A LOOK AT ENVIRONMENTAL EDUCATION THROUGH SCIENCE TEACHERS` PERSPECTIVES AND TEXTBOOKS` COVERAGE

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Abstract

The importance of teaching environmental issues within science curriculum is getting more important, because environmental education offers an opportunity to learn not only science subject matter but also introduce social and cognitive skills. The purpose of this paper is to look at the relationship between science education and environmental education. In this research there were two main parts which are related to each other: a survey designed to provide descriptive information about science teachers` perspective on environmental issues, and a content analysis of how and to what extent environmental education was presented in science textbooks used in grade 6-12. The survey was done during the SSMA conference which took place in Columbus, OH, between October 23-25, 2003 and Cleveland Regional of Science Teachers Fall Conferences which took place in Cleveland, OH, October 25, 2003. From the results of this study, it is apparent that science teachers are interested in teaching environmental education. However, limited information was enabled in science textbook about environmental issues. Due to time constraints researchers reached limited number of teachers, but the study provided an initial understanding of science teachers` perspective of environmental education and some implications for development environmental textbooks.

Introduction

Education has no higher purpose than preparing people to lead personally fulfilling and responsible lives. Project 2061: Science for all Americans (AAAS, 1989) consists of a set of recommendations on what understanding and ways of thinking are essential for all citizens in a world shaped by science and technology. However, how would it be possible to build and protect the society without environmental consciousness?

Ramsey (2001) supported the idea that:

> All science students, however, will become citizens. All will be consumers of the products and services of science and technology. All will assume and be responsible for the benefits and risks of scientific and technological knowledge, products, systems, and services… Science-technology-society issues-based instruction has attempted to construct an appropriate means to achieve the much-sought end of social responsibility (p.381).

Social responsibility, thus, has an established life space in science education. Environmental education (EE) can be a tool to shape this responsibility. In addition, it can be the bridge between science education and social responsibility. Therefore, the purpose of this paper is to look at the relationship between science education and EE. Moreover, it is to examine science teachers` feeling about addressing environmental issues in the classrooms and using textbooks to teach environmental issues.

Science Education and Environmental Education

Many studies have suggested that EE enhances critical-thinking, problem-solving, and effective decision-making skills (e.g. Disinger, 1983; Ramsey, 1993). Lucas (1980, 1981) indicated EE should include education *about, in,* and *for* environment. Education *about* the

environment concerns the cognitive understanding including the provision of information on environmental issues and the teaching of appropriate technical and intellectual skills. Education *in* the environment constructs real-life situations based on inquiry learning. Education *for* the environment promotes well-being as its goal.

Through this approach EE offers science education a range of perspectives on knowledge and situated learning that assist those in science education (Dillon & Scott, 2002). Moreover, EE offers a conceptual richness. It introduces not only new science subject matter but also new and useful social and cognitive skills (Ramsey, 1993).

Science Teachers Perspective of Environmental Education

If there is an urge to do something *for* the environment, the teacher will try to teach EE despite the barriers, since the main aim of EE is to develop environmentally responsible individuals who are informed and skilled enough to act *for* the environment (Ko & Lee, 2003). EE has now progressed to where teachers who take a more traditional view of environmental education are likely to find themselves out of step with some of the important ideas put forward by modern environmentalists. Gayford (1998), put forward the view that there was an increasing awareness among the teachers of matters related to sustainability. There had been a shift over the period of the study in their perception of the most important issues that affect the environment and many of the teachers had an appreciation of some of the changes in environmental thinking in recent years.

In contrast, Mosothwane (2002), suggested EE has no single meaning for pre-service teachers. It is therefore important to assess pre-service teachers` conceptions of EE so as to have a clear picture of their understanding of EE. From the findings, pre-service teachers complained about the lack of EE courses in their teacher education programs. The participants of the study

argue that what is now available about EE is offered only in social studies and science curriculum.

To understand the importance of teacher education programs in EE, Plevyak et al. (2001) compared teachers in Wisconsin and Ohio. In Wisconsin, elementary school teachers are required to get EE certification. In Ohio directives regarding EE are less clear. EE is not required within preservice teachers education curriculum, but teacher education programs are incorporating it. Regarding teacher attitudes, similarities between Ohio and Wisconsin teachers include a desire to integrate EE concepts into their teaching. Ohio and Wisconsin elementary school teachers enjoy teaching EE concepts and consider themselves to be environmentally aware, responsible, and active citizens who support the integration of EE concepts into the K-12 curriculum. The differences regarding teacher attitudes include Wisconsin teachers` feeling more confident about teaching EE concepts than Ohio teachers do, since findings from this study indicated that Wisconsin elementary teachers received more preservice EE preparation and implemented more EE than Ohio teachers.

