduate courses.

Discussion

Based on the information from the interviews, the differences between Stone Lab and non-Stone Lab participating teachers is slight. No major differences were discovered between the two groups of teachers based on their teaching style, integration of other subjects, and forms of assessment. The differences that were discovered led to more questions. For example, Stone

Lab teachers' teaching style valued individual time for their students. Perhaps Stone Lab teachers found that individual time for their students allowed the students extra moments to reflect on what they are learning giving them a better opportunity to connect context to real life applications (an objective valued by SL teachers). Also, Stone Lab teachers varied their assessment with the use of lab practicals. Some of the courses at Stone Lab utilize lab practicals as a method of assessing learning over the course of the week.

When the implementation and recommendation of Stone Lab courses was compared to other graduate courses, Stone Lab participating teachers recommended SL courses more often and tended to implement these courses quickly. In the school, teacher colleagues usually work closely and share ideas and activities with each other. When Stone Lab teachers implement activities quickly, they may also be sharing these activities with other teachers in their school. Indirectly, they are recommending the course to the other teachers. Also, recommendation of the Stone Lab courses aids in building a good reputation of Stone Lab as an excellent learning experience for educators. Stone Lab as an institution should build on this networking among teachers to enhance their educator programs. If writers of this section are typical, science teachers tend to be people who enjoy communing with nature, working on hands-on projects, relating information in group discussions, and actively participating in the learning process. Usually, the ideals of the individual teacher are reflected in his/her teaching style. This may have contributed to our findings of little difference between Stone Lab teachers and non-Stone Lab teachers.

Although the results of the research were not definitely conclusive, Stone Lab faculty may benefit from the study. Teachers stated that they usually take classes that will enable them to reach their goals and objectives better as a teacher. By understanding the goals of the individual teacher, Stone Lab faculty may be able to generate new courses or arrange current courses to better fit the objectives of the teacher participant. As stated earlier, Stone Lab classes were recommended to other teachers. This technique is one of the best ways to spread information and to extend the reputation of Stone Lab. Stone Lab faculty could "piggy-back" on this idea to increase educator enrollment.

Suggestions for Further Study

In this study, time within the academic quarter limited the number of interviews conducted. Ideally, the team was striving toward a collection of 24 surveys (12 middle school – with 6 from Stone Lab and 6 not from Stone Lab, 12 high school – with 6 from Stone Lab and 6 not from Stone Lab). We also found that contact by email was not the best route to actively pursue participants. Email was an easy way to contact the person; however, the time between emails was too long for this study. Also, by talking to the interviewee on the telephone, the interviewer was able to probe the questions and encourage the respondent to elaborate on responses.

As a team, we also agreed that another pilot study of the interview would have helped word the questions better and narrow the focus of the study. If a comparison were made between Stone Lab courses and other graduate level courses, then questions could have been directed more towards just the Stone Lab people. An entire new interview could have been conducted to only the Stone Lab people asking them to compare, in depth, the two types of courses.

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IV. Literature Review: Evaluating Environmental Learning in an Experiential Setting

Lisa S. Bircher

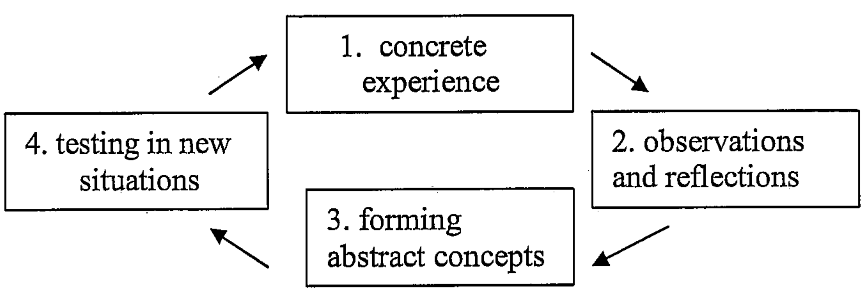
Introduction

" Tell me and I will forget; show me and I may remember; involve me and I will understand" (Association for Experiential Education, 2002)

This statement seems to encompass the concept of experiential learning very concisely. After all, what does it mean to "experience" but to be involved. Excellent educators have always known the power of involvement for students. For example, renowned science educator Edwin Lincoln Moseley (1865-1948) was constantly involving students in some form of experiential learning. He is best known for his "excursions" with students while teaching at both Sandusky High School (1889-1914) and Bowling Green College (1914-1936). Moseley stimulated students to inquire about the world and experience the natural world so they might better understand (Niederhofer and Stuckey, 1998). Another great educator F.W. Sanderson (1856-1922) was remembered by H.G. Wells (1924). Sanderson believed in reducing competition between students, and instead incorporated cooperative experiential learning for his students. He stated in his final lecture on the learning that was practiced in his Oundle School for boys: "...to replace explicit teaching by finding out...we could not have anybody who was not working." Sanderson was known not only for involving boys of the school in enterprises of science, but also in music and drama, thus demonstrating experiential education in all aspects of learning (Wells 1924). The list of great experiential educators could go on, but the purpose of this paper is to identify the outcomes and impacts that can follow experiential learning, especially in terms of environmental education.

Experiential Learning

Stated simply, experiential education is any teaching method that involves students in doing activities and then reflecting on such activities. This may include case studies, simulations, field work, and any activity that uses real life experience as its basis (Quick 1998). David A. Kolb envisioned an experiential learning cycle based on how people learn as a result of an experience:



The model shows how a person may apply the concepts gained from a particular learning experience and apply that learning to new situations, thereby completing the cycle (Smith 2001). Kolb stated that abstract conceptualization (step 3) involves using logic and ideas rather than feelings to understand problems, therefore relying on systematic planning to solve problems (Kelly 1997). For example, an educator who uses abstract conceptualization may have certain rules of thumb about how to handle situations and deal with everyday problems that may occur in the classroom (Smith 2001). Active experimentation (step 4) involves taking practical approaches to influence situations and find what really works to solve the problem (Kelly 1997). For example, a person who is taking a test in a new situation may use general patterns (s)he has seen in the past and attempt to alter responses appropriately. This often times leads to a feedback process that will allow the person to change the approach to meet the needs of the new situation (Smith 2001). The experiential learning cycle allows individuals to link past experiences to future experiences and make connections to effectively address challenges.

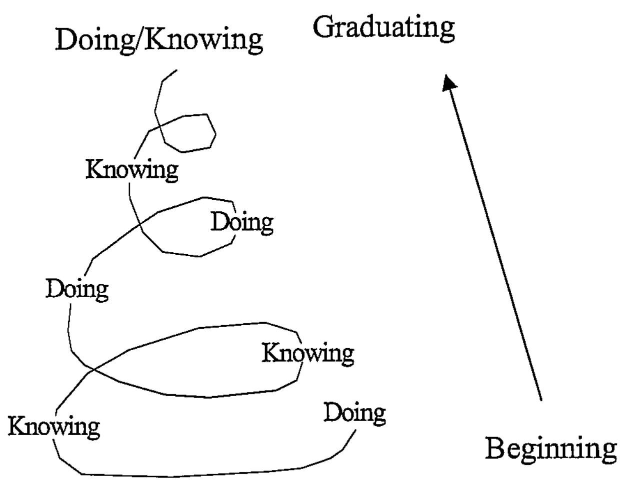
Kolb's experiential learning cycle provides a good description of learning; however, it does not provide direction on how to teach in such a manner. "Involve me and I will understand." To implement experiential learning requires a knowledge of methods conducive to such learning. Jernstedt (1995) recommended field trips, outdoor laboratories, journal writing and cooperative education experiences. Svinicki and Dixon (1994) further recommended academic readings, laboratory experiments and games, case studies and simulations (Wright 1999).

John Dewey (1859-1952) made some of the most significant contributions to experiential learning. He believed that sound education practices must engage and enlarge experience including an exploration of thinking and reflection; interaction with environments for learning was seen as critical (Smith 2001). Student involvement and action, thoughtful reflection and rigorous assessment, imagination and problem solving, and applications beyond the classroom, which includes the community, characterize the Foxfire Approach to teaching and learning (Foxfire 2002). The Foxfire Approach to Teaching and Learning corresponds with John Dewey's notion of experiential education. These approaches overlap in four categories (Starnes 1999):

1. ***Relationships among teachers, learners, curriculum and community***- the give-and-take among all those involved increases the student centered nature of the experience.
2. ***The way learning occurs***- the engagement of learners in posing and solving problems, making meaning, producing products and building understanding.
3. ***Preparing for lives as citizens/individuals***- inclusion of teamwork, creativity and innovation.
4. ***Thinking about what is learned and how***- time for learners to stand apart and reflect on the learning activities.

The overlap of the Foxfire Approach and Dewey's writings demonstrates the possibility of transforming the classroom into an experiential laboratory in which students can learn and grow (Starnes 1999). Another recommended use of experiential learning is in the use of structured experiences. This technique can address controversial topics or topics in which understanding oneself may be the foremost goal of the educator. Structured experiences may be used in any educational setting in which the learner is involved and encouraged to take ownership of the experience in that they will be able to assimilate the concepts personally. They can also be tailored to the needs of the group or the issues at hand; in this way the experience can be truly meaningful even though it will normally be conducted in a classroom environment (Thayer 1976).

Some institutions have adopted use of experiential learning across the curriculum. For example, at Alverno College in Milwaukee, Wisconsin (a liberal arts college for women), experiential learning has been integrated into the course of study and students are required to participate in a series of experiential events. The program includes four general principles and strategies that will allow students to develop as they participate in the program. The first principle is *concreteness* that relates all learning experiences to the student's own experience. Second is *involvement* of the student, which includes the kinesthetic, affective, ethical, attitudinal, and behavioral dimensions of learning. Third is *dissonance* in which students are temporarily thrown out of balance as they move towards deeper understanding. Finally, *reflection* in which students step back and ponder on their experiences in order for transformation of experience into learning. Alverno College has developed an "Integrated Performance Model" that illustrates how students should develop over time as participants in the program:



This "bedspring model" illustrates how a student will grow from beginning to graduation and will emerge understanding that learning and doing should be the same thing (Hutchings & Wutzdorff 1988).

Cross curriculum experiential learning also demands changes in the role of teachers. Several schools in which experiential learning has been implemented have required changes in time blocks. Often the teacher becomes an active participant in learning, and lessons cannot be planned around concise pre-planned time periods. For example, the University Heights Alternative School in the Bronx uses the Project Adventure experiential learning program, and this has caused the school to eliminate 45-minute class periods in favor of an all-day time block. Teachers arrange the curriculum by project rather than by separate disciplines (Stevens & Richards 1992). One educational researcher, Noel McInnis (1968), suggested that educational systems adopt "gestalt" configurations of content presentation. This is well illustrated by the University Heights Alternative School, which is moving toward a future where students are capable of understanding that solving problems will not be possible if we only consider solutions in one discipline or another. For example a solution for a problem may not come from a distinctly biological analysis or an economic analysis or sociological analysis but rather from an interrelationship of those disciplines (McInnis 1968).

A problem in experiential education experienced by many teachers is the ability to evaluate students in a context that aligns with traditional evaluations. This is difficult because many critics of experiential learning believe that learning is not complete until a student can quantify the learning experience. Therefore, new methods of evaluation must be employed to show that learning has occurred. Some criteria for evaluation in experiential learning include the following:

1. allow more than one way to do things; there is more than one correct alternative
2. require that students display an understanding of the whole, not just the parts
3. promote cooperation since is required in most tasks; limit solo performances
4. promote transference by requiring students to demonstrate adaptation of learning tools (Hendricks 1994).

Experiential Learning in Environmental Education

"The first law of environmental education: an experience is worth 10,000 pictures"
- Noel McInnis (Braus & Wood 1994)

Definitions

What is environmental education? Why are educators today so interested in environmental science? Why do our students need to learn environmental concepts? These are questions that are not easily answered. However, it may be helpful to examine definitions of environmental education as well as examine studies to understand why this area in education has grown so much since the 1970s.

Looking at the history of environmental education may be a good place to start. When Rachel Carson published *Silent Spring* in 1962, an environmental awareness was triggered. Carson's book made the public aware of the quality of the environment as well as ecological issues, which had been previously ignored. When the public is concerned about issues, a reasonable approach is that it should enter the arena of public education. The International Workshop of Environmental Education was held in the fall of 1975 in Belgrade, Yugoslavia. The United Nations Environmental Program (UNEP) and United Nations Educational, Scientific and Cultural Organization (UNESCO) sponsored the conference to establish goals for environmental education. The main goal defined was the need to educate a world population that is aware of and concerned about the environment and also to develop knowledge, skills, attitudes, motivations and commitment to work towards solving environmental problems. Two years later, in 1977 at the Tbilisi Intergovernmental Conference on Environmental Education, the objectives of environmental education were established. The main goal was to help individuals acquire a set of values, then a concern for the environment, followed by active participation in environmental protection and improvement (Mittelstaedt et al. 1999). In 1990, the U.S. Congress passed the National Environmental Education Act in an attempt to increase the public's environmental literacy by providing programs to educate youth (EPA 1994). More recently, in 1996, the U.S. Environmental Protection Agency (EPA) defined environmental education as follows:

> " Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action (Knapp and Poff 2001)".

The issue of "environmental literacy" has also emerged and guidelines have been established on what it means for a person to be literate on the environment:

- An awareness and sensitivity to the total environment
- A variety of ***experiences*** in and a basic understanding of environmental problems
- A set of environmental values and feelings of concern for the environment
- Skills for identifying, investigating and solving environmental problems (Braus & Wood 1994)

In *A Primer for Environmental Literacy (1998)*, Frank B. Golley states that his personal interest in ecological science came from his own childhood experiences in nature. He further states that experience in natural settings when combined with understanding the science can lead to profound insights. When environmental science is combined with experiential learning it increases student motivation, cooperation and retention, thus nothing can replace first-hand experience in studying environmental issues (Braus and Wood 1994). Numerous studies indicate that people can develop an awareness and appreciation for the environment by being involved in outdoor, experiential settings (including issue investigation, role playing, service learning, etc). One of the aims of environmental education is to foster learning about nature as well as developing skills, which should enable the individual to make a difference in the environment (Haluza-DeLay 1999).

Some forms of environmental education have been referred to as "nonformal." Environmental education often takes place in an outdoor setting and students are encouraged to determine their own objectives in learning; this by definition is classified as nonformal education. A successful nonformal environmental education program is one that is responsive to the learner and develops continually based on the interests and desires of the student (Heimlich 1993). The EPA has a serious commitment to educating youth and can serve many as the vehicle for nonformal education. For example, the EPA has established grants, youth programs, award programs, and internships to encourage involvement of the citizenry in environmental education activities. The commitment of the government to environmental education in an experiential format such as this demonstrates recognition of the effectiveness of this form of learning (EPA 1994).

Selected Research on Experiential Outdoor Education

Environmental education research has often focused on learner outcomes/impacts, on program methods or on experiences individuals have had. The studies described here have wide implications and may be applied across age and socioeconomic groups. These studies also illustrate that even in different environments and when used for different purposes, environmental education works, *especially* in an experiential format.

Multiple examples of effective environmental learning experiences have been suggested. For example, Louise Chawla (1999) has illustrated that the most important motivating factor for individuals who are today part of the environmental work force was experiences during childhood in natural areas.

One representative study analyzed the short-term impact of an environmental interpretive program. The research involved a class of fourth graders who participated in a field trip to a U.S.

Forest Service site near the school. One of the goals of the program was to allow students to explore the chosen site in an experiential fashion. A theme that appeared as a result of the study was that students are more likely to retain content that results from direct actions such as "catching, looking, searching, chasing, acting, etc." Several of the activities that students participated in were environmental games. This suggests that the games must be strongly embedded with environmental content if the environmental education impact is to be maximum (Knapp & Poff 2001).

Another project was conducted in which participants were observed during a 12-day wilderness adventure trip both individually and as a group. The participants were teens, ages 14 to 16. During this study the participants became more group focused (social) as the trip progressed and the natural setting depreciated in significance. The goals of the trip did **not** include a specific environmental education thrust; therefore the individuals and the group activities were not specifically focused on the natural environment. This suggests that in order for an experience in nature to be truly educational, it must be part of the program to "notice" and reflect on the natural setting so that individuals may grow cognitively as well as socially from the experience (Haluza-DeLay 1999). A similar study was conducted during a week-long "science camp" setting; however, during this study, individuals were purposefully instructed in environmental topics. The participants were youths, ages 9-12. The mission of the camp was to instill comfort, awareness, inspiration and passion as well as to develop stewardship for the planet through experiential activities. The participants were led in activities that increase appreciation of the natural world. By the end of the week, campers experienced dramatic improvement in environmental attitudes and over 50% of the campers returned for a second summer to the same program. This indicates that naturalists should foster development of educational methods in environmental experiential programs; this could result in citizens who are willing and motivated to participate in environmental activities (Mittelstaedt, et. al. 1999).

