Evaluating an environmental literacy requirement chosen as a method to produce environmentally literate university students

Gwyneth L. Moody and Peter G. Hartel
University of Georgia, Athens, Georgia, USA

Abstract

Purpose – Few US universities choose an environmental literacy requirement (ELR) as a method to increase student environmental literacy. Even fewer universities have evaluated their ELRs. The paper aims to assess the ELR at the University of Georgia (UGA) in Fall 2005 and Spring 2006 semesters.

Design/methodology/approach – A total of 7,268 of the 13,740 students (53 percent) currently taking an ELR course and the 86 of 100 faculty teaching ELR courses were surveyed with a voluntary questionnaire on their awareness, support, and satisfaction for the requirement. The assessment involved 58 courses with 120 sections.

Findings – Although a majority of faculty (87 percent) was aware of the ELR, a majority of students (68 percent) was not. In spite of their awareness, most faculty (81 percent) did not know the specifics of the two ELR criteria. Both a majority of faculty (89 percent) and students (84 percent) supported the idea of an ELR. The ELR increased student knowledge (76 percent) and concern (65 percent) about environmental issues and changed some students' behavior (26 percent). A majority of students (86 percent) and faculty (74 percent) were also satisfied with the ELR criteria and that the course they were taking (66 percent) or teaching (82 percent) satisfied the ELR. Most students (74 percent) thought that they were environmentally literate before taking an ELR course, although almost a majority of faculty (49 percent) thought students were environmentally illiterate.

Research limitations/implications – The evaluation showed widespread support and satisfaction with the requirement, but strong leadership, publicity, and continuous evaluation is needed to improve the requirement.

Originality/value – The UGA's ELR could serve as a model for other institutions.

Keywords Universities, United States of America, Environmental management, Students

Paper type Research paper

Introduction

Since, the 1960s there has been considerable interest in increasing environmental literacy of the general public to solve our complex environmental challenges.

The authors thank Janice Easton, University of Wisconsin-Stevens Point, for helping us develop the survey. At the UGA, the authors thank Jack Crowley, Dean of the College of Environment and Design, and Frank Golley for their support for the ELR and our research. The authors thank Carol Alexander, Jim Bason, Hugo Collantes, Sarah Hemmings, and Kauoa Fraiola for their technical assistance. Finally, authors thank all of the faculty and students for their cooperation in taking the voluntary survey.

International Journal of Sustainability in Higher Education
Vol. 8 No. 3, 2007
pp. 355-370

1467-6370
DOI 10.1108/14676370710817192

This interest has translated not only into federal and state regulations, but also into national and international conferences and declarations that encouraged universities to increase their environmental literacy (University Leaders for a Sustainable Future, 2001). Although these conferences and declarations have been an impetus for some universities to strengthen environmental literacy through research, education, training, policy formation, and information exchange, for other universities, attending these conferences and signing declarations are purely symbolic acts that address bold visions and vague notions. This disconnect is illustrated by the conclusion, that overall, universities and colleges do not produce environmentally literate students (National Wildlife Federation (NWF, 2001)) and, in the case of the USA, Americans have a limited understanding of environmental issues and exhibit less than optimal responsible environmental behavior (Roper Starch Worldwide, 2001; Elder, 2003).

Most scholars agree that environmentally literate students should have basic awareness and understanding of how the earth works as a physical system, recognize the relationship between the natural environment and human impacts on it, and have an appreciation for the complexity of these interactions (Eagan and Orr, 1992). Also, most scholars agree that environmental literacy is the intended outcome of the process of environmental education, which, more or less, includes one acquiring awareness and knowledge of environmental issues and problems, and the skills to identify and solve them, and above all, exhibiting environmentally responsible behavior (Elder, 2003). Even so, there are still disparate views about the knowledge necessary to become environmentally literate, as well as methods of achieving this goal. These views result in an absence of national standards as to the criteria, curriculum, and essential course material to assist and guide universities in establishing and monitoring such programs.

There is considerable variation in the methods and extent to which universities infuse environmental literacy into their academic curricula. Although a majority of universities in the country have some form of environmental education, only a handful have initiated comprehensive environmental literacy programs. For example, in 1990, Tufts University established an Environmental Literacy Institute to train faculty in virtually all disciplines in order to infuse a sophisticated level of environmental literacy into their courses (Roth, 1992). Infusion examples include:

> ... an English course using novels ... to discuss how the environment relates to culture; a drama [course] using role playing [to address] environmental themes; and a mechanical engineering course ... focus[ed] on getting more energy efficiency out of a machine (Wilke, 1995, p. 29).

The (NWF, 2001) queried the nation's 4,100 universities and colleges to determine the extent to which universities and colleges offer majors and minors in environmental studies. Of the 891 responses, the NWF found that 43 percent of universities and colleges offer an environmental studies major (35 percent) or minor (32 percent), but the vast majority of students are not enrolled in these programs. For example, by 1995, the University of Wisconsin-Stevens Point had the largest Natural Resources Program in the nation with 1,750 majors receiving "intensive environmental literacy instruction" (Wilke, 1995, p. 30), yet these students were a minority of the University's total 8,011 students (University of Wisconsin-Stevens Point, 2004).