So far, science teachers and pre-service teachers` perspective of EE has been examined. We may conclude that if teachers have knowledge, skills or commitment to “environmentalise” the curriculum, EE has a greater chance for implementation. Therefore, EE programs that enhance teacher competence and assess the conceptions for intellectual development may be justified. Next, some of these programs will be examined.

Teacher Education Programs

Generally EE in pre-service teacher programs is not institutionalized. Programs vary greatly across the United States and they are not systematically preparing future teachers to effectively teach about environment (McKeown-Ice, 2000).

Currently some training programs such as ENVISION (Shepardson et. al., 2003), enhancing middle school science teachers` understanding of environmental science and inquiry, engage teachers in conducting their own environmental research. This professional development process provides teachers with more dynamic learning experiences than the traditional college course or in-service workshop.

Another study assessed the effectiveness of a quasi-experimental design based on environmental problem solving for the initial training of future teachers of environmental education (Alvarez et al., 2002). Results suggested that in both attitudes about environmental problems among participants significantly improved.

In sum, teachers who are involved in any aspect of environmental education should understand the ideas that are being debated among scientist, environmentalists, politicians, academics and planners. This is a rapidly changing field and it is easy for teachers to find themselves out of step with current ideas and, therefore, to appear misinformed. Emphasis within teacher training programs might develop teachers understanding of EE and it might also enable curriculum development in EE.

So far, science teachers perspective of EE has been summarized. On the next, environmental issues within science textbooks will be examined.

Environmental Issues in Textbooks

Studies on science textbooks showed that K-12 mathematics and science classes and the way that they are taught are enormously influenced by textbooks (e.g. Budiansky, 2001; Holliday, 2003). The third International Mathematics and Science Study (TIMMS) (Schmior, McKnight, & Raizen, 1996) indicates most of the teachers use textbooks as their primary source

of curriculum and lessons. Thus, textbooks have become one of the main resources for what is taught in schools and how science is delivered.

While Hamm and Adams (1989) found that less than 2% of sixth and seventh grade science textbooks contain content that dealt with environmental issues later studies finds better coverage. The Independent Commission on Environmental Education (ICEE) found some very good materials at all levels that reveal the environmental education which meets the highest standards, for instance, global science, energy resources, environment, biological science, an ecological approach, plastics in our lives, risk communication, project learning tree, aquatic project wild, project wild (Salmon, 2000). However, less research has been conducted on textbooks in EE (Gardella, 1993; Hungerford et al. 1980 ; Kim 2003).

Setting for This Study

In autumn 2003 a group of 10 students in Natural Resources course at Ohio State University undertook research related to the coming School Science and Mathematic Association (SSMA) conference in Columbus, Ohio. The course, Case Studies and Evaluation of Environmental Communication, focuses on a current environmental issue (EI) or ongoing research thrust relation to media coverage and public opinion. Students are involved in action research that includes both content analysis of survey research and textbooks.

In this research there were two main parts which are related to each other. One was a survey designed to provide some descriptive information about science teachers` perspective on EI. The other one was a content analysis of how and what extent environmental education (EE) was presented in science textbooks used in grade 6-12. The following research questions were addressed in this study:

1- What is teachers` perceptions of efficacy, confidence, and ability to teach about EI?

2- Which EI do teachers teach or would like to teach?

3- What are the barriers to teach EI in science classrooms?

4- How much do science textbooks used in grades 6-12 cover EI?

Study 1: Teacher survey

Primary Question: How do teachers feel about addressing EI in the classroom?

Methods

Data collection

The survey was done during the SSMA conference which took place in Columbus, OH, between October 23-25, 2003 and Cleveland Regional of Science Teachers Fall Conferences which took place in Cleveland, OH, October 25, 2003. A table was prepared at the conference entrance including appropriate labels publicizing the survey. The goal was to reach as many as to science teachers who attended to the conference. The survey was administered by ten members of a graduate level Environmental Communication class. Data collectors not only collected data but also observed the setting. For instance, they observed the number of participants who were voluntary or invited and the kinds of interactions with the participants.

Design

The questionnaire was designed to have five sections. The first section included 13 questions about respondents' attitudes toward science education and EE. Three aspects of attitudes were measured: (a) attitudes toward science; (b) attitudes toward the relevance of science with EE; and (c) attitudes toward environmental education. Seven point Likert-scale items used for each question ranged from strongly disagree to strongly agree.