A recent regional study of note is the Great Lakes vessel-based program. It is common practice in all the Great Lakes to involve students in experiences aboard ships that encourage observation, data collection and other skills. In a review of the Great Lakes Education Program (GLEP), fourth grade student participants were pre- and post-tested to determine the effect of the program on their attitudes and knowledge of the Great Lakes. Activities including limnology, aquatic biology, weather, navigation/geography and nautical topics were presented while on-board the vessel. The results of the study indicate that all students experience significant positive impacts from involvement in the vessel-based program. Interestingly, girls in the study demonstrated a significant increase in positive attitude toward the Great Lakes. This type of experience for children, even in the early elementary grades, can significantly affect their attitudes toward a natural ecosystem, especially for those who live near the Great Lakes (Williamson & Dann, 1999).

Teachers and Experiential/ Environmental Education

Most teachers would agree that environmental education is necessary for today's students, however, they are not particularly prepared to present such topics in their classrooms. Teachers, like other learners, require certain input to experience positive growth and development. Educators of all experience levels express an interest in improving their instructional skills while also developing new styles and strategies (Panasuk & LeBaron 1999). Quality professional development must include collaboration of professionals that are working on developing curriculum that involves experimentation, solving real world problems and then reflecting on such methods (Vukelich & Wrenn 1999). Teachers as professionals tend to prefer collaboration and camaraderie in their professional development options. This may be the result of the feeling of isolation when teaching behind "closed doors" with very little interaction with other teachers (Sandholtz & Dadlez 2000). Not only is it important for teachers to be actively involved in learning, but it must also be self-initiated. This means that teachers propose the activities because they are based on personal needs and interests (Zigo 2001).

Since teachers are the most likely presenters of environmental topics to students, they require a certain amount of training in environmental education methods and processes. Ideally, inservice for teachers should include an experiential component and then the opportunity to practice these methods in the classroom (Stowitschek, et. al. 2000). Unfortunately, teachers express a certain amount of "fear" in teaching environmental topics in certain settings. For example, most teachers surveyed by Simmons (1998) agreed that a "deep woods" environment would be an appropriate location for teaching environmental topics, but this area also presented the greatest need in terms of training required as well as the greatest perceived hazards.

One study among teachers in Hong Kong was intended to demonstrate the effectiveness of experiential learning as inservice training for teachers. The learning situation was designed to give teachers an experience in discrimination that would mimic typical experiences their students may have in the schools. The experience was determined by teachers involved to be very beneficial; however, the teachers also indicated that such an exercise in their own classrooms would not be possible. The results of this study indicate that teachers cannot be expected to implement certain experiential techniques as part of their practice without receiving professional development that will equip them to generate major changes in their teaching styles. The Hong Kong study illustrates how teachers are aware of the needed changes in education but not equipped to make those changes. Therefore, if teachers are to be the initiators of change, they must be trained to understand their roles and sensitized to techniques that may be invaluable for educational reform (Harris 2001). For systemic changes to occur, teachers must be able to experience and reflect on training in order for changes to take place in the classroom (Harris 2001). Kolb's Experiential Education Cycle would support this finding as well.

One of the primary responsibilities of formal science educators is to guide students in discovery about environmental topics. Some teachers may be confident and qualified in instructing students about environmental education. Other teachers may feel ill prepared and/or lack the time to sufficiently prepare environmental lessons. Since choices for science lead most curriculum decision-making processes, teachers feel the pressure, prepared or not, to teach environmental topics. A survey was designed to evaluate the environmental education attitudes and assess policy and science teaching practices of primary teachers in the United Kingdom. Some of the conclusions resulting from the survey are

- there is a need to enhance teachers' understanding and confidence in science and environmental education
- many teachers regard environmental education as an important part of their teaching
- teachers who lack understanding of environmental issues may perpetuate inappropriate understanding of science in children

- deterring factors for teaching environmental education include limited policy development, lack of teaching support and poor resourcing (Littledyke 1997).

Such results can be used to encourage allocation of future resources in the training or inservice that teachers may receive as they begin their own environmental education process (Littledyke 1997).

Teachers agree that changes are necessary for reform in environmental education. However, one theme tends to reappear in many sources of literature, the idea that teachers are ill equipped to do environmental education. Even though there are many sources suggesting that teachers need more training to be better prepared to teach environmental topics, there are also many sources of literature that demonstrate teachers' success in environmental education. One example comes from a group of high school teachers in Canada. These teachers attempted to use a "novel approach" in their ninth grade science classes. The classes were transformed by using stories as a springboard to initiate student research and inquiry. The teachers enlisted the help of English teacher colleagues for techniques for teaching the novel, *Ring Rise, Ring Set.* The novel is an environmental story set in the future in which two groups of people and their lifestyles are compared and contrasted. The two groups included one which is technologically advanced, and another living as traditional native people. The main character in the story is caught between the two worlds. Environmental topics such as hydroponically grown plants, human-created biospheres and growth of molds were illustrated in the novel. Therefore students were stimulated to attempt experiments in which they would test hypotheses and determine whether these topics were based on sound science or science fiction. This is not only exemplary of experiential learning in environmental education, but it is also student initiated and student-centered as is suggested in Kolb's model of experiential learning. The teachers in the study were pleasantly surprised by their students' results. They found that students demonstrated depth of understanding of science concepts rather than simply memorizing facts and concepts (Drake, et. al. 1996).

Another success story comes as a result of a field trip experience. Field trips have been shown to create relevancy of the science concepts that are presented in the classroom. Research supports the notion that a science field trip can positively impact the knowledge and attitude of the participants (Mayer & Fortner, 1995). However, one problem with the field trip experience is follow-up. Teachers need to be encouraged to enhance the field trip concepts when back in the classroom with repetitive exercises. In this way, teachers will prevent the decay or interference of concepts presented that is typical of many field trip experiences. This will also stimulate the long-term retention of the concepts so that when students are asked at a later date about the trip, they will be able to recall not only the physical and social circumstances of the trip, but also the science concepts presented (Knapp 2000).

Traditional science teaching methods have included experiential and cross-curriculum work. One final example of excellent use of experiential learning combined with science teaching is in the suggested use of experience in a bioresearch course. Such a course might involve the study of an environmental toxin, using fish as subjects to study the effects of the toxin. Students would be required to do background readings and study on fish, water pollution and ecology. Reading would be followed with a field trip to an Environmental Protection Agency Laboratory. The student would then be required to write a proposal for a personal research project, carry out the research via collecting data and analyzing the results. Finally, the student would write a research report and possibly present findings to other pupils in the class as a culminating activity (Chickering 1977).

Teachers must understand that the goal of environmental education is to go beyond simply vicariously discussing the impact of human-created problems. It is important for educators to incorporate not only an environmental aspect in education but also to produce curriculum which is experiential in nature, so those students may go beyond simply learning *about* the environment. The meshing of environmental and experiential learning will enable us to produce students who are capable of actively participating in resolution of environmental problems. This could in turn lead us into a future where we are capable of changing the world through the environment (Wright 1999).

Final Remarks

The purpose of this section of the Technical Report has been to present highlights from the literature available in the field of experiential learning in environmental education. Experiential learning is the process of being actively involved in learning. The outcomes and impacts of such learning experiences have been shown to be positive and in some cases life-changing. The experiential student will be able to reflect on such experience as well as form abstract concepts and then test them in new situations. This is an active process shown to be effective for audiences as diverse as the youngest elementary students to adult learners. Environmental education has practiced experiential education methods, and since the beginning of the movement in the 1960s environmental educators have used experiential approaches. Much literature has been generated as a result.

Experience is the heart of environmental learning. Many scientists and professionals in environmental fields trace their interest in the field as having been exposed to "nature" at formative ages. Furthermore, it has been illustrated with children as well as with adults that a lesson presented in the experiential format will have lasting effects.

Teachers are often the presenters of environmental lessons, sometimes in the setting of the classroom, the field-trip, the simulation, the case study or other nonformal settings. Teachers must be prepared to present the information to their students, and therefore they need access to excellent in-service opportunities. Several approaches to environmental education have been developed in the experiential format. These ideas are revolutionary but in some ways hearken back to the day when the only way to learn was experientially. The craft guilds and apprenticeship systems of the past were strictly experiential. This system of training was the only way to learn and become the master of one's trade from medieval times up through the industrial revolution. As time went by, "experiential" training methods became less common, but the essential purpose of the "experience" has not been lost (Chickering 1977). Teachers today are trying new ways of presenting students with "experiences" that become the essence of their teaching. Teaching environmental topics through stories is exactly the kind of experience students needed to develop the ability to view problems and their solutions from more than just a single-disciplined approach. To be the most effective, field trips need to include reinforcement before, during and after the experience in order for students to "remember" the learning purpose of the event. After all, if an experience is to be effective, it must be recalled for the purpose that was intended.

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V. Survey of In-service teachers who have taken F.T. Stone Laboratory Courses: Outcomes and Impacts

Lisa Bircher and Rosanne W. Fortner

Rationale for the study

The teacher targeted courses offered at Stone Lab are often cited by the respondents in the final course surveys as being the "best course I ever had" or "I never knew this could be so interesting…" or "can hardly wait to use this in my classroom." Research indicates that teachers desire professional development with a clear focus in a subject area or teaching method as well as a focus on the teachers' needs and interests (Vukelich & Wrenn 1999). There is clearly a wide range of take-home values for the teachers who have attended the courses at Stone Lab. Furthermore, many of the teachers who have taken the courses at Stone Lab have returned year after year to take more courses. The teachers must have experienced some value in the experiences to elect to return year after year.

Some studies indicate that collegial environments which include camaraderie and support within the context of the professional development are necessary for teachers to get the most out of their experience (Sandholtz & Dadlez 2000). This is certainly true of the courses offered to teachers at Stone Lab. Other studies indicate that teachers are in need of inservice on environmental education topics and that such training will lead to better understanding and confidence in science and they will be better equipped to teach such topics (Littledyke 1997). The courses at Stone Lab are all related to some aspect of education about the environment and seem to satisfy the needs of teachers who desire more knowledge in the environmental sciences.

Since the implementation of teacher targeted courses at Stone Lab, there has been little beyond anecdotal study of the effects these experiences have had on the methods and subject matter teachers use in their classrooms. It was determined based on casual discussion with many teachers involved in the Stone Lab program that such research on the effects and outcomes of the Stone Lab professional development experience would be beneficial. It is further noted that the planners of the Stone Laboratory curriculum may use the information generated from this study. The objectives of the study were to determine teachers' perceptions of

- reasons to take courses at Stone Lab
- how teachers have benefited professionally and personally from their Stone Lab experience
- how teachers are using the information from Stone Lab in their own classrooms
- whether the Stone Lab experience has caused changes in teaching methods or information presented in the classroom
- whether there is benefit from the collegial interactions experienced with other teachers while at Stone Lab
- any areas of improvement that may be made to the courses offered in the future.

Methods

<u>Academic setting and methodology</u>

This study was a part of the requirement for a Masters of Science in Natural Resources at The Ohio State University, protocol number 02E0165 for research involving human subjects. The project was conducted from May - June, 2002. The research is ex post facto, not based on control over the events experienced at Stone Lab but rather an analysis of how teachers have used or benefited from the experience (Yin 1994). The method chosen was a mail survey, for economically reaching the audience and because of the kinds of research objectives. Preliminary research done using personal interviews (Section III of this Report) indicated the need for additional information in order to generalize to the larger population of participant teachers in Laboratory courses. A proportionally large group of respondents was necessary to describe the aspects or characteristics experienced and the outcomes of the experiences (Fraenkel and Wallen 1996).

Survey Development

The survey was developed to meet the objectives in a form that was short, entailing only 5-10 minutes of the respondents' time in order to encourage response. The questions developed were very general and allowed for different responses, as the respondent would feel appropriate. A cover letter introduced the researchers, explained the purpose of the project and encouraged response. The survey was pilot tested with two teachers who had been to Stone Lab and their input was incorporated into the final survey (Appendix 2). Respondents to the mailed survey were supplied a self-addressed stamped envelope for return. When the survey was returned, the respondent received a thank you "gift" of a flag lapel pin.

Sample

The sample of teachers to be surveyed was determined to be the group of educators, both formal and nonformal, who had taken summer courses between the years of 1999 and 2001. Most of the educators surveyed had taken more than one course at Stone Lab. The names and addresses of those 105 teachers, excluding the pilot test teachers, were obtained from Ohio State's Stone Laboratory office in Columbus. Because of the relatively small population, the researchers attempted a complete census rather than sampling within the group.

Survey Administration

The Stone Lab office supplied mailing labels and surveys were sent by mail to the potential respondents on May 3, 2002. Two surveys were returned with incorrect addresses, reducing the list to 103 possible respondents. Approximately 56 completed surveys had been received by May 29, 2002. There were 18 non-respondents with email addresses and they were contacted via email; this was followed by a phone call to the same group. By June 15, 2002, a total of 66 completed surveys had been received. The content analysis technique used was to generate a list of answer statements by survey question. Since many statements were repeated from one respondent to another, a tally of responses served as a frequency count. For those items to be answered strongly agree, agree, neutral, disagree, strongly disagree, frequencies were also recorded.

The response rate of 64% for this survey indicates that many of the respondents have a vested interest in the courses they have taken at Stone Lab. Those surveys not returned may be the result of lost materials, a lack of time or interest on the part of the respondent, or unwillingness to be surveyed (Fraenkel and Wallen 1996). Another reason for nonresponse may be that those individuals only view Stone Lab as a learning vacation experience and not an important part of their professional development. Several of the respondents made comments at the end of the survey that they were very close to retirement and do not have an interest in future professional development, therefore this may be another reason why some teachers did not respond.

Results

<u>What courses were taken?</u>
The teachers indicated the courses they attended on the survey. The most frequently attended course was Ornithology (41% of respondents). The following courses were also reported in decreasing rates of enrollment:

Geology of Lake Erie (33%)
Oceanography (32%)
Entomology (27%)
Global Climate Change (24%)
Great Lakes Education Workshop (20%).

Several other courses were mentioned as being attended by only a small number of respondents: Projects Wet, Wild, Wow Workshops (6%), EPA Research Vessel (6%) Great Lakes Limnology (3%), Stream Ecology (3%), Aquatic Biology (1%) and the Marine Ecology of a Coral Reef, Jamaica (1%).

<u>2. Why take the course?</u>
There were many reasons the respondents indicated for taking the courses. However, the most common reason indicated was personal interest in the topics (39% of respondents), followed closely by obtaining college credit (35%). Many respondents indicated that the course was used to upgrade or renew their teaching certificate (17%) or for an increase on the pay scale in their district (6%). For the latter, some added that while this was the initial reason they took the course, they continued in successive years because of personal interest in the topics taught.

Many respondents indicated that the hands-on and field experience component was very important to them and an important reason for taking the course (12%). Other reasons listed for taking courses at Stone Lab include the beautiful surroundings of the island or the fact that the area is a "great place to learn" (12%), as well as the "educational vacation" aspect (11%). Some teachers indicated that the courses were taken as preparation for teaching a new unit in the classroom or to implement information into the classroom required by state grants or to match their course of study (6%) or to increases skills in the subject area (9%). Other comments made include that the courses are research-based and high quality (3%), the courses could be taken with a friend, family member or a close colleague (8%) or simply for networking with other teachers (6%). Some teachers indicated that their advisor initially recommended the course but then they continued to take other courses later (3%).

<u>3. What value does this course have for a professional?</u>
Teachers most frequently listed their increase in knowledge and confidence as a teacher (44% of respondents). Not only did the teachers include knowledge by itself but the fact that it gave them greater confidence for teaching those topics in the classroom. Many teachers listed the ability to use materials in their classroom as the value of the course (27%) or felt it was important for a professional to learn how fieldwork is done in a hands-on fashion (9%). Some found the focus on local issues as valuable (6%), whereas others mentioned understanding the environmental impact that humans have as valuable (3%). Another value of the course professionally is the

networking with other teachers from around the state (5%). Some teachers made comments like the course "changed my assessment methods of my students" or "I am very interested in the subject as a result of having taken the course" or "enjoyed the exposure to timely information."

4. How is the material used in the classroom?

Many of the teachers surveyed indicated that unfortunately, their teaching assignment has changed. Therefore, they do not use the information learned at Stone Lab in their classroom because they are presently teaching a different subject or it is not applicable to the age level of the children they presently teach (15% of respondents). For those teachers who do still teach in areas related to subjects learned at Stone Lab, 14% find use of personal collections of insects, fossils or photos they took on field trips to be important to supplement topics taught in their classrooms. Some teachers mentioned their ability to now assign rock or insect collections to their own students as a result of the information and confidence they gained in the courses. In other field applications, teachers indicated that they use field experiences similar to those experienced at Stone Lab with their own students now (9%); some indicated specific areas like water chemistry/sampling/levels as being integrated into their classroom studies (11%).