Nevertheless, there is a small minority of universities and colleges that require all students to take at least one course with environmental content before they graduate

(NWF, 2001). In another study with 496 respondents, 7.0 percent of public and 14.5 percent of private universities and colleges "required all students to take one or more courses specifically intended to increase their environmental literacy" (Wolfe, 2001). However, when we contacted these public universities and colleges to confirm the presence of such a requirement, only seven of the 14 institutions still had a requirement (Table I). These requirements ranged from students having to take one course with environmental content to students taking one of a list of courses that satisfy certain criteria in order to graduate.

It is important to note that the University of Georgia (UGA) has had an environmental literacy requirement (ELR) in place since 1993, but was not reported in these studies, supporting the notion that some universities did not respond to the surveys, and that there may be more universities with such requirements in place.

UGA's method of producing environmentally literate students

The UGA has had an ELR since 1993. Originally, the requirement had six criteria (Table II), but in 1998 these six criteria were reduced to two due to concern over the number of hours required for students to graduate and concern for the overall effectiveness of the requirement (*UGA Bulletin*, 2006). The original idea was that the ELR would be a dynamic requirement, which would be periodically reviewed by both internal and external panels and overseen by a coordinator. In its current version, undergraduate students must choose one of approximately 80 courses that fulfill the ELR. Although the ELR has been reviewed internally, it has never been externally reviewed or assigned a coordinator. Over the years, differences among the faculty and lack of funding have weakened the ELR to such an extent that the university is considering abolishing it.

University or college	Description of ELR
Bemidji State University	Take required course, people and the environment (three credits)
Colorado School of Mines	Take required course, nature and human values (three credits)
James Madison University	Take four courses from a list of approximately 35 courses in the natural world category (ten credits)
University of Mary Washington	Take any course that examines human activity and the biosphere
University of Minnesota-Twin Cities	Take one course from a list of approximately 100 courses in the environment category (three credits)
University of Science and Arts of Oklahoma	Take two courses as part of interdisciplinary core, foundations of physical science (three credits) and foundations of life science (three credits)
University of Wisconsin-Stevens Point	Take one course from a list of six courses that satisfy ELR criteria

Notes: Public US universities and colleges that continue to require "all students to take one or more courses specifically intended to increase their environmental literacy." An additional seven public universities and colleges had a requirement in 2001, but no longer do; they are: University of Nebraska-Lincoln, New Jersey Institute of Technology, University of Northern Iowa, Northwestern State University, Ramapo College of New Jersey, San Jose State University, and South Dakota State University

Table I.
US universities' ELRs

Table II.
The UGA's original six ELR criteria and their reduction in 1998 from six to two criteria

Year	Criteria
1993-1998	Basic scientific principles which govern natural systems, using these to understand the limits and major factors associated with the earth's capacity to sustain life
	Linkages among living things, including humans, and their dependency on each other as well as the physical environment
	Consequences of human activity on local, regional and global natural systems
	Impact of changes within natural systems of life, health and welfare
	Cultural, economic, and political, past and present forces that affect environmental attitudes and decision making
	Role of ethics and morality in individual and group decision-making related to the environment
1999-Present	Basic scientific principles that govern natural systems
	Consequences of human activity on local, regional and global natural systems

Evaluating ELRs

Although some individual environmental courses have been assessed (Battles *et al.*, 2001; Benton, 1993; Carpenter, 1981; Hsu, 2004; Leeming *et al.*, 1993; Mangas *et al.*, 1997; McMillan *et al.*, 2004), other than three ELR assessments conducted at the UGA, there have been no published studies assessing ELRs. Understanding the benefits and shortcomings of a university's ELR is essential for both its improvement and to other institutions wishing to implement or improve their own requirement.

Of the three ELR assessments at the UGA, one was formal and two were informal. The first informal evaluation involved interviews of faculty and students (Garrison, 1993). The study concluded that environmental responsibility, the goal of the UGA's environmental policy, was not adequately defined in the ELR and therefore, the faculty interpreted the goal of the ELR in contradictory ways. For example, faculty responses ranged from, "Yes, the ultimate goal of the program is to produce behavior change," to "The professor's job is to convey knowledge *only*. It's up to the student to change" (Garrison, 1993, pp. 9-10).

The second informal study involved comparable self-evaluations to determine students' knowledge before, immediately after, and eight months after taking one of three ELR courses (introductory ecology, introductory geography, and introductory anthropology; Alkaff, 1996). Although significant differences existed among courses, students significantly increased their knowledge of the environment and retained this information for at least eight months.