The second section consisted of items about concern for teaching EI from students and teachers aspects. Current and preferred ability was compared by five point Likert- scale items

from not at all to a great deal. The third section included items that were intended to measure the extent to which participants have taught and would like to teach about 23 selected EI in science classroom. Five point Likert- scale items from not at all to a great deal was used in this part. Perceived barriers contributing to teachers` decisions to teach EI were measured in the fourth section by seven point Likert-scale items. The final section focused on basic demographic characteristics of the participants, including gender, education level, zip code, teaching situation, setting of school, and the number of EI courses they have taken. The structure and the content of the questionnaire are summarized in Table I.

The questionnaire was pilot-tested with 37 participants and revised through class discussion. Items on attitudes, concern and barriers were derived from Ko and Lee`s study (2003). The internal consistency reliability ( Cronbach`s alpha) of different scale was satisfactory (see Table 1).

Data Analysis

As a baseline, a descriptive analysis was conducted for each variable, and correlation tests were performed among collected variables by survey selection.

Table 1. The Structure and the Content of the Questionnaire

Section name	Contents	No. of items	Question type	Cronbach alpha	Cronbach alpha (Ko&Lee)
			(1=strongly agree,7= strongly disagree)		
Attitudes	Attitudes toward science	5	7-point Likert-scale items	0.4927	0.6025
	Relevance of science education and EE	4	7-point Likert-scale items	0.5960	0.7718
	Attitudes toward EE	4	7-point Likert-scale items	0.8888	0.8484
			(1=not at all, 5=a great deal)		
Teaching practice	Student aspects (current condition/preferred condition)	9	5-point Likert-scale items	0.8776 0.9310	
	Teachers aspects (current condition/preferred condition)	9	5-point Likert-scale items	0.9443 0.9332	
			(1=not at all, 5=a great deal)		
Environmental issues	(Have taught/would like to teach)	23	5-point Likert-scale items	0.9483 0.9332	
			(1=strongly agree,7= strongly disagree)		
Barriers	Logistic barriers	7	7-point Likert-scale items	0.6347	0.8149
	Personal barriers	4	7-point Likert-scale items	0.6871	0.7238

Results

One – hundred - fifty questionnaires were printed and 78 of them were given out at the conferences. Forty-nine questionnaires were completed by respondents. Five subjects were omitted from the study due to sample error, leaving a final sample size of 44. This sample consisted of 31 females (70.4 %) and 13 males (29.5 %). Forty – three (97.7 %) subjects were science teachers. Highest degree earned by subjects was 17 bachelor (38.6 %), 20 master (45.5 %), and 7 doctoral (15.9 %). Thirty-two subjects (72.7 %) took courses that included EI.

Questionnaire survey results showed that, on average, teachers` attitudes were positive. Among the three subscales, attitude toward environmental education was the highest and this was followed by relevance of science education, and then attitude toward science. Subjects perceived barriers to environmental education were moderate (Table 2).

Table 2. The Mean Scores of Teachers` Perceptions

Scale	M	SD
Attitudes toward science	4.34	0.86
Relevance of science education and EE	5.50	0.94
Attitude toward EE	5.56	1.11
Barriers	3.46	0.97

Teaching to standards takes all class time (M= 4.65, SD= 1.95) was the most important barrier for teachers` in teaching of EE. It was found from the questionnaire survey that teachers actually interested in teaching EI (Table 3).

Table 3. The Mean Scores of Barriers

Scale	M	SD
Teaching to standards takes all class time.	4.65	1.94
Standards for my subject do not address environmental issues.	4.63	2.03
Lack of instructional materials.	4.56	2.17
Inadequate textbook coverage.	4.47	2.25
Credible updated information is too hard to find.	3.63	2.14
Lack of knowledge about environmental issues.	3.29	1.92
Lack of knowledge about teaching environmental issues.	3.24	1.82
No natural environment readily available.	3.18	2.02
Students are not interested in learning about environmental issues.	2.42	1.53
Environmental education is not relevant to what I teach.	2.16	1.50
I am NOT interested in teaching environmental issues.	1.53	0.98

Teachers' current and preferred practice of teaching EI are shown in Table 4. The results showed that, teachers current abilities are higher than students current conditions. Teachers` preference on teaching EE significantly scored higher than their current practice ($t = 7.79$, $\alpha = 0.3$) , and students` preferred condition on learning EE significantly scored higher than current condition ($t = 9.96$, $\alpha = 0.5$) .

Table 4. Current and Preferred Teaching Practice Mean Scores

	Current Condition		Preferred Condition	
Scale	M	SD	M	SD
Teaching practice-student aspects	2.76	0.65	4.32	0.73
Teaching practice-teacher aspects	3.48	0.68	4.50	0.52

Teachers current and preferred teaching of EI are shown in Table 5. According to the results, preferred teaching EI significantly scored higher than current condition ($t = 7.72$, $\alpha = 0.7$).