Even if field activities are not a possibility for them, teachers confined to classrooms gain from Stone Lab courses. They have found that creating new lesson plans has been an important part of what they learned (8%). Also many teachers mentioned that they use several of the activities from the Great Lakes booklets that were used in some of the classes (9%). Some teachers mentioned specific lessons they learned at Stone Lab that are now used in their classrooms, including the following: ocean currents, entomology and evolution, zebra mussels and other non-native species, wetlands, endangered species (specifically the bald eagle and Lake Erie water snake), stream quality indexing, strip mining and minerals, dichotomous keys/classification or identification, pollutants and water quality, animal migrations, algae identification, concept maps, maple seed migration. A few notable comments made on some surveys include "I am now able to prepare an envirothon team" and "I have a lot of interesting stories to relate to students now." Some teachers have invited guest speakers to their classroom as a result of their experience or have improved the school district's (science) web site with information gathered at Stone Lab.

Table V-1

Frequency of Likert scale responses to perceived Stone Lab course values

	% of respondents*				
Value of courses at SL	SA	A	N	D	SD
I use concepts I learned at SL regularly in my classroom.	21	36	15	20	8
I feel the course(s) I have taken at SL have greatly improved my science knowledge.	52	33	6	9	0
I learned new and exciting teaching methods in the course I took at SL.	21	39	18	14	8

I have benefited positively from the collegial interactions I experienced at SL	55	33	6	5	1
My teaching practices have changed as a result of my experiences at SL.	15	29	32	15	9
The course(s) I have taken at SL have value to me beyond simple classroom application.	64	32	4	0	0
The course(s) I have taken at SL stimulated me to learn more about the environment.	47	44	6	1	0
I feel that certain courses offered at SL have more value than others.	14	30	44	5	0
Overall, the course(s) I have taken at SL are the best I have had.	36	26	24	14	0

*Note: SA=strongly agree A=agree N=neutral D=disagree SD=strongly disagree

5. Why take Stone Lab courses in the future?

The most widely reported reason for taking courses in the future would be to expand personal science knowledge and interest in the topic or to prepare to teach a new area (44% of respondents). Many respondents indicated the excellent location of Stone Lab and the fun, get-away aspect of the campus would be a good reason to continue taking Stone Lab courses (32%). Other teachers mentioned that the hands-on, field-based work that is practiced in the courses at Stone Lab would be an attractive reason for taking future courses (23%). One of the things that some respondents enjoyed about the summer courses offered is that they are completed in one week and at the same time, the short time period involved allows complete immersion in the topic. Some feel they are better able to learn in this way (9%). An important factor for some is to be able to relate what is learned in the course to the curriculum taught in their classrooms (8%). Other teachers felt that it is important for them to learn how to use field techniques to take back to their students and this is a motivating factor for taking additional courses (5%). Some teachers said they require the environmental training (including soil, air and water issues) to help teach these topics in their classrooms (5%). Several respondents indicated that the experiences they have at Stone Lab gives them credible information to use with students in the classroom (3%). A few teachers said the courses available are some of the best ways to obtain graduate credit for certificate renewal/upgrade or increase on their district's pay scale (5%). Some notable comments made by the respondents when asked why they would take future courses are as follows:

- "There are few places to get science courses if you are not a 'science' person"
- "Something for everyone"
- "The professors are experts in their area of study and I appreciate this"

6. What professional impact did the course have?

Most teachers noted that the most important impact they experienced as a result of the course was to gain knowledge, confidence and enthusiasm in the subject area (36% of respondents). Some felt as a result of the new knowledge they gained they now have more interest in certain areas (9%). Others perceived that the course imparted them greater credibility as a science teacher (8%). One of the most important topics mentioned was that the course at Stone Lab gave them an awareness of environmental issues they were previously unaware of, especially issues which affect individuals locally (9%). Some teachers benefited from the teacher networking they were able to do while at Stone Lab (8%). Certain teachers felt that the activities/resources they gathered while at Stone Lab are meaningful and expand their teaching expertise in those areas (6%). Some teachers even mentioned that as a result of attending the course at Stone Lab they have reevaluated their teaching and assessment techniques and their teaching strategies have changed (6%). Some respondents indicated that the course was part of their masters program or that it has increased their pay in the district in which they teach (5%). Certain teachers indicated an enjoyment of the more relaxed relationships with the professor or instructor who taught the course (3%). Some interesting comments made include the following:

- "The course made me realize that I really love what I teach."
- "Made me realize I would like to do some nonformal environmental education."
- "Rekindles the spark that originally lured me into teaching."

7. <u>What personal impact did the course have?</u>

The most important personal impact that the teachers experienced is the ability to meet and network with teachers from all around the state and beyond (39% of respondents). Many teachers indicated that they have developed an appreciation for the resources and environment of the Great Lakes and this has changed their personal outlook on certain topics (34%). Many teachers found the courses to be relaxing and enjoyable (14%), while others have developed more interest in biological topics now (9%). A number of respondents made unique comments about the experience as it affected them personally:

- "The most intensive learning in one week, but so much fun!"
- "I enjoy the work of 'being a scientist' personally."
- "The experience convinced me to become a science teacher and move to a different area."
- "The courses stimulated me to pursue my Ph.D. studies with a focus on the Great Lakes"
- "I met my fiancé at Stone Lab!"
- "I feel I have discovered a secret aspect of OSU."
- "The course was a 'once in a lifetime' experience."
- "I appreciate the respect the staff has for teachers."
- "The courses was the most satisfying and fun professional development experience I've had in 26 years of teaching"

8. <u>Suggestions for improvement</u>

Most comments made on the surveys were very positive and numerous individuals indicated that there is no reason to change anything at Stone Lab. However, the most common suggestions included adding more and different courses. Some course suggestions include the following:

- Topics such as Hazardous wastes/Superfund site education, butterflies, weather, herpetology, soil/water chemistry topics, botany, SCUBA underwater zoology,
- Follow-up [implying next level] to courses such as entomology and oceanography

- Integrated courses of science with literature/art/music/history (Some respondents indicated that inviting new professors to teach some of these courses may be necessary).
- More courses "off-campus" like the Jamaica "Coral Reef" or "Stream Ecology" at Old Woman Creek courses.
- Increase the number of day or weekend only courses.
- Increase the science/problem-based courses, reduce lesson-planning aspects.
- Provide more handouts on how certain demonstrations are planned and/or executed or allow teachers to do these demonstrations themselves. Also, offer labs and activities that can be done in the classroom with few supplies.
- Publish or make information on upcoming courses available earlier.
- In some cases, do less lecturing during the class and more application of concepts for use in the classroom.

Some other suggestions made include the issue of providing air conditioning in the dorms or classrooms to increase the comfort of the participants. Some respondents felt they would be willing to pay extra for a private room.

Finally, one concern mentioned by several respondents was the cost of attending Stone Lab. They mentioned the possibility of making more scholarships available to teachers, especially elementary teachers who can really benefit from the field experiences available at Stone Lab. Some other respondents indicated that it would be nice to have a discounted rate if you are only taking the course for personal interest and you do not require it for college credit.

9. <u>Additional Comments</u>

Many respondents added comments at the end of the survey, including positive notes like "thanks for the experience!" or "I had a great time." Some of the respondents reiterated the idea that they feel that more scholarships or funding should be made available to teachers, several even mentioned that perhaps a lottery or stipend be made available to teachers to help defray the cost of attending Stone Lab. One respondent mentioned the "Friends of Stone Lab" organization and the ability to be able to give back to Stone Lab by financial contributions to the organization.

Some comments were made regarding information to be given to first time attendees of Stone Lab. There is a need to make clear to them the intensity of the experience and amount of work involved in a condensed one-week course accompanied with the many field experiences. Some said that it could be a little overwhelming to experience so much with the heat, close living quarters and expectations of the course. Some teachers were concerned with the idea that the courses are to be primarily teacher courses and not just general field courses. Others indicated that they go to Stone Lab to experience and learn science and they do not want watered down content but a very intensive learning experience.

Many comments were made about the instructors and professors. Some respondents remarked about the quality of some instructors. One respondent said that certain instructors "make the program as good as it is;" comments were made that some instructors are "excellent, very knowledgeable and helpful." Many respondents remarked that the excellence of the overall experience caused them to recommend Stone Lab to others and to plan on taking more courses in the future.

Regarding public relations of Stone Lab, some respondents indicated a concern for the information to be available first-hand to teachers. It seems that in some cases, teachers were not notified directly but information was lost in the administrative offices of some schools. Stone Lab needs to be marketed to the individual teachers and not the school systems in general. One final comment of interest made by a respondent is the idea that there should be a component in which teachers would be able to regroup at some time during the school year to share ideas on how the information has been applied to their classrooms. Perhaps this component could be done via videoconferencing or in advance of the Winter Lecture to reduce the need to travel back to Stone Lab. This type of event may also allow teachers to recommend new areas of study or possible courses to the planners of Stone Lab.

Discussion

Interpretation of Findings

These research findings indicate that the main reason most respondents have taken courses at Stone Lab is to increase their knowledge in the different areas of science. Many respondents felt that one of the keys to the success of the Stone Lab program is that they are learning science first-hand, in a field-based setting. Previous research indicating that teachers desire camaraderie and collegial interactions in their professional development experience (Sandholtz and Dadlez 2000) has been supported. Many respondents indicated a satisfaction with the experiential aspect of Stone Lab and with course methods of putting teachers in the position of scientist and researcher. This supports the findings of Stowitschek, et al., 2000.

For many teachers who have taken courses at Stone Lab there is indeed a wide range of take-home values. Teachers listed numerous activities they have used in their classrooms as a result of the professional development experience. The experience has broadened many of the respondents' horizons and has even led them to areas where they may have previously had marginal interest. It is true that teachers need to continuously add to their repertoire of lessons and knowledge. There seems to be a definite trend that the respondents feel that more knowledge equals greater confidence and greater confidence imparts greater enthusiasm; it appears that Stone Lab delivers the entire sequence. Other studies indicate teachers realize that in order to do environmental education, they require tools and knowledge (Littledyke 1997). The courses available to teachers at Stone Lab appear to meet the need for training in environmental education. Like their range of reasons for participation, there is a range of desired content from rigorous science to ready-to-use classroom materials.

When the respondents were asked if their teaching methods have changed as a result of the concepts and techniques learned at Stone Lab there did not appear to be a definite trend. While some individual respondents were adamant that they have completely overhauled their teaching and assessment techniques as a result of the experience, others indicated very little has changed in their teaching strategies. Perhaps this is related to changes in teaching assignments. It may also be that educators are not truly aware of what has caused an evolution of their teaching style and cannot pinpoint one specific experience that has made a difference.

Teacher networking appears to be one of the most important benefits of attending Stone Lab. In short answer questions, respondents repeated the benefits of teacher networking. Some respondents insisted that the relationships forged at Stone Lab might even continue years beyond the initial experience. The teachers in the collegial relationships they develop are able to grow and develop as well as trade or create new lessons as part of their experience. This is always a very important benefit of the most excellent professional development activities, especially when so many teachers in their daily teaching schedule feel as though they are working "behind closed doors." Teachers who participate in excellent professional development are able to work collaboratively and engage in a constant dialogue with one another to develop curriculum, experiment and solve real problems (Vukelich and Wrenn 1999). Stone Lab is a unique setting in which teachers have the time and are encouraged to work together to develop new lessons, experiment, solve problems and reflect on pedagogy. This is indeed the reason why so many teachers surveyed enjoy and thus benefit from collegial interactions.

Finally, teachers surveyed in this study seem to have many ideas for the future of Stone Lab, including additional courses and improvements in the physical aspects of Stone Lab living. However, the most widely cited issue that limits the appeal of Stone Lab to some is the financial issue. Family expenses, duplication of housing, loss of income from summer jobs foregone, and simply the rising tuition and housing costs are difficult obstacles for prospective participants. Some respondents suggest the development of additional scholarships for teachers in order to facilitate their attendance.

Suggestions for use of findings

The planners of Stone Lab summer programs will most likely benefit from the results of this study. The respondents made some valuable comments indicating how they feel about the courses available in the summer at Stone Lab. Most teachers made comments for improvement that include addition of different types of courses, improvement of the facilities as well as finding a means for teacher discussions to continue later after the course has been completed. It would be worthwhile for the planners of Stone Lab to take into consideration the desire teachers have to continue dialogue as a group and create possible additional class meetings via videoconferencing or interactive distance learning modules.

One major aspect of Stone Lab that seems to be important to teachers is the increased availability of scholarships, stipends or lotteries for additional financial support. Perhaps in working with the "Friends of Stone Lab" it would be possible to establish new scholarships to help teachers in financially need or teachers in need of the field experiences with the monetary burden of attending Stone Lab.

Suggestions for enhanced research

Some possible sources of enhanced research may be to interview teachers to gather data that was not readily apparent on a written survey. In an interview, the researcher may encourage the respondents to elaborate on experiences or activities used in the classroom. Perhaps responses could be solicited from teachers that attended Stone Lab as far back as the early 1990s to find out more about the long-term effects of the courses. Another possible dimension that could be added to this research would be to use a control teacher group and a Stone Lab teacher group and compare the results of their experiences in their professional development, i.e. expand the study begun in Section II of this report. Finally, it would be a good idea to continue to solicit response from teachers, perhaps with a suggestion box at the Lab or a Comment Corner on the internet site.

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Appendix 1.

Teacher Interview Script and Questions from III: Preliminary Study (White, et al)

For teachers from Stone Lab:
I am a student in Dr. Rosanne Fortner's Environmental Education and Communication course offered at Ohio State University. Our class is doing a group study on teachers' evaluation of courses/workshops that they have taken. You are being called because you have taken courses for teachers at Stone Lab, but our brief survey relates to all kinds of inservice courses you have taken at OSU and elsewhere.

Would you be willing to take a few minutes to answer some questions? Our survey will take about 15 minutes and your responses will be held anonymous in any report development.

If this is not a good time for you to talk, may I call you back when it is more convenient? When would be a good time for you?

For teachers not from Stone Lab:
I am a student in Dr. Rosanne Fortner's Environmental Education and Communication course offered at Ohio State University. Our class is doing a group study on teachers' evaluation of courses/workshops that they have taken. You are being called because you have taken inservice courses at OSU and elsewhere.

Would you be willing to take a few minutes to answer some questions? Our survey will take about 15 minutes and your responses will be held anonymous in any report development.

If this is not a good time for you to talk, may I call you back when it is more convenient? When would be a good time for you?

Interview Questions

Teacher name ______________________________ Interviewer ____________________
Date ________________ Time ________________

How many years have you been teaching? _____
What subject(s) and grade(s) do you teach?
Subject(s) ______________________
Grade(s) ______________________

Think about the graduate courses/workshops in your teaching area that you have taken. What were your 2 or 3 most valuable inservices and your 2 or 3 least valuable?

Where did you take these courses?

Rate the value of these courses/workshops to your teaching methods and then to the content as the course/workshop pertains to your classroom.

1 = no value
2 = some value
3 = valuable
4 = very valuable
5 = exceptional value

Course Title	Location	Rating - Teaching Method	Rating - Content	Implementation	Recommendation	Content Method Both

4. In a typical week or month, what % of classroom time do you spend on…

_____ hands-on activities
_____ lecture
_____ group learning
_____ discussion
_____ outdoor activities
_____ technology learning/activities
_____ individual work
_____ projects
_____ other: ______________________________

5. If you had a choice, would you prefer a methods course/workshop or a content course/workshop or a combination of both?

Methods _____ Content_____ Both _____

What do you enjoy about that type of course?

6. Have you changed your teaching style over time? Y N

If so, how do you feel your teaching style has changed over time?

To what extent have the changes been a result of your inservice experience?

7. What are some general goals/objectives that you have for your students? (some content goals and non-content goals)

Do these goals have an influence on your choice of which workshops/courses to take?

Y N Why or why not?

8. What type of classroom setting and teaching style do *you* prefer to learn in?

Indoor	Outdoor
Lecture	Hands-on
Individual	Group

9.What other subjects do you integrate into your classroom? (History, Literature, Music, Art)
How often?

10. Do you vary your forms of assessment? (either throughout the school year or over the course of your years of teaching experience) Y N

If so, how and how often?

OPTIONAL Questions:
Describe the support given from your school district for continuing educational opportunities.

Do you have responsibilities that keep you from pursuing graduate courses or workshops? Y N
Explain… (?)

Thanks very much for participating in our survey!