The third study was a formal survey of the ELR. A total of 408 students and 103 faculties were randomly sampled, and therefore, the study represented the general faculty and undergraduate student populations. Although many students (43 percent) and faculty (44 percent) were unaware of the ELR, the vast majority of students (89 percent) and faculty (94 percent) supported the idea of an ELR (Moody *et al.*, 2005). Nevertheless, almost half (48 percent) of the faculty was dissatisfied with the ELR criteria. Despite these formal and informal studies, a focused survey of students and faculty participating in the ELR courses had not been conducted, nor had the ELR been analyzed in depth for awareness, support, and satisfaction. Therefore, we surveyed all students and faculty taking or teaching ELR courses.

Methods

There is no national standard method for evaluating ELRs, and therefore a survey was developed to assess the UGA's ELR. The survey consisted of two questionnaires, one for students (Table III) and one for faculty (Table IV). The student questionnaire consisted of 19 questions, which, excluding two questions on demographics, was divided into five categories:

(1) awareness;

(2) course efficacy;

(3) criteria efficacy;

(4) student self-evaluation; and

(5) ELR importance and method chosen.

Awareness	Are you aware of UGA's ELR?
	Are you aware that this course satisfies the ELR?
	Aside from this course, have you already taken a class that satisfies your ELR?
Course efficacy	To what extent are basic scientific principles that govern natural systems, covered in this course? (example: second law of thermodynamics) (first criterion)
	To what extent are the consequences of human activity on local, regional, and global natural systems covered in this course? (example: loss of biodiversity) (second criterion)
	In terms of current environmental issues do you feel this course covered: (level of adequacy)
	What do you think was the most important environmental issue discussed in this course? (written response)
	Do you think that this course fulfills the ELR?
Criteria efficacy	Do you think that the above criteria are adequate for a course to satisfy the ELR?
	Why do you think the criteria are inadequate? (additional criteria, better definition, or both)
Student self evaluation	How would you rate your level of environmental literacy before taking this course?
	To what extent has your awareness and knowledge of environmental issues and problems increased as a result of this course?
	Has your concern about environmental issues and problems increased as a result of this course?
	Has the content of this course influenced you to take action to address environmental issues and problems?
	In what ways have you taken action? (modified daily activities, joined organization[s], other)
ELR importance and method chosen	Do you think the idea of an ELR at UGA is: (level of importance)
	Do you think the way UGA has implemented the ELR is satisfactory (i.e. students must take one out of approximately 80 courses that cover the ELR criteria)? (fewer courses, only one course, different procedure for fulfilling an ELR)

Note: All questions are multiple choice except questions identified with "written response"

Table III.
Voluntary questionnaire developed to assess students currently taking the UGA's ELR

Awareness	Are you aware of UGA's ELR? Are you aware that this course is one of approximately 80 that satisfies the ELR? UGA has established two criteria for evaluating whether a course satisfies the ELR. If asked, would you know what they are?
Opinion	Please list three major environmental topics/issues that you feel are essential knowledge of an environmentally literate student: (written response) How many of the topics/issues you listed are addressed in this course? Do you think the ELR should provide students with knowledge only, or also skills that allow for responsible behavioral change and environmental action?
Efficacy of course	To what extent are basic scientific principles that govern natural systems covered in this course? To what extent are the consequences of human activity on local, regional, and global natural systems covered in this course? Do you think that your course satisfies the ELR? Why/why not? (written response)
Efficacy of criteria	Do you think that the current criteria are adequate for a course to satisfy the ELR? (level of adequacy) If not, why do you feel the criteria are inadequate? (additional criteria, better definition, or both)
Environmental literacy of student body	Do you consider UGA's undergraduate student body environmentally literate?
ELR importance and method chosen	Do you think the idea of an ELR at UGA is: (level of importance) Do you think the way UGA has implemented the ELR is satisfactory (i.e. students must take one course out of approximately 80 courses that cover the ELR criteria)? (fewer courses, only one course, different procedure for fulfilling an ELR)

Note: All questions are multiple choice except questions identified with "written response"

Table IV.
Voluntary questionnaire developed to assess faculty currently teaching courses that fulfill the UGA's ELR

In the case of student satisfaction/dissatisfaction with a course fulfilling the ELR, an outstanding course was identified as having ≥ 90 percent satisfaction and a failing course identified as having ≤ 70 percent satisfaction (or ≥ 30 percent dissatisfaction). The faculty questionnaire was similar with three exceptions. First, the number of questions differed slightly (20 questions). Second, the student outcome was changed to reflect faculty opinion of student outcome. Third, 14 faculty taught more than one ELR course and their responses varied depending on the course. Therefore, there were 100 questionnaires for 86 faculties. The voluntary surveys were administered at the end of the Fall 2005 and Spring 2006 semesters.

There are a total of 86 ELR courses listed on the *UGA Bulletin*. Of these courses, 76 have been taught recently or will be offered in the near future, and 10 are no longer offered (Office of Curriculum Services, 2005). A total of 11 ELR courses were either taught in the summer or offered on an irregular basis (e.g. offered odd or even years), and these courses were not surveyed. Therefore, a total of 65 courses were offered

during Fall 2005 and Spring 2006 semesters. These courses were composed of 142 class sections taught in 25 departments across seven colleges.

Results

Demographics

Overall, of the 65 ELR courses offered during the Fall 2005 and Spring 2006 semesters, 58 (89 percent) were surveyed, which consisted of 120 (85 percent) of the 142 classes. There were a total of 13,740 students enrolled in these 58 courses, of which 7,268 (53 percent) were surveyed. A total of 100 faculties taught the 65 courses offered in 2005-2006 and 86 (86 percent) were surveyed.

Of the 7,268 student responses, 59 percent were female and 41 percent were male. In terms of year of study, 35 percent were freshman, 31 percent were sophomore, 20 percent were juniors, and 14 percent were seniors. The highest percentage (45 percent) of students was in the college of arts and sciences. Of the 86 faculties surveyed, 26 percent were female and 74 percent were male. Of the faculty, 48 percent had taught at the university since the ELR's inception in 1993.

Because there were no significant differences observed in the results between the two semesters, all the data were combined.

Student awareness

The majority of students (68 percent) were unaware of the ELR. Of those students who were aware of the ELR, 68 percent were aware that the course they were taking satisfied the ELR, while 32 percent were not. In addition, of those students who were aware of the ELR, 55 percent reported having already taken a class to satisfy the ELR, 26 percent had not, and 19 percent were uncertain if they had or had not.

Satisfaction with ELR courses and ELR criteria

The majority of students were satisfied that:

- their course fulfilled both of the two ELR criteria (Criterion no. 1, 76 percent; Criterion no. 2, 88 percent);
- their course satisfied the ELR (66 percent); and
- the two ELR criteria were adequate in fulfilling the ELR (86 percent).

Students identified 60 classes – half the total number of classes – as outstanding and only 12 classes as failures (Table V). In addition, there was some faculty-to-faculty variation with different classes within courses. In the most extreme example, student satisfaction for three classes taught by different professors in Basic Concepts in Biology (BIOL 1103) was 33, 74, and 88 percent.

Even though a majority of students were satisfied with their ELR class, slightly less than a majority (50 percent) thought that their course covered a sufficient number of environmental issues. Over a quarter (28 percent) of the students reported "global warming" as the most important environmental issue discussed in their course (Table VI). Other than "pollution" (12 percent), all other environmental issues were <10 percent.

Table V.
Individual classes in which ≥30 percent of the students were dissatisfied with the course as satisfying the ELR

Course title	Dissatisfaction (percent)
CHEM 1110-1110L (Elementary chemistry)	58.6
AAEC 4650 (Environmental economics)	44.4
PBIO 1210 (Principles of plant biology)	44.4
GEOL(ANTH) 4700 (Archaeological geology)	40.0
BIOL 1107-1107L (Principles of biology I)	37.0
ANTH 1102 (Introduction to anthropology)	35.7
CHEM 1110-1110L (Elementary chemistry)	35.0
GEOL 1122 (Earth's history of global change)	34.4
ENTO(CRSS)(PATH) 4740-4740L (Integrated pest management)	33.3
PBIO 1220 (Principles of plant biology)	33.3
RLST 4840 (Environmental interpretation for recreation)	33.3
GEOL 1122 (Earth's history of global change)	30.8

Table VI.
The most important environmental issues that students thought were discussed in their ELR course

Environmental issues	Number of responses	Percentage of total
Global warming	1,181	27.8
Pollution	512	12.0
Abiotic and biotic interactions	411	9.7
Resource use, conservation, and management	395	9.3
Population growth	296	7.0
Biodiversity loss	249	5.9
Habitat destruction/deforestation	226	5.3
Role of humans/environmental ethics	212	5.0
Agricultural impacts/issues	203	4.8
Human impact on the environment	172	4.0
Water quality issues	105	2.5
Environmental impact on humans	74	1.7
Economics/governmental issues	42	1.0
Subtotal	4,078	96.0
None/do not know	172	4.0
Total	4,250	100.0

Student outcome

The majority (74 percent) of students thought they had a high to moderate level of environmental literacy before taking the course, while just over a quarter (27 percent) reported having a low level of environmental literacy to none at all. The majority of students thought their knowledge (76 percent) and concern (65 percent) for environmental issues had increased a great, considerable, and moderate extent as a result of taking the course. However, only 26 percent of the students changed their behavior. Of those students who changed their behavior, 65 percent said they modified their daily activities, 6 percent said they joined an organization, 10 percent said they did both, and 19 percent responded with other.

When the data were cross-tabulated, students with low levels of environmental literacy reported a great, considerable, and moderate increase in knowledge (77 percent) and concern (66 percent). Surprisingly, the majority of students who reported high to

moderate levels of environmental literacy before taking a course also reported similar increases in knowledge (77 percent) and concern (65 percent) to a great, considerable, and moderate extent as a result of taking an ELR course. Similarly, the students whose courses influenced them to take action the most were those with high to moderate levels of environmental literacy before taking the course (58 percent), followed by those with low levels of environmental literacy, to none at all (38 percent). The small percentage of students having no environmental literacy before taking the course increased their knowledge (56 percent) and concern (51 percent) for environmental issues only slightly or not at all.