Appendix 2.
Stone Lab Teacher Survey (Section V, Bircher)

Name____________________________________ Date____________________

Background:

1. When did you attend Stone Lab (SL)? Summer ______
2. What course(s) have you taken at SL?
3. Why did you take this course(s) at SL?
4. What value did this course(s) have for you as a professional teacher?
5. Give an example of how you have used information you gathered at SL in your classroom.

Survey:

For each statement, please indicate your level of agreement by circling the letters according to the following scale:

SA= Strongly Agree A= Agree N= Neutral D= Disagree SD=Strongly Disagree

6. I use the concepts I learned at SL regularly in my classroom.	SA	A	N	D	SD
7. I feel the course(s) I have taken at SL have greatly improved my science knowledge.	SA	A	N	D	SD
8. I learned new and exciting teaching methods in the course(s) I took at SL.	SA	A	N	D	SD
9. I have benefited positively from the collegial interactions I experienced at SL.	SA	A	N	D	SD
10. My teaching practices have changed as a result of my experiences at SL.	SA	A	N	D	SD
11. The course(s) I have taken at SL have value to me beyond simple classroom application.	SA	A	N	D	SD
12. The course(s) I have taken at SL stimulated me to learn more about the environment.	SA	A	N	D	SD
13. I feel that certain courses offered at Stone Lab have more value than others.	SA	A	N	D	SD
14. Overall, the course(s) I have taken at SL are the best I have had.	SA	A	N	D	SD

Finally:

15. What reasons would you list for taking future courses at SL?

16. How have the course(s) you have taken at SL impacted you professionally?

17. How have the course(s) you taken at SL impacted you personally?

18. What would you like to suggest as improvement for teacher courses offered at SL in the future?

19. Any additional comments:

Thank you for your cooperation with this survey!

Teacher Education at Stone Laboratory: Program description, literature setting, and impact on educators

Ohio Sea Grant Technical Report

Rosanne W. Fortner[1], Lisa M. Bircher[2], Sara White[3], Hongxia Duan, Paul Genzman, Becky Lippman, and Melissa Simons

Abstract:
Since the implementation of courses for educators at F. T. Stone Laboratory, there has been little beyond anecdotal study of the effects these learning experiences have had on the methods and subject matter teachers use in their classrooms. Based on the objectives of the teacher education program, the Ohio Sea Grant Education office has assembled descriptive and analytical data about teachers' responses to the one-week summer courses. The report includes a list of courses taught over several summers, a review of literature related to environmental learning in experiential modes, and two research efforts designed to identify teachers' perceptions of course outcomes and impacts.

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[1] Professor, OSU School of Natural Resources and Associate Director, F.T. Stone Laboratory; instructor of NR 810 course where ideas and research format originated for the report.

[2] Biology teacher, Columbiana County, OH. Lisa pursued course ideas for projects in completion of her MS in Natural Resources, 2002.

[3] Biological and Earth Systems Science teacher, Worthington, OH. Sara's class report for NR 810: Case Studies and Evaluation of Environmental Communication, was selected as a comprehensive review of the preliminary research in 2001. The remaining authors constituted a research team working with Sara on the study.

Teacher Education at Stone Laboratory: Program description, literature setting, and impact on educators

I. Overview

Rosanne W. Fortner

In an analysis of the outcomes of NSF-supported teacher enhancement programs, Supovitz & Turner (2000) found that teachers who have participated in the greatest amount of inservice professional development are far more likely to have both inquiry-based teaching practices and a classroom culture that encourages investigation. At the individual level, the researchers found that "teachers' content preparation also has a powerful influence on teaching practice and classroom culture" (p. 974). The factors that are critical to high quality professional development are the ability of programs to offer

- Models of inquiry forms of teaching
- both intensive development and sustained efforts
- engagement of teachers in concrete teaching tasks
- recognition and use of teachers' experiences with students
- a focus on subject matter knowledge and ways to deepen content skills
- specific ways to connect work to standards for student performance
- connections to other aspects of school change. (Supovitz & Turner, 2000, 964-5)

Most professional development programs are designed with the idea that high quality training will translate into superior teaching, and then improve student achievement. The National Science Foundation took great stock in the sequence with years of funding for State, Local and Rural Systemic Initiatives. Ohio's Statewide Systemic Initiative was able to statistically link their professional development with gains in student achievement (Kahle & Rogg, 1996). Regionally, the Ohio Sea Grant and Eisenhower programs for professional development of Cleveland area teachers also demonstrated cognitive gains among the students of participating teachers (Fortner, Corney & Mayer, 2004). Relatively few studies have reported such changes at the classroom level.

Teacher education at F. T. Stone Laboratory

Teachers have always been welcomed into graduate courses on the campus of Franz Theodore Stone Laboratory (Stone Lab) on Gibraltar Island in Lake Erie, but each summer since 1984 the Lab has focused on providing University courses specifically for educators (Table I-1). The courses may be taken for either undergraduate credit for preservice teachers, or graduate credit for practicing classroom teachers or nonformal educators. With small classes and intensive interactions with both the faculty and the learning environment, educators have an opportunity to study and learn new instructional methods and current science information. The courses have a reputation for excellence and for attention to the varied backgrounds and needs of educators. Many teachers return annually to enroll in new offerings, and the Laboratory continues to adjust scheduling and topics to meet teacher needs.

Table I-1
Timeline of the development of educators' courses at F.T. Stone Laboratory (adapted from F.T. Stone Laboratory Annual Report, 2002, J.M. Reutter, editor)

Year	Program development
1984	First courses taught for educators: Marine and Aquatic Education and Great Lakes Education Workshop. Used curriculum materials developed through Ohio Sea Grant
1993	Began offering Principles of Oceanography for Science Teachers, 1-week course
1995	First offering of Global Change Education, using materials from Ohio Sea Grant
1996	First offering of Geologic Setting of Lake Erie, week-long trip from Gibraltar to Niagara Falls, begun with support of Lake Erie Protection Fund and Ohio Sea Grant; First offering of Insect Biology for Teachers
1999	New courses: Ornithology for Teachers and Lake Erie Shipboard Research for Teachers on USEPA's 180-ft research vessel, the *Lake Guardian*
2000	Three new courses for educators, two with experimental schedules and venues: National Curricula for Water Education (2-credit course taught on three Sundays), Marine and Aquatic Education: Tropical Studies (10-day course at a marine lab in Jamaica offered jointly with SUNY, Buffalo), and Biological Oceanography for Educators (1-week on Gibraltar); Instituted Project Exploration course for proposed MNR program development.
2001	Stream Ecology for Teachers course begun (one week at Old Woman Creek); Natural History of Ohio attempted for 5-week term (cancelled: low enrollment)
2002	Great Lakes Limnology, one-week course aboard the *Lake Guardian* (teachers and grad students); new course Curriculum Development for Environmental Decision Making supported by Ohio Sea Grant Education project
2004	New courses from old: Aquatic Environmental Science for Teachers split into new course of same title, and Fisheries Science for Teachers Marine & Aquatic Education revamped to contribute to other marine courses; New 1-week courses: Alien Species Education, Local Flora for Teachers, Field Ecology

Table I-2 demonstrates the range of course offerings over several summers at Stone Lab. All focus on using the Lake Erie island setting to teach concepts and techniques for curriculum-appropriate disciplines or interdisciplinary subjects. In some cases the courses are supported by special grants [e.g., Curriculum Development for Environmental Decision Making], but in most instances the topics are offered based on the interest and availability of graduate faculty from OSU and other institutions, and the needs and interests of teacher participants. The Lab program strives to be current and relevant, responding to topical and sponsorship opportunities and to enrollment trends. The table clearly indicates expansion of course offerings over time, and reaction to levels of participant and faculty interest. Some courses are offered in alternate years, some annually, and occasionally one is attempted once and then dropped for various reasons.

Table I-2
Courses offered at F. T. Stone Laboratory for educators, 1997-2004

Title	Department	Level	Credit	1997	1998	1999	2000	2001	2002	2003	2004
Great Lakes Education Wkshop	Nat Res	T	3	X		X		X		X	
Marine & Aquatic Education	Nat Res	T	3	X				X			X
Marine & Aquatic Educ: Tropical	Nat Res	T	3				X	X			
Insect Biology for Teachers	Ent	T	3	X	X	X	X	X	X	X	X
Principles of Oceanogr for Tchers	GeoSci	T	3	X		X	X	X	X	X	X
Field Geology for Sci Teachers	GeoSci	T	3	X		X					
Geologic Setting of Lake Erie	GeoSci	T	3		X	X	X	X	X	X	X
Global Change Education	Nat Res	T	3		X		X	X		X	
Shipboard Research , USEPA	NR/EEOB	T/G	3			X			X		
Ornithology for Teachers	EEOB	T	3			X	X	X	X	X	X
National Water Educ Curricula	Nat Res	T	2				X	X			
Biological Oceanog for Educators	EEOB	T	3				X				
Natural History of Ohio	Nat Res	U,T,G	5					X			
Stream Ecology for Teachers	EEOB	T	3					X		X	X
Project Exploration Seminar	Nat Res	T	3				X	X	X		
Aquatic environment for teachers	Nat Res	T	3						X	X	X
Curric for Envir Decisionmaking	Nat Res	T	3						X		
Alien Species Education	Nat Res	T	3								X
Field Ecology	EEOB	T/G	3								X
Fisheries Science for Teachers	Nat Res	T	3								X
Local Flora for Teachers	EEOB	T	3								X

While all the courses for educators demonstrate effective teaching methods, some are more oriented toward instructional methods and some toward subject matter enhancement. Instruction in the courses tries to accommodate the needs of adult learners and the background training of the teacher participants. This means that faculty make themselves available to participants for additional assistance, and progress in the courses may be monitored by alternative assessment [projects, portfolios, applications, etc.] rather than by objective tests. Most classroom teachers are accustomed to providing precise directions to their students, and to varying the learning activities at fairly short intervals to account for attention spans. When the teachers are the learners, they expect this kind of approach as well. They find the Stone Lab instructors are interested in making their learning experience a positive one by responding to expressed needs.

Rationale for this Technical Report

Over the years the range of Stone Lab courses for educators has expanded and the number of teacher participants has increased. Evaluation of the courses has consisted primarily of a Lab-initiated assessment and the Student Evaluation of Instruction [SEI] required of courses taught by faculty of The Ohio State University. The Stone Lab assessment serves to signal student response to teaching styles and faculty interest in the subjects, and review of the forms may be used to recognize the quality of faculty. SEI forms go directly to OSU faculty and their departments and do not inform the Lab's choice of instructors.

For most purposes the existing evaluation methods for Stone Lab courses have been adequate, but the Lab's mission to enhance the quality of science education in Ohio demands that courses for educators be of the highest quality. Stone Lab expects that teacher enhancement courses not only benefit the teachers who enroll, but also result in a better education for the students of those teachers. No external funds were available for a rigorous formal assessment of the impacts of the courses, so graduate students in an Environmental Communications research course in late 2001 undertook an assessment as part of their research training. Their work is reported here.

References cited in this section:

Fortner, R.W., J.R. Corney & V.J. Mayer, in press for 2004. Student achievement as an outcome of inservice education using Standards-based infusion materials. NAAEE Monograph Series.

Kahle, J.B. & S.R. Rogg, 1996. A pocket panorama of the landscape study. Miami University, Oxford, OH.

Supovitz, J.A. & H.M. Turner, 2000. The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching* 37(9): 963-980.

II. Description of Study Sources

In the early part of the 21st Century, the School of Natural Resources at The Ohio State University enrolled students doing Master's degree coursework and non-thesis projects that led to this synthesis of research about how the teacher education courses at F.T. Stone Laboratory impact the teachers' professional goals and development. The following research components are presented in this Technical Report:

<u>Preliminary study: Impact of Teacher Inservice Courses at Stone Lab and Elsewhere on the Instructional Practices of Participating Teachers</u>.

This component was done as a collaborative team effort in the graduate course NAT RES 810: Case Studies and Evaluation of Environmental Communication, in autumn 2001. Dr. Rosanne Fortner, Associate Director of Stone Lab and Professor of Environmental Science Education, was the instructor for the course. Student teams elected to do research projects on either workshop student outcomes or teacher course outcomes from Stone Lab programs. Those class members studying teacher course outcomes were Lisa Bircher, Hongxia Duan, Paul Genzman, Becky Lippman, Melissa Simons and Sara White. From this group, a representative student report was adapted for inclusion in this Technical Report.

<u>Literature Review: Evaluating Learning in an Experiential Setting in Environmental Education.</u>

Based on the results of the class research in 2001, graduate student Lisa Bircher from Columbiana County Schools (OH) elected to expand on the teacher course study as her Master's project in the School of Natural Resources. Her review of the literature considerably expands that of the class effort and reflects the broad view of Stone Lab's efforts as a site for experiential, place-based learning.

<u>Research on Program Impacts. Survey of In-service Teachers Who Have Taken F.T. Stone Laboratory Courses: Outcomes and Impacts</u>

Dr. Fortner advised this research and assisted Lisa Bircher with her audience contacts, questionnaire development and data analyses. The results of the research offer insight into the unique opportunities in professional development to be achieved with teacher courses at Stone Laboratory. Suggestions made by teachers may be used by program planners to enhance future programs for educators.

III. Preliminary study: Impact of Teacher Inservice Courses at Stone Lab and Elsewhere on the Instructional Practices of Participating Teachers

Sara White, reporting graduate course research by Bircher, Duan, Genzman, Lippman, Simons and White.

Background

Franz Theodore Stone Laboratory (Stone Lab) is a research laboratory located on Gibraltar Island in the Western Basin of Lake Erie. Host to a wide range of students, Stone Lab offers great opportunities for participation in hands-on activities by utilizing equipment, recording and analyzing data, and interpreting results (Acosta, 1997). One of the student audiences targeted during the summer months is educators. Teachers from various grade levels travel to Stone Lab and take part in weeklong courses geared toward enhancing the teachers' content knowledge and teaching strategies.

Ornithology, oceanography, insect biology, stream ecology, geology of Lake Erie, Great Lakes education workshop, and global change education are examples of the courses Stone Lab hosts for educators. Offering a range of teaching styles, these courses focus on science content, teaching methodology, or a combination of both science content and teaching methodology.

Stone Lab Learning

A variety of educational terms describe the learning environment of Stone Lab. Nonformal education, experiential learning, and outdoor education overlap in their categorization of Stone Lab as a place where learning occurs with active participation of the audience. Heimlich (1993) would categorize Stone Lab as a nonformal learning setting. A nonformal classroom is one where the "learner controls the objectives but not the means" of the course. When a person chooses to participate in a given course, the learner is controlling the objectives; however, the institution offering the course is controlling the means by which those objectives will be met. Definitions of this term are compared to formal, informal, and self-directed educational settings in Table III-1.

Table III-1
Definitive characteristics of environmental learning types [Heimlich, 1993]

Type of Learning	Characteristics
Formal Learning	Institution controls objectives and means
Nonformal Learning	Learner controls objectives, but not the means
Informal Learning	Learners control the means, but not the objectives
Self-Directed Learning	Learners control both objectives and means

Nonformal education, which usually consists of workshops or seminars, contains characteristics of activities that are "learner centered, community oriented, local resources utilized, present-time focused, and equal relationship of teacher and learner" (Heimlich, 1993). As teachers choose which class they want to participate in at Stone Lab, they are choosing the objectives that they want to achieve. However, it is the faculty of Stone Lab who decide how those objectives will be met. Stone Lab must consider course supply-and-demand as Lab coordinators study where the interests of their audience, teachers, lie and then align those interests in the objectives of their offered courses.

Experiential education describes the hands-on approach to learning employed by Stone Lab. The wide definition of experiential education includes "team-building adventures in the wilderness" (Fenwick, 2000), "learning by doing" (Connors, 2001), and promoting "learning through participation, reflection, and application to situations of consequence" (Hendricks, 1994). Through the use of a variety of teaching techniques that promote active learning and reflecting, experiential learning helps to emphasize the value of authentic science, real-life science, and outside-the-classroom-science. Many of the courses offered at Stone Lab integrate lectures with hands-on labs and connect content topics with real-life situations while allowing time for the participants to reflect on how their classroom embodies these applications. Courses that focus on methodology compared to content tend to propose more questions or situations that cause the teacher participants to reflect on how the workshop fits into their continuum of teaching styles. By writing journal entries, creating portfolios, and observing weeklong learning, these science methods courses challenge the teacher participant to adapt experiential learning to their classroom.

Outdoor education is promoted easily at Stone Lab. With the beautiful real-life lab of Lake Erie, students at Stone Lab are given opportunities to interact with the outdoor environment through measuring, observing, and data collecting. As students are able to participate in outdoor education, they apply science education to their life (Boss, 1999). The "community rather than the classroom" becomes a place where learning is occurring (Boss, 1999). Knapp (1992) defines outdoor education as the utilization of nature "beyond the school to expand and enrich learning." Fostering a sense of place within the students, outdoor education surfaced as a needed alternative to the traditional classroom where students are not actively learning (Knapp, 1992). As teachers face many new obstacles in the classroom, they must find a way to meet the needs of every individual student. Outdoor education meets the needs of numerous individuals as nature becomes the focus of the lesson rather than lecture notes on nature. Students who have attention problems in the classroom can immerse themselves in the outdoors and focus on realistic situations. The student's attention problem is redirected to applying science content to reality.

The reason for teachers to take graduate coursework or inservices/workshops anywhere varies from person to person. Most school districts encourage their teachers to continue their education post-degree. With new teacher licensure in the state of Ohio, teachers graduating with undergraduate degrees have a period of time in which they need to complete a master's degree. Those graduating with a teaching license must continue their education to maintain a license status. Incentives such as pay-scale increases and tuition reimbursement factor into the decision of what type of graduate class to take. Also, the logistics of when, where, and how long may play a key role in obtaining continuing education credits. Wood (2000), a graduate school educator, asked a few teachers their reasons for taking extra graduate courses. With the increased step on the pay scale as the only motive, some teachers decided to choose the easiest route possible; others felt that they wanted another degree to mean something to them and to "make them a better teacher" (Wood, 2000). While these responses reflect a long continuum of reasons, teachers generally choose a program of graduate work or an inservice workshop that best fits their needs and objectives.

When an educator decides to participate in an inservice or graduate course, characteristics of the workshop play a role in its reputation among teachers. Reputation is part of the reason why teachers decide to spend a week of their summer taking a class at Stone Lab. Excellent reviews of Stone Lab spread among teachers and motivate teachers to become a part of the learning experience on Lake Erie. Vukelich & Wrenn (1999) developed a list of qualities, illustrated in Table III-2, which enhance teacher workshops. They emphasize that meaningful, active involvement enhances professional development greatly. Participants are not necessarily actively involved with just hands-on activities, especially if those activities do not personally relate to the participant. Stone Lab, which utilizes interdisciplinary Lake Erie information, caters to many teachers who are land-locked and do not have easy access to the lake for first hand experiences with their students. Therefore, the faculty of Stone Lab must attempt to adapt these experiences to authenticate the hands-on participation. Vukelich & Wrenn (1999) also described the ability of the professional development to help teachers network with each other to generate lessons and ideas. On a tiny island teacher participants are forced to be interactive with each other as they eat, sleep, and learn together. This generates great connections back in the classroom and lasting friendships that are renewed at the lake each summer.

Table III-2
Qualities that enhance teacher workshops (Vukelich & Wrenn, 1999)

Workshop trait	Rationale
Clear focus on a subject	-gives participants a common purpose and a single identity -balance between the institutions' and the teachers' professional development initiatives
Focus on the need of participating teachers	-relevant to actual classroom work and to students' learning achievement needs
Ongoing and sustained	-need reflection time -teachers must unlearn as much as learn -need experimentation time
Views teachers as intellectuals, engaged in the pursuit of answers to genuine questions, problems, and curiosities	-allows opportunity to reconsider their assumption about best practice -debate new ideas -struggle with the notion of how to substitute old practices with new practices
Provides for participants' meaningful engagement	-materials and ideas must meet the teacher participants' interests -engage participants' in intellectual pursuit of solutions to real-life classrooms
Develops collegial relationships	-allow teachers to network with each other -learning in group settings for active participation
Encourages reflection	-time to analyze and reflect with opportunities to absorb new information and perspectives

The success of a professional development experience weighs heavily on the ability of the teacher to implement the knowledge and methods learned into his/her classroom. Rogers (1995) has studied the ability of people to adopt new ideas, and his diffusion theory illustrates "adopter categories" and "factors that influence the rate of adoption." In general, Rogers states that those who implement theories most readily are considered to be "innovators" while those who greatly delay in the implementation process are called "laggards." Factors that contribute to the rate of adoption are socioeconomic status, personality values, and communication behavior (Rogers, 1995). Teachers employed in a wealthy school district may have the necessary tools to implement change in their classroom more quickly compared to school districts with limited budgets. In a wealthy school district, personality may be liberal and open-minded to changes in the curriculum. Also, they may instigate change more readily and actively participate in the learning process along with their students.

If a teacher wants to implement a change into the classroom, then that change must be well suited for that particular teacher, curriculum, students, and school. Teachers are eager to develop improved teaching strategies; however, they also do not want to waste their time if the teaching strategy is not going to fit the mold of the circumstances. Rogers (1995) and Zaltman and Duncan (1977) propose characteristics influencing the speed of adoption (Table III-3).

Table III-3
Factors influencing rate of adoption of an innovation

Factor	Description
Relative advantage (Rogers, 1995)	-must be superior to what it is replacing
Compatibility (Rogers, 1995)	-consistent with past experiences and values of potential innovators
Complexity (Rogers, 1995)	-aim toward less complexity -doesn't need to be difficult to understand and use
Trialability (Rogers, 1995)	-should be able to experiment with on a limited basis
Observability (Rogers, 1995)	-demonstrated to the teacher before utilized in the classroom (helps to make the teacher feel comfortable with the activity)
Impact of social relations (Zaltman & Duncan, 1977)	-positive and negative impact
Reversibility (Zaltman & Duncan, 1977)	-how easily can it be discontinued without irreconcilable impacts
Time required for implementation (Zaltman & Duncan, 1977)	-the time of class periods and preparation for teachers

Risk involved in implementation (Zaltman & Duncan, 1977)	-teachers want low risk so that reversibility is not in jeopardy
Amount of commitment required for implementation (Zaltman & Duncan, 1977)	-depends on the teacher -most teachers do not want a heavy commitment with the implementation
Capacity for successive modification (Zaltman & Duncan, 1977)	-can this information be modified to fit the needs of the teacher, students, classroom, and school

Speaking as members of the target audience for inservice, writers of this section know that teachers are basically looking for a low risk, small time commitment, easy-to-modify, positive impact on change activity that allows the teacher high comfort with the knowledge and activity. If the knowledge or activity meets a curriculum need that is already met, then the teacher most likely will not implement the new activity. However, if the knowledge meets a need, then the teacher may favor the change (Doyle & Ponder, 1978). Stone Lab faculty must observe these criteria for diffusion if their objective is to help teachers implement new teaching strategies, new knowledge, and new activities into the everyday classroom. These criteria help to build the reputation of Stone Lab educator courses and facilitate the continuance of the teacher education program.

Rationale for the research

Stone Lab provides the teacher participants with a brief chance to evaluate the course. This evaluation is presented to the teachers on the last day of the workshop and does not allow them time to implement what they have learn ed and give feedback to the faculty of their Stone Lab course. This study is intended to assist Stone Lab with enhancing its educator workshop programs.

Answers to the following research questions were sought:

1) How do teachers who have taken Stone Lab courses compare with those who have not taken Stone Lab courses, in terms of flexibility of teaching style, variety of subjects integrated, and variety of assessment strategies used?

2) Is there a correlation between certain teaching styles and participation in Stone Lab courses?

3) How do Stone Lab courses compare to other graduate courses/workshops taken by the same individual?

4) Have teacher workshops/courses influenced a teacher's teaching style?

5) Are Stone Lab or non-Stone Lab courses implemented more quickly?

6) Do teachers' goals match the choice of courses taken?

Methods

This evaluation of Stone Lab educator workshops was a group effort of graduate level students in an Environmental Education and Communication course offered by the School of Natural Resources at The Ohio State University. Over the course of about three weeks, the research team developed a survey. Each question was analyzed and evaluated concerning its connection to the research questions. Utilizing other members of the class, the survey was pilot tested for wording improvement and appropriateness for both Stone Lab and non-Stone Lab teachers. A copy of the script and interview questions is attached in the Appendix.

A partial list of teachers who had taken Stone Lab courses from 1999-2001 was provided to the team by Stone Lab. From this list, middle school teachers and high school teachers were contacted either by telephone or electronic mail. Some teachers did not respond to the emails while others declined to participate because of lack of time or burden. The teachers who accepted asked that the survey be administered by electronic mail or telephone. Also, at this time, the survey administrators asked if there would be a non-Stone Lab teacher who would be willing to participate in the survey as well. The non-Stone Lab teacher taught the same subject, grade, and in the same school as the Stone Lab teacher. The non-Stone Lab teachers were contacted either by telephone or electronic mail and were informed of the purpose of the survey.

Eleven interviews were completed. Of the eleven, seven were Stone Lab (SL) participants while four were non-Stone Lab (non-SL) participants. Each question response was analyzed by two members of the research team to avoid bias. Because of the small number of interviews, percentages are not used in the results and analysis section, and measures of significance were not applied. Only a comparison of group (SL versus non-SL) responses will be analyzed.

Results and Analysis

Participants in the survey ranged in teaching experience from 3-14 years and taught grades 4-12. The subjects taught by the interviewees were integrated science, earth systems, chemistry, physics, environmental issues, ecology, art, language arts, and health.

Course comparisons. Respondents rated the graduate courses taken at Stone Lab as slightly more valuable in methods and content compared to non-SL courses. When asked to categorize their inservice experiences, the majority of SL courses were said to be a combination of content and methods, while the non-SL courses were mostly methods. Also, the SL courses were more often recommended to other teachers. For the majority of courses, both SL and non-SL, methods and information were implemented in teachers' classrooms within 12 months; however, more people implemented SL courses than non-SL. The same ratio was present in the questions of implementation and recommendation for SL. The people who chose not to implement SL courses were also the ones who chose not to recommend the course to other teachers.

Current teaching preferences. To get an idea of typical teaching styles, the interviewees were asked to assign a percentage to the type of activities they use in the classroom in a given week or month. Some teachers gave percentages that totaled 100% while others did not. Those that did not total 100% were simplified to 100% to provide a better comparison. Once again, the number of interviews limited the ability to perform statistic tests. Participants in SL courses tended to favor hands-on activities, outdoor activities, and individual activities. An "other" category for activities was listed on the interview and SL teachers chose to provide additional teaching tactics in this column (non-SL teachers did not use the "other" column at all). SL teachers noted they also used "joint projects, portfolio assignments, exhibits," "working with living organisms," and "guided problem solving." The SL teacher that works with living organisms stated that she does this every day with her middle school students. The non-SL participating teachers favored lecture, group learning, discussion, technology activities, and projects.

When the results of this same question were evaluated based on the order of preference for each teaching style, the orders were slightly different between SL and non-SL participating teachers. For example, SL and non-SL both ranked hands-on activities as the largest part of their teaching style and group learning as the second biggest part of their teaching style. SL teachers ranked individual learning and then group discussion as their third and fourth main teaching style respectively. Non-SL teachers ranked group discussion and then lecture as their third and fourth main teaching style respectively. Both groups of teachers ranked outdoor activities as the smallest part of their teaching style. This category may be more related to location of the school rather than SL versus non-SL. Since SL teacher interviews were accompanied by non-SL interviews from the same school, these comparisons of outdoor activities could be similar because of a lack of natural areas for activities near the school itself.

Another question pertained to teaching style concerning integration of subject areas in teaching. All teachers stated that they do integrate other subjects, including social sciences (history, geography, social studies), language arts (English, literature, writing), fine arts (music, art), math, and technology. One SL teacher also added an integration of "interconnectedness of human endeavors" citing it as one of his strengths as a science teacher while another SL teacher stated that he tried to "connect science to the real world." Part of the question related to how often teachers integrate other subjects. Most teachers (SL and non-SL) stated that once a month or every quarter they usually integrate topics through projects.

Teacher learning preferences. A question was asked as to whether the teacher preferred a content course, a methods course, or a combination of content and methods. Overall, both groups of teachers (SL and non-SL) stated that they prefer to participate in a graduate course with both content and methods. As a Stone Lab teacher herself, writer White felt that courses with both content and methods are "more exciting and interesting" and the courses have a "better flow."

Another question relating to preference concerned the type of learning environment in which teachers learn best. The interviewees were given the options of indoor, outdoor, lecture, hands-on, group and individual. The majority of all teachers preferred outdoor, hands-on, and both group and individual learning. One SL teacher chose all categories stating that she "liked variety." No consistent differences between SL and non-SL surfaced from this question.

Teaching style changes. Through adoption of ideas presented at an inservice or workshop, teachers may change their teaching style. Interviewees were asked if they have changed their teaching style over time and if they attributed that change to inservice/workshop experience. All non-SL teachers said that they have changed their teaching style over time; however, that change was not credited to inservices or workshops. Most SL teachers said that they have changed their teaching style over time and that it was mostly a result of inservices and workshops. When asked how they have changed their teaching style over time most SL teachers said that they have

- decreased their dependence on lecture
- increased hands-on activities
- improved their ability to relate to individual students
- make better connections of content to activity, and
- provide more realistic applications of science for their students.

Non-SL teachers said that they have increased their integration with technology and structured their classroom to fit proficiency time frames. The two teachers (both SL) who have not changed their teaching style over time stated that inservices have given them more confidence in the classroom and have contributed to their activity repertoire.

The study asked if teachers chose graduate courses/workshops that connected to the specific goals they have for their students. The majority of teachers, both SL and non-SL, did choose courses that related to their classroom goals and objectives. Searching for "useful ideas," "more creative ways to teach," and methods of "exciting students" were reasons cited. The general goals that teachers have for their students ranged from "appreciation for science" to "proficiency objectives" and from "pass the AP exam" to "make science fun." The goals of the SL teachers tended to promote authentic science, life applications, and a strong science content background while the goals and objectives of non-SL teachers promoted general organizational skills, science lab skills, and making science interesting.

All interviewed teachers claimed that they vary their forms of assessment throughout the school year. Overall, teachers varied their forms of the traditional test or quiz, using multiple choice, essay, true/false, and fill-in; they use both verbal and written tests. Both SL and non-SL teachers use projects, journals, and technology in their assessments. In general, SL teachers varied their forms of assessment with lab practicals, while non-SL teachers vary their assessment with concept mapping, powerpoint presentations, and demonstrations.

Depending on the enthusiasm of the interviewee to participate in the survey, we also asked some optional questions. Initially, these questions were part of the survey; however, after a discussion with the pilot test group, the team discovered that they really did not connect with the outlined objectives. Of the eleven respondents, seven offered feedback on the optional questions. These questions were more personal, asking if the teacher had responsibilities outside of school that would hinder their ability to take graduate courses/workshops. A second optional question asked about support from their school district. Overall, the teachers cited lack of time and financial support as reasons for not taking graduate courses. One SL teacher participant stated that he did not take classes that related to his curriculum; he took classes at Stone Lab because it was "extremely energizing." The teachers who did not take SL class said they were at the top of their pay scale and therefore did not have any reason to take more graduate courses.

Discussion

Based on the information from the interviews, the differences between Stone Lab and non-Stone Lab participating teachers is slight. No major differences were discovered between the two groups of teachers based on their teaching style, integration of other subjects, and forms of assessment. The differences that were discovered led to more questions. For example, Stone

Lab teachers' teaching style valued individual time for their students. Perhaps Stone Lab teachers found that individual time for their students allowed the students extra moments to reflect on what they are learning giving them a better opportunity to connect context to real life applications (an objective valued by SL teachers). Also, Stone Lab teachers varied their assessment with the use of lab practicals. Some of the courses at Stone Lab utilize lab practicals as a method of assessing learning over the course of the week.

When the implementation and recommendation of Stone Lab courses was compared to other graduate courses, Stone Lab participating teachers recommended SL courses more often and tended to implement these courses quickly. In the school, teacher colleagues usually work closely and share ideas and activities with each other. When Stone Lab teachers implement activities quickly, they may also be sharing these activities with other teachers in their school. Indirectly, they are recommending the course to the other teachers. Also, recommendation of the Stone Lab courses aids in building a good reputation of Stone Lab as an excellent learning experience for educators. Stone Lab as an institution should build on this networking among teachers to enhance their educator programs. If writers of this section are typical, science teachers tend to be people who enjoy communing with nature, working on hands-on projects, relating information in group discussions, and actively participating in the learning process. Usually, the ideals of the individual teacher are reflected in his/her teaching style. This may have contributed to our findings of little difference between Stone Lab teachers and non-Stone Lab teachers.

Although the results of the research were not definitely conclusive, Stone Lab faculty may benefit from the study. Teachers stated that they usually take classes that will enable them to reach their goals and objectives better as a teacher. By understanding the goals of the individual teacher, Stone Lab faculty may be able to generate new courses or arrange current courses to better fit the objectives of the teacher participant. As stated earlier, Stone Lab classes were recommended to other teachers. This technique is one of the best ways to spread information and to extend the reputation of Stone Lab. Stone Lab faculty could "piggy-back" on this idea to increase educator enrollment.