Idea of an ELR

Finally, the majority (84 percent) of students supported the idea of an ELR, and two thirds (67 percent) of students thought the procedure UGA had chosen to produce environmentally literate students was satisfactory. Of those students who were dissatisfied, 9 percent said that fewer courses should fulfill the ELR, 3 percent said only one course should fulfill the ELR, 5 percent said a different procedure is needed altogether, and 15 percent had no opinion.

Faculty awareness

The vast majority of faculty (87 percent) was aware of the ELR. Of the faculty who were aware of the ELR, 92 percent were aware that the specific course they were teaching satisfied the ELR. However, of the faculty who were aware of the ELR, a surprising 79 percent were unfamiliar with the two ELR criteria.

Satisfaction with ELR courses

Once the faculty was given the two ELR criteria and the ELR procedure explained to them, the majority was satisfied that their class fulfilled the ELR (84 percent), Criterion no. 1 (88 percent), and Criterion no. 2 (89 percent) to a great, considerable, or moderate extent. Faculties were not asked to rank courses, but to report whether or not the class they were teaching satisfied the ELR. A total of 14 faculties thought that the 12 courses (22 classes) they taught did not satisfy the ELR (Table VII). When asked the reason behind the course's unsatisfactory nature, typical faculty responses were: "Instructor has no clear mandate to concentrate sufficiently on environmental issues" to "If I had known this was one of these courses I would have emphasized principles more," to "My course does not fulfill it because the environmental component is just one small (too small) portion of the objective of the course."

There was little agreement between the 22 classes that faculty thought were unsatisfactory for the ELR and the classes with which students were dissatisfied. Faculty thought that only three courses (RLST 4840, Environmental interpretation for recreation; BIOL 1107, Principles of biology I; PBIO 1210, Principles of plant biology) were unsatisfactory of the 12 courses that had ≥ 30 percent student dissatisfaction; conversely, faculty thought that seven courses were unsatisfactory of the 60 courses that had ≥ 90 percent student satisfaction.

ELR criteria

The majority (74 percent) of faculty thought that the two ELR criteria were adequate for a course to cover in order to satisfy the ELR. When those who felt the criteria were

Course	No. of classes
BIOL 1103 (Basic concepts in biology)	6
BIOL 1107 (Principles of biology I)	3
FORS 3020 (Forest ecology)	1
GEOG 1101 (Introduction to human geography)	3
GEOG 1111 (Introduction to physical geography)	1
GEOG 1112 (Introduction to weather and climate)	1
GEOG 1113 (Introduction to landforms)	1
GEOL 1121 (Earth processes and environments)	1
HONS 2080 (Honors science)	1
PATH 3530 (Introductory plant pathology)	1
PBIO 1210 (Principles of plant biology)	2
RLST 4840 (Environmental interpretation for recreation)	1

Note: 22 classes within 12 courses, taught by 14 faculty

Table VII.
ELR courses faculty taught that they thought should not satisfy the ELR

inadequate were asked the reason why, 36 percent felt that there should be additional criteria included (addressing cultural, political, economic, and ethical factors), 14 percent felt the criteria should be better defined, 41 percent felt the criteria should be better defined and have additional criteria included, and 9 percent answered other.

Desired student outcome

In terms of the overall undergraduate level of environmental literacy at UGA, only 16 percent of the faculty considered the student body environmentally literate, 49 percent considered students environmentally illiterate, and 35 percent were uncertain. These percentages are in direct contrast to the large percentage of students (74 percent) who thought that they had a high to moderate degree of environmental literacy before taking their ELR course. The majority (67 percent) of faculty thought an ELR course should increase student knowledge and skills to address environmental issues rather than just knowledge alone (33 percent).

When faculty were asked to list three major environmental issues that would be essential knowledge for any environmentally literate student, the responses varied, but over 40 percent mentioned knowledge of abiotic and biotic interactions, and separately, resource use, conservation, and management (Table VIII). The vast majority (87 percent) felt that all or most of the issues they reported were covered in the ELR course they were currently teaching.

Idea of ELR

Although the majority (84 percent) of faculty supported the idea of an ELR, over half (54 percent) thought that the way the university implemented the ELR was unsatisfactory. Of those who were dissatisfied, 23 percent said that fewer courses should fulfill the ELR, 14 percent said a different procedure is needed altogether, and 19 percent had no opinion.

Environmental issues	Number of responses	Percentage of total
Abiotic and biotic interactions	60	25.0
Resource use, conservation, and management	37	15.4
Role of humans/environmental ethics	22	9.2
Economics/governmental issues	16	6.7
Global warming	15	6.3
Population growth	15	6.3
Habitat destruction/deforestation	14	5.8
Biodiversity loss	14	5.8
Pollution	13	5.4
Water quality issues	8	3.3
Agricultural impacts/issues	7	2.9
Environmental impact on humans	2	0.8
Human impact on the environment	17	7.1
Total	240	100.0

Table VIII.
Faculty list of major environmental issues they felt were essential knowledge of an environmentally literate student (81 responses)

Discussion

Positive and negative aspects of the ELR

For other universities and colleges considering an ELR, UGA's requirement had three positive and three negative aspects. These positive and negative aspects are summarized in Table IX.