Suggestions for Further Study

In this study, time within the academic quarter limited the number of interviews conducted. Ideally, the team was striving toward a collection of 24 surveys (12 middle school – with 6 from Stone Lab and 6 not from Stone Lab, 12 high school – with 6 from Stone Lab and 6 not from Stone Lab). We also found that contact by email was not the best route to actively pursue participants. Email was an easy way to contact the person; however, the time between emails was too long for this study. Also, by talking to the interviewee on the telephone, the interviewer was able to probe the questions and encourage the respondent to elaborate on responses.

As a team, we also agreed that another pilot study of the interview would have helped word the questions better and narrow the focus of the study. If a comparison were made between Stone Lab courses and other graduate level courses, then questions could have been directed more towards just the Stone Lab people. An entire new interview could have been conducted to only the Stone Lab people asking them to compare, in depth, the two types of courses.

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IV. Literature Review: Evaluating Environmental Learning in an Experiential Setting

Lisa S. Bircher

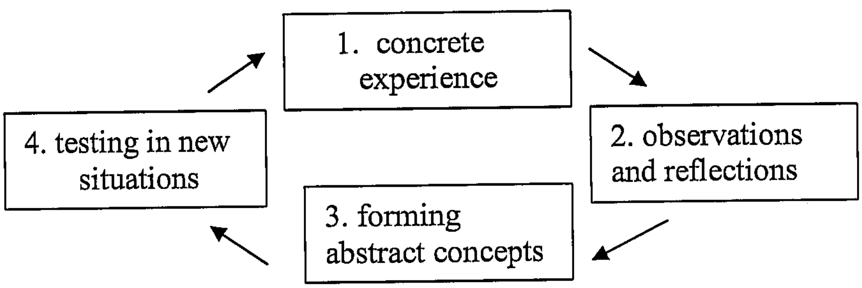
Introduction

> " Tell me and I will forget; show me and I may remember; involve me and I will understand" (Association for Experiential Education, 2002)

This statement seems to encompass the concept of experiential learning very concisely. After all, what does it mean to "experience" but to be involved. Excellent educators have always known the power of involvement for students. For example, renowned science educator Edwin Lincoln Moseley (1865-1948) was constantly involving students in some form of experiential learning. He is best known for his "excursions" with students while teaching at both Sandusky High School (1889-1914) and Bowling Green College (1914-1936). Moseley stimulated students to inquire about the world and experience the natural world so they might better understand (Niederhofer and Stuckey, 1998). Another great educator F.W. Sanderson (1856-1922) was remembered by H.G. Wells (1924). Sanderson believed in reducing competition between students, and instead incorporated cooperative experiential learning for his students. He stated in his final lecture on the learning that was practiced in his Oundle School for boys: "...to replace explicit teaching by finding out...we could not have anybody who was not working." Sanderson was known not only for involving boys of the school in enterprises of science, but also in music and drama, thus demonstrating experiential education in all aspects of learning (Wells 1924). The list of great experiential educators could go on, but the purpose of this paper is to identify the outcomes and impacts that can follow experiential learning, especially in terms of environmental education.

Experiential Learning

Stated simply, experiential education is any teaching method that involves students in doing activities and then reflecting on such activities. This may include case studies, simulations, field work, and any activity that uses real life experience as its basis (Quick 1998). David A. Kolb envisioned an experiential learning cycle based on how people learn as a result of an experience:



The model shows how a person may apply the concepts gained from a particular learning experience and apply that learning to new situations, thereby completing the cycle (Smith 2001). Kolb stated that abstract conceptualization (step 3) involves using logic and ideas rather than feelings to understand problems, therefore relying on systematic planning to solve problems (Kelly 1997). For example, an educator who uses abstract conceptualization may have certain rules of thumb about how to handle situations and deal with everyday problems that may occur in the classroom (Smith 2001). Active experimentation (step 4) involves taking practical approaches to influence situations and find what really works to solve the problem (Kelly 1997). For example, a person who is taking a test in a new situation may use general patterns (s)he has seen in the past and attempt to alter responses appropriately. This often times leads to a feedback process that will allow the person to change the approach to meet the needs of the new situation (Smith 2001). The experiential learning cycle allows individuals to link past experiences to future experiences and make connections to effectively address challenges.

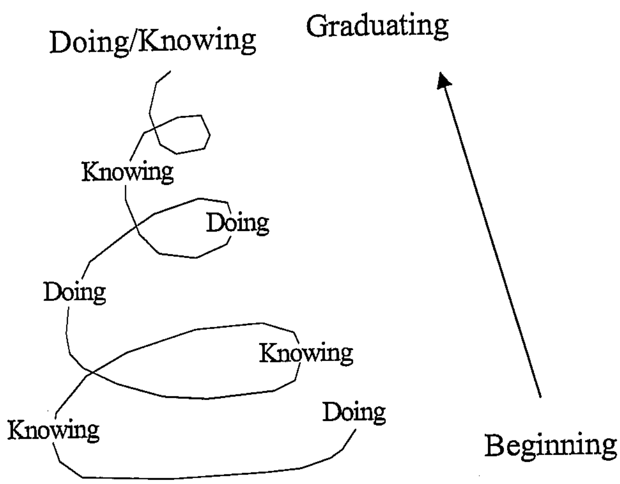
Kolb's experiential learning cycle provides a good description of learning; however, it does not provide direction on how to teach in such a manner. "Involve me and I will understand." To implement experiential learning requires a knowledge of methods conducive to such learning. Jernstedt (1995) recommended field trips, outdoor laboratories, journal writing and cooperative education experiences. Svinicki and Dixon (1994) further recommended academic readings, laboratory experiments and games, case studies and simulations (Wright 1999).

John Dewey (1859-1952) made some of the most significant contributions to experiential learning. He believed that sound education practices must engage and enlarge experience including an exploration of thinking and reflection; interaction with environments for learning was seen as critical (Smith 2001). Student involvement and action, thoughtful reflection and rigorous assessment, imagination and problem solving, and applications beyond the classroom, which includes the community, characterize the Foxfire Approach to teaching and learning (Foxfire 2002). The Foxfire Approach to Teaching and Learning corresponds with John Dewey's notion of experiential education. These approaches overlap in four categories (Starnes 1999):

1. ***Relationships among teachers, learners, curriculum and community***- the give-and-take among all those involved increases the student centered nature of the experience.
2. ***The way learning occurs***- the engagement of learners in posing and solving problems, making meaning, producing products and building understanding.
3. ***Preparing for lives as citizens/individuals***- inclusion of teamwork, creativity and innovation.
4. ***Thinking about what is learned and how***- time for learners to stand apart and reflect on the learning activities.

The overlap of the Foxfire Approach and Dewey's writings demonstrates the possibility of transforming the classroom into an experiential laboratory in which students can learn and grow (Starnes 1999). Another recommended use of experiential learning is in the use of structured experiences. This technique can address controversial topics or topics in which understanding oneself may be the foremost goal of the educator. Structured experiences may be used in any educational setting in which the learner is involved and encouraged to take ownership of the experience in that they will be able to assimilate the concepts personally. They can also be tailored to the needs of the group or the issues at hand; in this way the experience can be truly meaningful even though it will normally be conducted in a classroom environment (Thayer 1976).

Some institutions have adopted use of experiential learning across the curriculum. For example, at Alverno College in Milwaukee, Wisconsin (a liberal arts college for women), experiential learning has been integrated into the course of study and students are required to participate in a series of experiential events. The program includes four general principles and strategies that will allow students to develop as they participate in the program. The first principle is *concreteness* that relates all learning experiences to the student's own experience. Second is *involvement* of the student, which includes the kinesthetic, affective, ethical, attitudinal, and behavioral dimensions of learning. Third is *dissonance* in which students are temporarily thrown out of balance as they move towards deeper understanding. Finally, *reflection* in which students step back and ponder on their experiences in order for transformation of experience into learning. Alverno College has developed an "Integrated Performance Model" that illustrates how students should develop over time as participants in the program:



This "bedspring model" illustrates how a student will grow from beginning to graduation and will emerge understanding that learning and doing should be the same thing (Hutchings & Wutzdorff 1988).

Cross curriculum experiential learning also demands changes in the role of teachers. Several schools in which experiential learning has been implemented have required changes in time blocks. Often the teacher becomes an active participant in learning, and lessons cannot be planned around concise pre-planned time periods. For example, the University Heights Alternative School in the Bronx uses the Project Adventure experiential learning program, and this has caused the school to eliminate 45-minute class periods in favor of an all-day time block. Teachers arrange the curriculum by project rather than by separate disciplines (Stevens & Richards 1992). One educational researcher, Noel McInnis (1968), suggested that educational systems adopt "gestalt" configurations of content presentation. This is well illustrated by the University Heights Alternative School, which is moving toward a future where students are capable of understanding that solving problems will not be possible if we only consider solutions in one discipline or another. For example a solution for a problem may not come from a distinctly biological analysis or an economic analysis or sociological analysis but rather from an interrelationship of those disciplines (McInnis 1968).

A problem in experiential education experienced by many teachers is the ability to evaluate students in a context that aligns with traditional evaluations. This is difficult because many critics of experiential learning believe that learning is not complete until a student can quantify the learning experience. Therefore, new methods of evaluation must be employed to show that learning has occurred. Some criteria for evaluation in experiential learning include the following:

1. allow more than one way to do things; there is more than one correct alternative
2. require that students display an understanding of the whole, not just the parts
3. promote cooperation since is required in most tasks; limit solo performances
4. promote transference by requiring students to demonstrate adaptation of learning tools (Hendricks 1994).

Experiential Learning in Environmental Education

"The first law of environmental education: an experience is worth 10,000 pictures"
- Noel McInnis (Braus & Wood 1994)

Definitions

What is environmental education? Why are educators today so interested in environmental science? Why do our students need to learn environmental concepts? These are questions that are not easily answered. However, it may be helpful to examine definitions of environmental education as well as examine studies to understand why this area in education has grown so much since the 1970s.

Looking at the history of environmental education may be a good place to start. When Rachel Carson published *Silent Spring* in 1962, an environmental awareness was triggered. Carson's book made the public aware of the quality of the environment as well as ecological issues, which had been previously ignored. When the public is concerned about issues, a reasonable approach is that it should enter the arena of public education. The International Workshop of Environmental Education was held in the fall of 1975 in Belgrade, Yugoslavia. The United Nations Environmental Program (UNEP) and United Nations Educational, Scientific and Cultural Organization (UNESCO) sponsored the conference to establish goals for environmental education. The main goal defined was the need to educate a world population that is aware of and concerned about the environment and also to develop knowledge, skills, attitudes, motivations and commitment to work towards solving environmental problems. Two years later, in 1977 at the Tbilisi Intergovernmental Conference on Environmental Education, the objectives of environmental education were established. The main goal was to help individuals acquire a set of values, then a concern for the environment, followed by active participation in environmental protection and improvement (Mittelstaedt et al. 1999). In 1990, the U.S. Congress passed the National Environmental Education Act in an attempt to increase the public's environmental literacy by providing programs to educate youth (EPA 1994). More recently, in 1996, the U.S. Environmental Protection Agency (EPA) defined environmental education as follows:

> " Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action (Knapp and Poff 2001)".

The issue of "environmental literacy" has also emerged and guidelines have been established on what it means for a person to be literate on the environment:

- An awareness and sensitivity to the total environment
- A variety of ***experiences*** in and a basic understanding of environmental problems
- A set of environmental values and feelings of concern for the environment
- Skills for identifying, investigating and solving environmental problems (Braus & Wood 1994)

In *A Primer for Environmental Literacy (1998)*, Frank B. Golley states that his personal interest in ecological science came from his own childhood experiences in nature. He further states that experience in natural settings when combined with understanding the science can lead to profound insights. When environmental science is combined with experiential learning it increases student motivation, cooperation and retention, thus nothing can replace first-hand experience in studying environmental issues (Braus and Wood 1994). Numerous studies indicate that people can develop an awareness and appreciation for the environment by being involved in outdoor, experiential settings (including issue investigation, role playing, service learning, etc). One of the aims of environmental education is to foster learning about nature as well as developing skills, which should enable the individual to make a difference in the environment (Haluza-DeLay 1999).

Some forms of environmental education have been referred to as "nonformal." Environmental education often takes place in an outdoor setting and students are encouraged to determine their own-objectives in learning; this by definition is classified as nonformal education. A successful nonformal environmental education program is one that is responsive to the learner and develops continually based on the interests and desires of the student (Heimlich 1993). The EPA has a serious commitment to educating youth and can serve many as the vehicle for nonformal education. For example, the EPA has established grants, youth programs, award programs, and internships to encourage involvement of the citizenry in environmental education activities. The commitment of the government to environmental education in an experiential format such as this demonstrates recognition of the effectiveness of this form of learning (EPA 1994).

Selected Research on Experiential Outdoor Education

Environmental education research has often focused on learner outcomes/impacts, on program methods or on experiences individuals have had. The studies described here have wide implications and may be applied across age and socioeconomic groups. These studies also illustrate that even in different environments and when used for different purposes, environmental education works, *especially* in an experiential format.

Multiple examples of effective environmental learning experiences have been suggested. For example, Louise Chawla (1999) has illustrated that the most important motivating factor for individuals who are today part of the environmental work force was experiences during childhood in natural areas.

One representative study analyzed the short-term impact of an environmental interpretive program. The research involved a class of fourth graders who participated in a field trip to a U.S.

Forest Service site near the school. One of the goals of the program was to allow students to explore the chosen site in an experiential fashion. A theme that appeared as a result of the study was that students are more likely to retain content that results from direct actions such as "catching, looking, searching, chasing, acting, etc." Several of the activities that students participated in were environmental games. This suggests that the games must be strongly embedded with environmental content if the environmental education impact is to be maximum (Knapp & Poff 2001).

Another project was conducted in which participants were observed during a 12-day wilderness adventure trip both individually and as a group. The participants were teens, ages 14 to 16. During this study the participants became more group focused (social) as the trip progressed and the natural setting depreciated in significance. The goals of the trip did **not** include a specific environmental education thrust; therefore the individuals and the group activities were not specifically focused on the natural environment. This suggests that in order for an experience in nature to be truly educational, it must be part of the program to "notice" and reflect on the natural setting so that individuals may grow cognitively as well as socially from the experience (Haluza-DeLay 1999). A similar study was conducted during a week-long "science camp" setting; however, during this study, individuals were purposefully instructed in environmental topics. The participants were youths, ages 9-12. The mission of the camp was to instill comfort, awareness, inspiration and passion as well as to develop stewardship for the planet through experiential activities. The participants were led in activities that increase appreciation of the natural world. By the end of the week, campers experienced dramatic improvement in environmental attitudes and over 50% of the campers returned for a second summer to the same program. This indicates that naturalists should foster development of educational methods in environmental experiential programs; this could result in citizens who are willing and motivated to participate in environmental activities (Mittelstaedt, et. al. 1999).

A recent regional study of note is the Great Lakes vessel-based program. It is common practice in all the Great Lakes to involve students in experiences aboard ships that encourage observation, data collection and other skills. In a review of the Great Lakes Education Program (GLEP), fourth grade student participants were pre- and post-tested to determine the effect of the program on their attitudes and knowledge of the Great Lakes. Activities including limnology, aquatic biology, weather, navigation/geography and nautical topics were presented while on-board the vessel. The results of the study indicate that all students experience significant positive impacts from involvement in the vessel-based program. Interestingly, girls in the study demonstrated a significant increase in positive attitude toward the Great Lakes. This type of experience for children, even in the early elementary grades, can significantly affect their attitudes toward a natural ecosystem, especially for those who live near the Great Lakes (Williamson & Dann, 1999).

Teachers and Experiential/ Environmental Education

Most teachers would agree that environmental education is necessary for today's students, however, they are not particularly prepared to present such topics in their classrooms. Teachers, like other learners, require certain input to experience positive growth and development. Educators of all experience levels express an interest in improving their instructional skills while also developing new styles and strategies (Panasuk & LeBaron 1999). Quality professional development must include collaboration of professionals that are working on developing curriculum that involves experimentation, solving real world problems and then reflecting on such methods (Vukelich & Wrenn 1999). Teachers as professionals tend to prefer collaboration and camaraderie in their professional development options. This may be the result of the feeling of isolation when teaching behind "closed doors" with very little interaction with other teachers (Sandholtz & Dadlez 2000). Not only is it important for teachers to be actively involved in learning, but it must also be self-initiated. This means that teachers propose the activities because they are based on personal needs and interests (Zigo 2001).