In terms of positive aspects, both faculty and students supported and were satisfied with the ELR. These results were similar to those reported earlier in Moody *et al.* (2005), but in the more recent survey, included only students and faculty actively participating in the ELR. It is likely that an ELR would receive the same support and satisfaction at other institutions with an ELR.

It was assumed that students with low levels of environmental literacy would show the greatest increases in knowledge and concern for the environment, and indeed these increases did occur. However, it was also assumed that students with high levels of environmental literacy before taking an ELR course would show less of an increase; this assumption was incorrect: these students showed both an increase in knowledge (76 percent) and an increase in concern (65 percent). This increase suggested that the worth of an ELR was across a wide percentage of students and not just those whose environmental literacy was low.

Positive aspects	Negative aspects
Widespread support and satisfaction by both faculty and students	Students were largely unaware of the requirement
Students increased knowledge of and concern for environmental issues as a result of taking the course, even if they thought they were already environmentally literate	Students were dissatisfied with the number of environmental issues covered in their courses and faculty were dissatisfied with their own course in fulfilling the ELR
Some students changed their behavior to address environmental issues as a result of taking the course	Lack of a faculty consensus on their role as to how students can achieve environmental responsibility, the goal of environmental literacy.

Table IX.
Summary of positive and negative aspects of UGA's ELR

Students change in behavior to address environmental issues – even if only a quarter of the students – should be considered as positive, especially since action is the most widely accepted final competency level for environmental literacy among scholars, organizations, and institutions (Roth, 1992; Ruskey, 1995; National Environmental Education Advisory Council, 1996; Volk and McBeth, 1998; Elder, 2003). A reason for the small percentage change in behavior may be that if 74 percent of the students think that they are environmental literate before taking the ELR course, then student behavior may have already changed before taking the course.

In terms of negative aspects, a high percentage of students (68 percent) were unaware of the ELR. These results are dissimilar from that of Moody *et al.* (2005), who reported that only 43 percent of randomly sampled students were unaware of the ELR. Furthermore, even though the faculty was aware of the ELR, the majority was unaware of the two criteria that they must cover to satisfy the requirement. Also, because of the large number of courses fulfilling the requirement, some students unknowingly took an ELR course without ever realizing that it satisfied the ELR.

The dissatisfaction of some courses in satisfying the ELR was not only felt by students due to an inadequate amount of environmental issues covered, and faculty due to disagreements with the ELR criteria, inadequate time, and the unsuitability of the subject material in fulfilling the ELR, but also by the ELR Review Committee, who felt that some ELR courses "[did] not appear to have environmental issues as a core of their class" (Environmental Literacy Requirement Review Committee, 2003, p. 5).

The importance of reaching a consensus among faculty on their role in producing environmentally literate students is necessary for the ultimate objective of UGA's ELR – responsible environmental behavior – to be attained. The majority of faculty thought an ELR course should increase student knowledge and skills to address environmental issues. Here, the majority of faculties are in agreement with various studies (Ramsey, 1981; Hungerford and Volk, 1990; Moseley, 2000; Hsu, 2004) that report environmental responsibility must include the necessary prerequisites of:

- knowledge;
- concern; and
- environmental problem-solving skills, and having only one or two of these prerequisites is insufficient.

Unfortunately, there was still a minority of faculty who felt that knowledge alone was adequate for environmental responsibility. This assumption may be illustrated in the large percentage of students who increased their knowledge and concern, but did not change their behavior. Thus, even though UGA is committed to environmental responsibility (University of Georgia Curriculum Committee, 1998), it can be assumed that some students are not environmentally literate because they are graduating without the skills to address environmental issues, and are not changing their behavior.

Recommendations

For other universities and colleges considering an ELR, the negative aspects of the survey support the need for three recommendations. First, the insufficient student awareness, faculty unfamiliarity, and outdated ELR list of courses show the need for a coordinator. Logically, a coordinator would:

- publicize the requirement to incoming students;
- ensure that all faculty teaching ELR courses were made aware and reminded of the ELR criteria they were required to cover; and
- update the ELR course list.

Second, thorough and continuous evaluation by both an internal and external review panels is needed of the:

- ELR criteria;
- ELR courses; and
- environmental literacy level of students.

In the case of the ELR criteria at UGA, an external panel has never reviewed them. This panel is important for establishing guidelines and updating the criteria to reflect the increasing interdisciplinary nature of environmental education or to include the non-traditional (i.e. cultural, political, economic, and ethical) elements. For example, an external review might determine a different procedure is needed to produce environmentally literate students, such as reducing the courses that satisfy the ELR, and perhaps creating opportunities and additional requirements for students to develop and increase levels of environmental literacy (i.e. internship programs, independent research projects, campus service projects, community service projects, and mastery learning; NWF, 2001).

In terms of the ELR courses, they need periodic evaluation to ensure that they continue to fulfill the ELR, especially with the continuous influx of new faculty. While the majority of faculties were happy to be evaluated, or to say that their course satisfied the ELR, some faculties were reluctant to be evaluated, or to say that their course satisfied the ELR. It is possible that some of these reluctant faculties did not want to give in-depth analysis of the ELR for fear of losing their autonomy or being reprimanded for not satisfying the ELR. Nevertheless, it is essential that all courses with a large percentage of dissatisfaction (≥ 30 percent) by faculty or students receive immediate attention and either be improved or delisted. For example, in both this survey and Moody *et al.* (2005), Elementary Chemistry 1110 had the highest percent of student dissatisfaction, but there is no means to improve this course or to have this course delisted. It is also important that many of the classes within the same course had significantly different approval ratings, further supporting the need for periodic individual class evaluation. Regardless, the process of listing and delisting courses is the responsibility of the University Curriculum Committee, which has not reviewed any courses since the ELR's modification in 1998.

In terms of environmental literacy levels, the students also need to be accurately evaluated in order to reduce the discrepancy between perceived faculty and student environmental literacy. This evaluation would involve giving a pre- and post-environmental literacy test to students taking the ELR course, or before and after attending UGA. For example, in 2000 and 2003, Michigan State University conducted an environmental evaluation to assess the level of environmental literacy of incoming freshman and graduating seniors (Mertig, 2005). In this way, everyone would have an improved understanding of student knowledge, concern, and responsible behavior for environmental issues. This evaluation would allow for courses to be

modified more effectively to address and focus on those essential issues unfamiliar to students.

Third, faculty's lack of consensus on the essential environmental issues that a student should know in order to be considered environmentally literate, and the faculty's opinion on how environmental literacy is achieved need to be addressed in some form of interactive evaluation (e.g. Delphi survey). Coordination and cooperation among departments and faculty are also necessary for effective internal and interdisciplinary discussion about the ELR, allowing for the sharing of ideas and techniques that could assist in continual requirement improvement. Although there is no standard definition or subject material for environmental literacy (Elder, 2003), it is important that each university agrees on these matters, or the requirement fails to have a unified, refined, and effective objective against which to measure progress.

Conclusions

Our results point to the relative effectiveness of an ELR as a method chosen to promote environmental literacy. More universities should adopt ELRs, however, ideally, environmental literacy should be infused into the entire university curriculum in order to attain its most sophisticated level and the most effective outcome. This infusion approach also offers the practical benefits of environmental education not becoming solely another add-on to the curriculum, as well as eliminating the burden of students having to add another course to their core requirements and limiting costs by reducing the number of new faculty needed to teach additional courses (Simmons, 1989). Offering interdisciplinary courses that combine environmental themes also allows students to learn how environmental issues complement their major. However, the feasibility of accomplishing this interdisciplinarity is difficult because it conflicts with the traditional university structure (Orr, 1991; Elder, 2003). Therefore, for such an interdisciplinary program to succeed, strong, centralized leadership is necessary. There must also be a mechanism for continuous internal and external evaluation of the components that make up the requirement as well as an oversight committee to ensure that the ELR continues to meet the overarching objectives. Given the increased attention to environmental issues such as global warming, it seems that an ever-growing number of universities will implement ELRs at their institutions in order produce students capable of addressing these environmental challenges.

References

Alkaff, H.F. (1996), "An exploratory study of the students' perceptions of the environmental literacy in higher education: 'are we doing all we can?'", unpublished master's thesis, University of Georgia, Athens, GA.

Battles, D.A., Reichard, J.S., Rich, F.J. and Franks, M.E. (2001), "Environmental literacy for all students of environmental science courses in new core curriculum, Georgia Southern University", *The Geological Society of America*, available at: http://gsa.confex.com/gsa/2001AM/finalprogram/abstract_23143.htm (accessed March 3, 2005).

Benton, R. (1993), "Does an environmental course in the business school make a difference?", *Journal of Environmental Education*, Vol. 24 No. 4, pp. 37-43.

Carpenter, J.R. (1981), "Measuring effectiveness of a college-level environmental earth-science course by changes in commitment to environmental issues", *Journal of Geological Education*, Vol. 29, pp. 135-9.

Eagan, D.J. and Orr, D.W. (Eds) (1992), *New Directions for Higher Education: The Campus and Environmental Education*, Jossey-Bass Publishers, San Francisco, CA, No. 77.

Elder, J. (2003), *A Field Guide to Environmental Literacy: Making Strategic Investments in Environmental Education*, Environmental Education Coalition, Rock Spring, GA.

Environmental Literacy Requirement Review Committee (2003), "Report of the environmental literacy requirement review committee", unpublished report, University of Georgia, Athens, GA.

Garrison, D. (1993), "The University of Georgia environmental literacy program: are we doing all we should?", unpublished graduate paper, University of Georgia, Athens, GA.

Hsu, S. (2004), "The effects of an environmental education program on responsible environmental behavior and associated environmental literacy variables in Taiwanese college students", *Journal of Environmental Education*, Vol. 35 No. 2, pp. 37-48.