Since teachers are the most likely presenters of environmental topics to students, they require a certain amount of training in environmental education methods and processes. Ideally, inservice for teachers should include an experiential component and then the opportunity to practice these methods in the classroom (Stowitschek, et. al. 2000). Unfortunately, teachers express a certain amount of "fear" in teaching environmental topics in certain settings. For example, most teachers surveyed by Simmons (1998) agreed that a "deep woods" environment would be an appropriate location for teaching environmental topics, but this area also presented the greatest need in terms of training required as well as the greatest perceived hazards.

One study among teachers in Hong Kong was intended to demonstrate the effectiveness of experiential learning as inservice training for teachers. The learning situation was designed to give teachers an experience in discrimination that would mimic typical experiences their students may have in the schools. The experience was determined by teachers involved to be very beneficial; however, the teachers also indicated that such an exercise in their own classrooms would not be possible. The results of this study indicate that teachers cannot be expected to implement certain experiential techniques as part of their practice without receiving professional development that will equip them to generate major changes in their teaching styles. The Hong Kong study illustrates how teachers are aware of the needed changes in education but not equipped to make those changes. Therefore, if teachers are to be the initiators of change, they must be trained to understand their roles and sensitized to techniques that may be invaluable for educational reform (Harris 2001). For systemic changes to occur, teachers must be able to experience and reflect on training in order for changes to take place in the classroom (Harris 2001). Kolb's Experiential Education Cycle would support this finding as well.

One of the primary responsibilities of formal science educators is to guide students in discovery about environmental topics. Some teachers may be confident and qualified in instructing students about environmental education. Other teachers may feel ill prepared and/or lack the time to sufficiently prepare environmental lessons. Since choices for science lead most curriculum decision-making processes, teachers feel the pressure, prepared or not, to teach environmental topics. A survey was designed to evaluate the environmental education attitudes and assess policy and science teaching practices of primary teachers in the United Kingdom. Some of the conclusions resulting from the survey are

- there is a need to enhance teachers' understanding and confidence in science and environmental education
- many teachers regard environmental education as an important part of their teaching
- teachers who lack understanding of environmental issues may perpetuate inappropriate understanding of science in children

- deterring factors for teaching environmental education include limited policy development, lack of teaching support and poor resourcing (Littledyke 1997).

Such results can be used to encourage allocation of future resources in the training or inservice that teachers may receive as they begin their own environmental education process (Littledyke 1997).

Teachers agree that changes are necessary for reform in environmental education. However, one theme tends to reappear in many sources of literature, the idea that teachers are ill equipped to do environmental education. Even though there are many sources suggesting that teachers need more training to be better prepared to teach environmental topics, there are also many sources of literature that demonstrate teachers' success in environmental education. One example comes from a group of high school teachers in Canada. These teachers attempted to use a "novel approach" in their ninth grade science classes. The classes were transformed by using stories as a springboard to initiate student research and inquiry. The teachers enlisted the help of English teacher colleagues for techniques for teaching the novel, *Ring Rise, Ring Set.* The novel is an environmental story set in the future in which two groups of people and their lifestyles are compared and contrasted. The two groups included one which is technologically advanced, and another living as traditional native people. The main character in the story is caught between the two worlds. Environmental topics such as hydroponically grown plants, human-created biospheres and growth of molds were illustrated in the novel. Therefore students were stimulated to attempt experiments in which they would test hypotheses and determine whether these topics were based on sound science or science fiction. This is not only exemplary of experiential learning in environmental education, but it is also student initiated and student-centered as is suggested in Kolb's model of experiential learning. The teachers in the study were pleasantly surprised by their students' results. They found that students demonstrated depth of understanding of science concepts rather than simply memorizing facts and concepts (Drake, et. al. 1996).

Another success story comes as a result of a field trip experience. Field trips have been shown to create relevancy of the science concepts that are presented in the classroom. Research supports the notion that a science field trip can positively impact the knowledge and attitude of the participants (Mayer & Fortner, 1995). However, one problem with the field trip experience is follow-up. Teachers need to be encouraged to enhance the field trip concepts when back in the classroom with repetitive exercises. In this way, teachers will prevent the decay or interference of concepts presented that is typical of many field trip experiences. This will also stimulate the long-term retention of the concepts so that when students are asked at a later date about the trip, they will be able to recall not only the physical and social circumstances of the trip, but also the science concepts presented (Knapp 2000).

Traditional science teaching methods have included experiential and cross-curriculum work. One final example of excellent use of experiential learning combined with science teaching is in the suggested use of experience in a bioresearch course. Such a course might involve the study of an environmental toxin, using fish as subjects to study the effects of the toxin. Students would be required to do background readings and study on fish, water pollution and ecology. Reading would be followed with a field trip to an Environmental Protection Agency Laboratory. The student would then be required to write a proposal for a personal research project, carry out the research via collecting data and analyzing the results. Finally, the student would write a research report and possibly present findings to other pupils in the class as a culminating activity (Chickering 1977).

Teachers must understand that the goal of environmental education is to go beyond simply vicariously discussing the impact of human-created problems. It is important for educators to incorporate not only an environmental aspect in education but also to produce curriculum which is experiential in nature, so those students may go beyond simply learning *about* the environment. The meshing of environmental and experiential learning will enable us to produce students who are capable of actively participating in resolution of environmental problems. This could in turn lead us into a future where we are capable of changing the world through the environment (Wright 1999).

Final Remarks

The purpose of this section of the Technical Report has been to present highlights from the literature available in the field of experiential learning in environmental education. Experiential learning is the process of being actively involved in learning. The outcomes and impacts of such learning experiences have been shown to be positive and in some cases life-changing. The experiential student will be able to reflect on such experience as well as form abstract concepts and then test them in new situations. This is an active process shown to be effective for audiences as diverse as the youngest elementary students to adult learners. Environmental education has practiced experiential education methods, and since the beginning of the movement in the 1960s environmental educators have used experiential approaches. Much literature has been generated as a result.

Experience is the heart of environmental learning. Many scientists and professionals in environmental fields trace their interest in the field as having been exposed to "nature" at formative ages. Furthermore, it has been illustrated with children as well as with adults that a lesson presented in the experiential format will have lasting effects.

Teachers are often the presenters of environmental lessons, sometimes in the setting of the classroom, the field-trip, the simulation, the case study or other nonformal settings. Teachers must be prepared to present the information to their students, and therefore they need access to excellent in-service opportunities. Several approaches to environmental education have been developed in the experiential format. These ideas are revolutionary but in some ways hearken back to the day when the only way to learn was experientially. The craft guilds and apprenticeship systems of the past were strictly experiential. This system of training was the only way to learn and become the master of one's trade from medieval times up through the industrial revolution. As time went by, "experiential" training methods became less common, but the essential purpose of the "experience" has not been lost (Chickering 1977). Teachers today are trying new ways of presenting students with "experiences" that become the essence of their teaching. Teaching environmental topics through stories is exactly the kind of experience students needed to develop the ability to view problems and their solutions from more than just a single-disciplined approach. To be the most effective, field trips need to include reinforcement before, during and after the experience in order for students to "remember" the learning purpose of the event. After all, if an experience is to be effective, it must be recalled for the purpose that was intended.

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V. Survey of In-service teachers who have taken F.T. Stone Laboratory Courses: Outcomes and Impacts

Lisa Bircher and Rosanne W. Fortner

Rationale for the study

The teacher targeted courses offered at Stone Lab are often cited by the respondents in the final course surveys as being the "best course I ever had" or "I never knew this could be so interesting…" or "can hardly wait to use this in my classroom." Research indicates that teachers desire professional development with a clear focus in a subject area or teaching method as well as a focus on the teachers' needs and interests (Vukelich & Wrenn 1999). There is clearly a wide range of take-home values for the teachers who have attended the courses at Stone Lab. Furthermore, many of the teachers who have taken the courses at Stone Lab have returned year after year to take more courses. The teachers must have experienced some value in the experiences to elect to return year after year.

Some studies indicate that collegial environments which include camaraderie and support within the context of the professional development are necessary for teachers to get the most out of their experience (Sandholtz & Dadlez 2000). This is certainly true of the courses offered to teachers at Stone Lab. Other studies indicate that teachers are in need of inservice on environmental education topics and that such training will lead to better understanding and confidence in science and they will be better equipped to teach such topics (Littledyke 1997). The courses at Stone Lab are all related to some aspect of education about the environment and seem to satisfy the needs of teachers who desire more knowledge in the environmental sciences.

Since the implementation of teacher targeted courses at Stone Lab, there has been little beyond anecdotal study of the effects these experiences have had on the methods and subject matter teachers use in their classrooms. It was determined based on casual discussion with many teachers involved in the Stone Lab program that such research on the effects and outcomes of the Stone Lab professional development experience would be beneficial. It is further noted that the planners of the Stone Laboratory curriculum may use the information generated from this study. The objectives of the study were to determine teachers' perceptions of

- reasons to take courses at Stone Lab
- how teachers have benefited professionally and personally from their Stone Lab experience
- how teachers are using the information from Stone Lab in their own classrooms
- whether the Stone Lab experience has caused changes in teaching methods or information presented in the classroom
- whether there is benefit from the collegial interactions experienced with other teachers while at Stone Lab
- any areas of improvement that may be made to the courses offered in the future.

Methods

<u>Academic setting and methodology</u>

This study was a part of the requirement for a Masters of Science in Natural Resources at The Ohio State University, protocol number 02E0165 for research involving human subjects. The project was conducted from May - June, 2002. The research is ex post facto, not based on control over the events experienced at Stone Lab but rather an analysis of how teachers have used or benefited from the experience (Yin 1994). The method chosen was a mail survey, for economically reaching the audience and because of the kinds of research objectives. Preliminary research done using personal interviews (Section III of this Report) indicated the need for additional information in order to generalize to the larger population of participant teachers in Laboratory courses. A proportionally large group of respondents was necessary to describe the aspects or characteristics experienced and the outcomes of the experiences (Fraenkel and Wallen 1996).

Survey Development

The survey was developed to meet the objectives in a form that was short, entailing only 5-10 minutes of the respondents' time in order to encourage response. The questions developed were very general and allowed for different responses, as the respondent would feel appropriate. A cover letter introduced the researchers, explained the purpose of the project and encouraged response. The survey was pilot tested with two teachers who had been to Stone Lab and their input was incorporated into the final survey (Appendix 2). Respondents to the mailed survey were supplied a self-addressed stamped envelope for return. When the survey was returned, the respondent received a thank you "gift" of a flag lapel pin.

Sample

The sample of teachers to be surveyed was determined to be the group of educators, both formal and nonformal, who had taken summer courses between the years of 1999 and 2001. Most of the educators surveyed had taken more than one course at Stone Lab. The names and addresses of those 105 teachers, excluding the pilot test teachers, were obtained from Ohio State's Stone Laboratory office in Columbus. Because of the relatively small population, the researchers attempted a complete census rather than sampling within the group.

Survey Administration

The Stone Lab office supplied mailing labels and surveys were sent by mail to the potential respondents on May 3, 2002. Two surveys were returned with incorrect addresses, reducing the list to 103 possible respondents. Approximately 56 completed surveys had been received by May 29, 2002. There were 18 non-respondents with email addresses and they were contacted via email; this was followed by a phone call to the same group. By June 15, 2002, a total of 66 completed surveys had been received. The content analysis technique used was to generate a list of answer statements by survey question. Since many statements were repeated from one respondent to another, a tally of responses served as a frequency count. For those items to be answered strongly agree, agree, neutral, disagree, strongly disagree, frequencies were also recorded.

The response rate of 64% for this survey indicates that many of the respondents have a vested interest in the courses they have taken at Stone Lab. Those surveys not returned may be the result of lost materials, a lack of time or interest on the part of the respondent, or unwillingness to be surveyed (Fraenkel and Wallen 1996). Another reason for nonresponse may be that those individuals only view Stone Lab as a learning vacation experience and not an important part of their professional development. Several of the respondents made comments at the end of the survey that they were very close to retirement and do not have an interest in future professional development, therefore this may be another reason why some teachers did not respond.

Results

What courses were taken?

The teachers indicated the courses they attended on the survey. The most frequently attended course was Ornithology (41% of respondents). The following courses were also reported in decreasing rates of enrollment:

Geology of Lake Erie (33%)
Oceanography (32%)
Entomology (27%)
Global Climate Change (24%)
Great Lakes Education Workshop (20%).

Several other courses were mentioned as being attended by only a small number of respondents: Projects Wet, Wild, Wow Workshops (6%), EPA Research Vessel (6%) Great Lakes Limnology (3%), Stream Ecology (3%), Aquatic Biology (1%) and the Marine Ecology of a Coral Reef, Jamaica (1%).

2. Why take the course?

There were many reasons the respondents indicated for taking the courses. However, the most common reason indicated was personal interest in the topics (39% of respondents), followed closely by obtaining college credit (35%). Many respondents indicated that the course was used to upgrade or renew their teaching certificate (17%) or for an increase on the pay scale in their district (6%). For the latter, some added that while this was the initial reason they took the course, they continued in successive years because of personal interest in the topics taught.

Many respondents indicated that the hands-on and field experience component was very important to them and an important reason for taking the course (12%). Other reasons listed for taking courses at Stone Lab include the beautiful surroundings of the island or the fact that the area is a "great place to learn" (12%), as well as the "educational vacation" aspect (11%). Some teachers indicated that the courses were taken as preparation for teaching a new unit in the classroom or to implement information into the classroom required by state grants or to match their course of study (6%) or to increases skills in the subject area (9%). Other comments made include that the courses are research-based and high quality (3%), the courses could be taken with a friend, family member or a close colleague (8%) or simply for networking with other teachers (6%). Some teachers indicated that their advisor initially recommended the course but then they continued to take other courses later (3%).

3. What value does this course have for a professional?

Teachers most frequently listed their increase in knowledge and confidence as a teacher (44% of respondents). Not only did the teachers include knowledge by itself but the fact that it gave them greater confidence for teaching those topics in the classroom. Many teachers listed the ability to use materials in their classroom as the value of the course (27%) or felt it was important for a professional to learn how fieldwork is done in a hands-on fashion (9%). Some found the focus on local issues as valuable (6%), whereas others mentioned understanding the environmental impact that humans have as valuable (3%). Another value of the course professionally is the networking with other teachers from around the state (5%). Some teachers made comments like the course "changed my assessment methods of my students" or "I am very interested in the subject as a result of having taken the course" or "enjoyed the exposure to timely information."

4. How is the material used in the classroom?

Many of the teachers surveyed indicated that unfortunately, their teaching assignment has changed. Therefore, they do not use the information learned at Stone Lab in their classroom because they are presently teaching a different subject or it is not applicable to the age level of the children they presently teach (15% of respondents). For those teachers who do still teach in areas related to subjects learned at Stone Lab, 14% find use of personal collections of insects, fossils or photos they took on field trips to be important to supplement topics taught in their classrooms. Some teachers mentioned their ability to now assign rock or insect collections to their own students as a result of the information and confidence they gained in the courses. In other field applications, teachers indicated that they use field experiences similar to those experienced at Stone Lab with their own students now (9%); some indicated specific areas like water chemistry/sampling/levels as being integrated into their classroom studies (11%).

Even if field activities are not a possibility for them, teachers confined to classrooms gain from Stone Lab courses. They have found that creating new lesson plans has been an important part of what they learned (8%). Also many teachers mentioned that they use several of the activities from the Great Lakes booklets that were used in some of the classes (9%). Some teachers mentioned specific lessons they learned at Stone Lab that are now used in their classrooms, including the following: ocean currents, entomology and evolution, zebra mussels and other non-native species, wetlands, endangered species (specifically the bald eagle and Lake Erie water snake), stream quality indexing, strip mining and minerals, dichotomous keys/classification or identification, pollutants and water quality, animal migrations, algae identification, concept maps, maple seed migration. A few notable comments made on some surveys include "I am now able to prepare an envirothon team" and "I have a lot of interesting stories to relate to students now." Some teachers have invited guest speakers to their classroom as a result of their experience or have improved the school district's (science) web site with information gathered at Stone Lab.