Hungerford, H. and Volk, T. (1990), "Changing learner behavior through environmental education", *Journal of Environmental Education*, Vol. 21 No. 3, pp. 8-20.

Leeming, F.C., Dwyer, W.O., Porter, B.E. and Cobern, M.K. (1993), "Outcome research in environmental education: a critical review", *Journal of Environmental Education*, Vol. 24 No. 4, pp. 8-21.

McMillan, E.E., Wright, T. and Beazley, K. (2004), "Impact of a university-level environmental studies class on students' values", *Journal of Environmental Education*, Vol. 35 No. 3, pp. 19-28.

Mangas, V.J., Martinez, P. and Pedauye, R. (1997), "Analysis of environmental concepts and attitudes among biology degree students", *Journal of Environmental Education*, Vol. 29 No. 1, pp. 28-33.

Mertig, A. (2005), "Michigan State University environmental survey of Freshmen – Fall 2000 and Spring 2003", paper presented at Ecofoot – Office of Campus Sustainability – University Committee for a Sustainable Campus, available at: www.ecofoot.msu.edu (accessed August 10, 2006).

Moody, G., Alkaff, H., Garrison, D. and Frank, G. (2005), "Assessing the environmental literacy requirement at the University of Georgia", *Journal of Environmental Education*, Vol. 36 No. 4, pp. 3-9.

Moseley, C. (2000), "Teaching for environmental literacy", *The Clearing House*, Vol. 36 No. 74, pp. 23-4.

National Environmental Education Advisory Council (1996), *Report Assessing Environmental Education in the United States and the Implementation of the National Environmental Education Act of 1990, US*, Environmental Protection Agency Environmental Education Division, Washington, DC.

NWF (2001), *State of the Campus Environment – A National Report Card on Environmental Performance and Sustainability in Higher Education*, National Wildlife Federation, Reston, VA.

Office of Curriculum Services (2005), personal communication, August 30.

Orr, D. (1991), "What is education for? Six myths about the foundations of modern education, and six new principles to replace them", *Context – A Quarterly of Humane Sustainable Culture*, available at: www.context.org/ICLIB/IC27/Orr.htm (accessed March 3, 2005).

Ramsey, J. (1981), "The effects of environmental action and environmental case study instruction on the overt environmental behavior of eighth-grade students", *Journal of Environmental Education*, Vol. 13 No. 1, pp. 24-30.

Roper Starch Worldwide (2001), "The national report card on environmental knowledge, attitudes, and behavior", *National Environmental Education & Training Foundation, 2001, 1999, 1998, 1997*, available at: www.neetf.org/roper/roper.shtm (accessed March 5, 2006).

Roth, C. (1992), "Environmental literacy: its roots, evolution and direction in the 1990s", ERIC Document Reproduction Service No. ED348235, ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, OH.

Ruskey, A. (1995), "State profiles in environmental education", *EPA Journal*, Vol. 21 No. 1, pp. 25-7.

Simmons, D.A. (1989), "More infusion confusion: a look at the environmental education curriculum materials", *Journal of Environmental Education*, Vol. 20 No. 4, pp. 5-18.

UGA Bulletin (2006), "Semester environmental literacy requirement", *University of Georgia Bulletin*, available at: http://bulletin.uga.edu/bulletin/prg/ELR_Req.html (accessed July 28, 2006).

University Leaders for a Sustainable Future (2001), *The Talloires Declaration*, available at: www.ulsf.org/programs_talloires_report.html (accessed July 7, 2006).

University of Georgia Curriculum Committee (1998) "University of Georgia Environmental Policy", Attachment E of University Curriculum Services, (1992), environmental literacy requirement time line. unpublished document, University of Georgia, Athens, GA.

University of Wisconsin-Stevens Point (2004), *Enrollment*, available at: www.uwsp.edu/instres/histchar.htm (accessed March 25, 2005).

Volk, T. and McBeth, B. (1998), *Environmental Literacy in the United States – What Should Be . . . What Is . . . Getting from Here to There, North*, American Association for Environmental Education and Environmental Education & Training Partnership, US Environmental Protection Agency, Rock Spring, GA.

Wilke, R. (1995), "Environmental literacy and the college curriculum", *EPA Journal*, Vol. 21 No. 2, pp. 28-30.

Wolfe, V. (2001), "A survey of the environmental education of students in non-environmental majors at four-year institutions in the USA", *International Journal of Sustainability in Higher Education*, Vol. 2 No. 4, pp. 301-15.

About the authors

Gwyneth L. Moody recently received her MS in Conservation Ecology and Sustainable Development from the University of Georgia's Institute of Ecology.

Peter G. Hartel is a Professor of Soil Microbiology in the Department of Crop and Soil Sciences at the University of Georgia. He is also Georgia Power Professor of Environmental Ethics and is associated with the University of Georgia's Environmental Ethics Certificate Program. Peter G. Hartel is the corresponding author and can be contacted at: pghartel@uga.edu