Table V-1

Frequency of Likert scale responses to perceived Stone Lab course values

	% of respondents*				
Value of courses at SL	SA	A	N	D	SD
I use concepts I learned at SL regularly in my classroom.	21	36	15	20	8
I feel the course(s) I have taken at SL have greatly improved my science knowledge.	52	33	6	9	0
I learned new and exciting teaching methods in the course I took at SL.	21	39	18	14	8

I have benefited positively from the collegial interactions I experienced at SL	55	33	6	5	1
My teaching practices have changed as a result of my experiences at SL.	15	29	32	15	9
The course(s) I have taken at SL have value to me beyond simple classroom application.	64	32	4	0	0
The course(s) I have taken at SL stimulated me to learn more about the environment.	47	44	6	1	0
I feel that certain courses offered at SL have more value than others.	14	30	44	5	0
Overall, the course(s) I have taken at SL are the best I have had.	36	26	24	14	0

*Note: SA=strongly agree A=agree N=neutral D=disagree SD=strongly disagree

5. Why take Stone Lab courses in the future?

The most widely reported reason for taking courses in the future would be to expand personal science knowledge and interest in the topic or to prepare to teach a new area (44% of respondents). Many respondents indicated the excellent location of Stone Lab and the fun, get-away aspect of the campus would be a good reason to continue taking Stone Lab courses (32%). Other teachers mentioned that the hands-on, field-based work that is practiced in the courses at Stone Lab would be an attractive reason for taking future courses (23%). One of the things that some respondents enjoyed about the summer courses offered is that they are completed in one week and at the same time, the short time period involved allows complete immersion in the topic. Some feel they are better able to learn in this way (9%). An important factor for some is to be able to relate what is learned in the course to the curriculum taught in their classrooms (8%). Other teachers felt that it is important for them to learn how to use field techniques to take back to their students and this is a motivating factor for taking additional courses (5%). Some teachers said they require the environmental training (including soil, air and water issues) to help teach these topics in their classrooms (5%). Several respondents indicated that the experiences they have at Stone Lab gives them credible information to use with students in the classroom (3%). A few teachers said the courses available are some of the best ways to obtain graduate credit for certificate renewal/upgrade or increase on their district's pay scale (5%). Some notable comments made by the respondents when asked why they would take future courses are as follows:

- "There are few places to get science courses if you are not a 'science' person"
- "Something for everyone"
- "The professors are experts in their area of study and I appreciate this"

6. What professional impact did the course have?

Most teachers noted that the most important impact they experienced as a result of the course was to gain knowledge, confidence and enthusiasm in the subject area (36% of respondents). Some felt as a result of the new knowledge they gained they now have more interest in certain areas (9%). Others perceived that the course imparted them greater credibility as a science teacher (8%). One of the most important topics mentioned was that the course at Stone Lab gave them an awareness of environmental issues they were previously unaware of, especially issues which affect individuals locally (9%). Some teachers benefited from the teacher networking they were able to do while at Stone Lab (8%). Certain teachers felt that the activities/resources they gathered while at Stone Lab are meaningful and expand their teaching expertise in those areas (6%). Some teachers even mentioned that as a result of attending the course at Stone Lab they have reevaluated their teaching and assessment techniques and their teaching strategies have changed (6%). Some respondents indicated that the course was part of their masters program or that it has increased their pay in the district in which they teach (5%). Certain teachers indicated an enjoyment of the more relaxed relationships with the professor or instructor who taught the course (3%). Some interesting comments made include the following:

- "The course made me realize that I really love what I teach."
- "Made me realize I would like to do some nonformal environmental education."
- "Rekindles the spark that originally lured me into teaching."

7. <u>What personal impact did the course have?</u>

The most important personal impact that the teachers experienced is the ability to meet and network with teachers from all around the state and beyond (39% of respondents). Many teachers indicated that they have developed an appreciation for the resources and environment of the Great Lakes and this has changed their personal outlook on certain topics (34%). Many teachers found the courses to be relaxing and enjoyable (14%), while others have developed more interest in biological topics now (9%). A number of respondents made unique comments about the experience as it affected them personally:

- "The most intensive learning in one week, but so much fun!"
- "I enjoy the work of 'being a scientist' personally."
- "The experience convinced me to become a science teacher and move to a different area."
- "The courses stimulated me to pursue my Ph.D. studies with a focus on the Great Lakes"
- "I met my fiancé at Stone Lab!"
- "I feel I have discovered a secret aspect of OSU."
- "The course was a 'once in a lifetime' experience."
- "I appreciate the respect the staff has for teachers."
- "The courses was the most satisfying and fun professional development experience I've had in 26 years of teaching"

8. <u>Suggestions for improvement</u>

Most comments made on the surveys were very positive and numerous individuals indicated that there is no reason to change anything at Stone Lab. However, the most common suggestions included adding more and different courses. Some course suggestions include the following:

- Topics such as Hazardous wastes/Superfund site education, butterflies, weather, herpetology, soil/water chemistry topics, botany, SCUBA underwater zoology,
- Follow-up [implying next level] to courses such as entomology and oceanography

- Integrated courses of science with literature/art/music/history (Some respondents indicated that inviting new professors to teach some of these courses may be necessary).
- More courses "off-campus" like the Jamaica "Coral Reef" or "Stream Ecology" at Old Woman Creek courses.
- Increase the number of day or weekend only courses.
- Increase the science/problem-based courses, reduce lesson-planning aspects.
- Provide more handouts on how certain demonstrations are planned and/or executed or allow teachers to do these demonstrations themselves. Also, offer labs and activities that can be done in the classroom with few supplies.
- Publish or make information on upcoming courses available earlier.
- In some cases, do less lecturing during the class and more application of concepts for use in the classroom.

Some other suggestions made include the issue of providing air conditioning in the dorms or classrooms to increase the comfort of the participants. Some respondents felt they would be willing to pay extra for a private room.

Finally, one concern mentioned by several respondents was the cost of attending Stone Lab. They mentioned the possibility of making more scholarships available to teachers, especially elementary teachers who can really benefit from the field experiences available at Stone Lab. Some other respondents indicated that it would be nice to have a discounted rate if you are only taking the course for personal interest and you do not require it for college credit.

9. Additional Comments

Many respondents added comments at the end of the survey, including positive notes like "thanks for the experience!" or "I had a great time." Some of the respondents reiterated the idea that they feel that more scholarships or funding should be made available to teachers, several even mentioned that perhaps a lottery or stipend be made available to teachers to help defray the cost of attending Stone Lab. One respondent mentioned the "Friends of Stone Lab" organization and the ability to be able to give back to Stone Lab by financial contributions to the organization.

Some comments were made regarding information to be given to first time attendees of Stone Lab. There is a need to make clear to them the intensity of the experience and amount of work involved in a condensed one-week course accompanied with the many field experiences. Some said that it could be a little overwhelming to experience so much with the heat, close living quarters and expectations of the course. Some teachers were concerned with the idea that the courses are to be primarily teacher courses and not just general field courses. Others indicated that they go to Stone Lab to experience and learn science and they do not want watered down content but a very intensive learning experience.

Many comments were made about the instructors and professors. Some respondents remarked about the quality of some instructors. One respondent said that certain instructors "make the program as good as it is;" comments were made that some instructors are "excellent, very knowledgeable and helpful." Many respondents remarked that the excellence of the overall experience caused them to recommend Stone Lab to others and to plan on taking more courses in the future.

Regarding public relations of Stone Lab, some respondents indicated a concern for the information to be available first-hand to teachers. It seems that in some cases, teachers were not notified directly but information was lost in the administrative offices of some schools. Stone Lab needs to be marketed to the individual teachers and not the school systems in general. One final comment of interest made by a respondent is the idea that there should be a component in which teachers would be able to regroup at some time during the school year to share ideas on how the information has been applied to their classrooms. Perhaps this component could be done via videoconferencing or in advance of the Winter Lecture to reduce the need to travel back to Stone Lab. This type of event may also allow teachers to recommend new areas of study or possible courses to the planners of Stone Lab.

Discussion

Interpretation of Findings

These research findings indicate that the main reason most respondents have taken courses at Stone Lab is to increase their knowledge in the different areas of science. Many respondents felt that one of the keys to the success of the Stone Lab program is that they are learning science first-hand, in a field-based setting. Previous research indicating that teachers desire camaraderie and collegial interactions in their professional development experience (Sandholtz and Dadlez 2000) has been supported. Many respondents indicated a satisfaction with the experiential aspect of Stone Lab and with course methods of putting teachers in the position of scientist and researcher. This supports the findings of Stowitschek, et al., 2000.

For many teachers who have taken courses at Stone Lab there is indeed a wide range of take-home values. Teachers listed numerous activities they have used in their classrooms as a result of the professional development experience. The experience has broadened many of the respondents' horizons and has even led them to areas where they may have previously had marginal interest. It is true that teachers need to continuously add to their repertoire of lessons and knowledge. There seems to be a definite trend that the respondents feel that more knowledge equals greater confidence and greater confidence imparts greater enthusiasm; it appears that Stone Lab delivers the entire sequence. Other studies indicate teachers realize that in order to do environmental education, they require tools and knowledge (Littledyke 1997). The courses available to teachers at Stone Lab appear to meet the need for training in environmental education. Like their range of reasons for participation, there is a range of desired content from rigorous science to ready-to-use classroom materials.

When the respondents were asked if their teaching methods have changed as a result of the concepts and techniques learned at Stone Lab there did not appear to be a definite trend. While some individual respondents were adamant that they have completely overhauled their teaching and assessment techniques as a result of the experience, others indicated very little has changed in their teaching strategies. Perhaps this is related to changes in teaching assignments. It may also be that educators are not truly aware of what has caused an evolution of their teaching style and cannot pinpoint one specific experience that has made a difference.

Teacher networking appears to be one of the most important benefits of attending Stone Lab. In short answer questions, respondents repeated the benefits of teacher networking. Some respondents insisted that the relationships forged at Stone Lab might even continue years beyond the initial experience. The teachers in the collegial relationships they develop are able to grow and develop as well as trade or create new lessons as part of their experience. This is always a very important benefit of the most excellent professional development activities, especially when so many teachers in their daily teaching schedule feel as though they are working "behind closed doors." Teachers who participate in excellent professional development are able to work collaboratively and engage in a constant dialogue with one another to develop curriculum, experiment and solve real problems (Vukelich and Wrenn 1999). Stone Lab is a unique setting in which teachers have the time and are encouraged to work together to develop new lessons, experiment, solve problems and reflect on pedagogy. This is indeed the reason why so many teachers surveyed enjoy and thus benefit from collegial interactions.

Finally, teachers surveyed in this study seem to have many ideas for the future of Stone Lab, including additional courses and improvements in the physical aspects of Stone Lab living. However, the most widely cited issue that limits the appeal of Stone Lab to some is the financial issue. Family expenses, duplication of housing, loss of income from summer jobs foregone, and simply the rising tuition and housing costs are difficult obstacles for prospective participants. Some respondents suggest the development of additional scholarships for teachers in order to facilitate their attendance.

Suggestions for use of findings

The planners of Stone Lab summer programs will most likely benefit from the results of this study. The respondents made some valuable comments indicating how they feel about the courses available in the summer at Stone Lab. Most teachers made comments for improvement that include addition of different types of courses, improvement of the facilities as well as finding a means for teacher discussions to continue later after the course has been completed. It would be worthwhile for the planners of Stone Lab to take into consideration the desire teachers have to continue dialogue as a group and create possible additional class meetings via videoconferencing or interactive distance learning modules.

One major aspect of Stone Lab that seems to be important to teachers is the increased availability of scholarships, stipends or lotteries for additional financial support. Perhaps in working with the "Friends of Stone Lab" it would be possible to establish new scholarships to help teachers in financially need or teachers in need of the field experiences with the monetary burden of attending Stone Lab.

Suggestions for enhanced research

Some possible sources of enhanced research may be to interview teachers to gather data that was not readily apparent on a written survey. In an interview, the researcher may encourage the respondents to elaborate on experiences or activities used in the classroom. Perhaps responses could be solicited from teachers that attended Stone Lab as far back as the early 1990s to find out more about the long-term effects of the courses. Another possible dimension that could be added to this research would be to use a control teacher group and a Stone Lab teacher group and compare the results of their experiences in their professional development, i.e. expand the study begun in Section II of this report. Finally, it would be a good idea to continue to solicit response from teachers, perhaps with a suggestion box at the Lab or a Comment Corner on the internet site.

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Appendix 1.

Teacher Interview Script and Questions from III: Preliminary Study (White, et al)

For teachers from Stone Lab:
I am a student in Dr. Rosanne Fortner's Environmental Education and Communication course offered at Ohio State University. Our class is doing a group study on teachers' evaluation of courses/workshops that they have taken. You are being called because you have taken courses for teachers at Stone Lab, but our brief survey relates to all kinds of inservice courses you have taken at OSU and elsewhere.

Would you be willing to take a few minutes to answer some questions? Our survey will take about 15 minutes and your responses will be held anonymous in any report development.

If this is not a good time for you to talk, may I call you back when it is more convenient? When would be a good time for you?

For teachers not from Stone Lab:
I am a student in Dr. Rosanne Fortner's Environmental Education and Communication course offered at Ohio State University. Our class is doing a group study on teachers' evaluation of courses/workshops that they have taken. You are being called because you have taken inservice courses at OSU and elsewhere.

Would you be willing to take a few minutes to answer some questions? Our survey will take about 15 minutes and your responses will be held anonymous in any report development.

If this is not a good time for you to talk, may I call you back when it is more convenient? When would be a good time for you?

Interview Questions

Teacher name ______________________________ Interviewer ____________________
Date ________________ Time ________________

How many years have you been teaching? _____
What subject(s) and grade(s) do you teach?
Subject(s) ______________________
Grade(s) ______________________

Think about the graduate courses/workshops in your teaching area that you have taken. What were your 2 or 3 most valuable inservices and your 2 or 3 least valuable?

Where did you take these courses?

Rate the value of these courses/workshops to your teaching methods and then to the content as the course/workshop pertains to your classroom.

1 = no value
2 = some value
3 = valuable
4 = very valuable
5 = exceptional value

Course Title	Location	Rating - Teaching Method	Rating - Content	Implementation	Recommendation	Content Method Both

4. In a typical week or month, what % of classroom time do you spend on…

_____ hands-on activities
_____ lecture
_____ group learning
_____ discussion
_____ outdoor activities
_____ technology learning/activities
_____ individual work
_____ projects
_____ other: ______________________________

5. If you had a choice, would you prefer a methods course/workshop or a content course/workshop or a combination of both?

Methods _____ Content_____ Both _____

What do you enjoy about that type of course?

6. Have you changed your teaching style over time? Y N

If so, how do you feel your teaching style has changed over time?

To what extent have the changes been a result of your inservice experience?

7. What are some general goals/objectives that you have for your students? (some content goals and non-content goals)

Do these goals have an influence on your choice of which workshops/courses to take?

Y N Why or why not?

8. What type of classroom setting and teaching style do *you* prefer to learn in?

Indoor	Outdoor
Lecture	Hands-on
Individual	Group

9.What other subjects do you integrate into your classroom? (History, Literature, Music, Art)
How often?

10. Do you vary your forms of assessment? (either throughout the school year or over the course of your years of teaching experience) Y N

If so, how and how often?

OPTIONAL Questions:
Describe the support given from your school district for continuing educational opportunities.

Do you have responsibilities that keep you from pursuing graduate courses or workshops? Y N
Explain… (?)

Thanks very much for participating in our survey!

Appendix 2.
Stone Lab Teacher Survey (Section V, Bircher)

Name____ Date____________________

Background:

1. When did you attend Stone Lab (SL)? Summer ______
2. What course(s) have you taken at SL?
3. Why did you take this course(s) at SL?
4. What value did this course(s) have for you as a professional teacher?
5. Give an example of how you have used information you gathered at SL in your classroom.

Survey:

For each statement, please indicate your level of agreement by circling the letters according to the following scale:

SA= Strongly Agree **A**= Agree **N**= Neutral **D**= Disagree **SD**=Strongly Disagree

6. I use the concepts I learned at SL regularly in my classroom.	**SA**	**A**	**N**	**D**	**SD**
7. I feel the course(s) I have taken at SL have greatly improved my science knowledge.	**SA**	**A**	**N**	**D**	**SD**
8. I learned new and exciting teaching methods in the course(s) I took at SL.	**SA**	**A**	**N**	**D**	**SD**
9. I have benefited positively from the collegial interactions I experienced at SL.	**SA**	**A**	**N**	**D**	**SD**
10. My teaching practices have changed as a result of my experiences at SL.	**SA**	**A**	**N**	**D**	**SD**
11. The course(s) I have taken at SL have value to me beyond simple classroom application.	**SA**	**A**	**N**	**D**	**SD**
12. The course(s) I have taken at SL stimulated me to learn more about the environment.	**SA**	**A**	**N**	**D**	**SD**
13. I feel that certain courses offered at Stone Lab have more value than others.	**SA**	**A**	**N**	**D**	**SD**
14. Overall, the course(s) I have taken at SL are the best I have had.	**SA**	**A**	**N**	**D**	**SD**

Finally:

15. What reasons would you list for taking future courses at SL?

16. How have the course(s) you have taken at SL impacted you professionally?

17. How have the course(s) you taken at SL impacted you personally?

18. What would you like to suggest as improvement for teacher courses offered at SL in the future?

19. Any additional comments:

Thank you for your cooperation with this survey!