Table 5. Current and Preferred Teaching of EI Mean Scores

	Current Condition		Preferred Condition	
Scale	M	SD	M	SD
Environmental Issues	2.83	0.93	4.18	0.62

Information about environmental issues that teachers have taught and would like to teach is presented as a bar graph that shows the mean score of each item. Item number 50, habitat destruction, was the most important issue that teacher wanted to teach whereas item number 42, war technology, was met with the least interest (Figure 1).

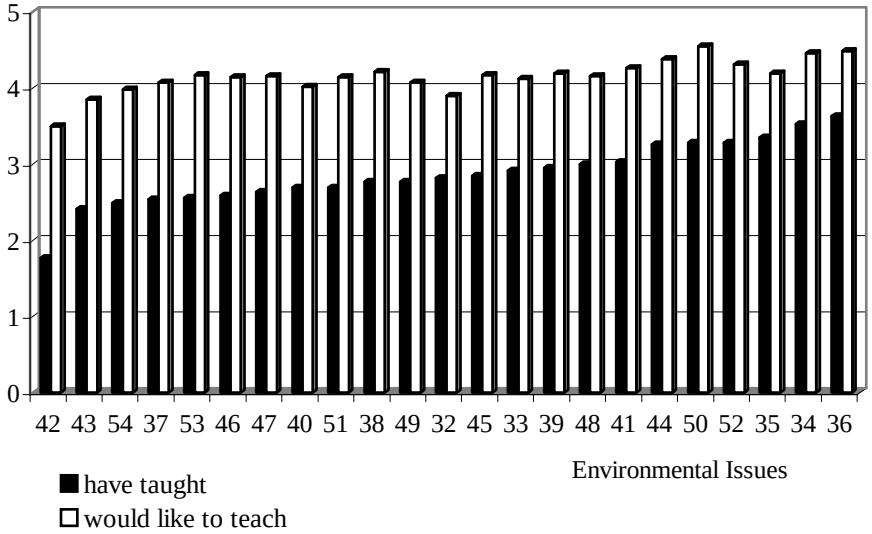

Figure 1. Comparison of EI in terms of Current and Preferred Condition

Study 2: Science textbooks

Primary Question: How much information about EI is available in grades 6-12 science textbooks?

Methods

Data collection

Science textbooks in grade 6-12 were used. The textbooks were chosen by asking science teachers in the survey which science textbooks they are using in their science classrooms. Spell out 29 books were suggested by educators at the conference and 19 were provided by Eisenhower National Clearinghouse for Mathematics and Science Education (ENC) in which its mission is to identify effective curriculum resources, create high-quality professional development materials, and disseminate useful information and products to improve K-12 mathematics and science teaching and learning. The books were written for biology, chemistry, physics, geology and middle school science classes. Three additional books specifically designed for environmental science were chosen by researchers.

Design

The textbook analysis instrument was designed to have three sections (see Appendix 1). The first section included questions about book's demographics information including title, ENC number, authors, publisher, date, total book length, number of chapters, and grade level. The second section consisted of EI content from three possible locations – index, glossary, and content pages of the books. The final section focused on other information indicating coverage of EI in specific chapters and ancillary activities.

Data analysis

Among 22 books included in analysis, rudimentary differences were evaluated in terms of demographics. Environmental issue content of books were determined by examining index, glossary and table of contents. If the EI is present in the index, the total number of pages addressing the key word (ozone depletion, global climate change, etc.) was coded. If not, it was coded as 0. Then, the glossary was examined to find occurrence of EI keywords and coded as 1 if the issue appeared, coded as 0 if the issue is not presented. Finally, the table of contents was examined to determine if any chapter or portion of a chapter addressed EI keywords. If so, the total number of pages in the chapter addressing the EI was coded. If it is not addressed, it was coded as 0. By the end, total number of different pages for all EI calculated. To establish the reliability of EI measurement, each book analyzed by two graduate students and page total compared. The number of pages about EI covered by index and table of contents of each book was not counted two times. The reliability for all textbooks was 81 %. For middle school's textbooks the reliability was 85 % and for high school's textbooks it was 78 %.

In the last part, any chapter totally devoted to an issue or any ancillary activities, for instance, case studies, labs, enrichment activities, career focus sections, or issue investigations address the issue was described.

Results

The breakdown of EIs presented in middle school (MS), high school (HS), and environmental science (ES) textbooks is shown in Table 6. Each score refers to average percent of book pages in which an EI was covered. Overall, erosion is the most covered topic with 0.74% and war technology is the least covered topic with 0.02%.

Table 6. The Average scores of EI Included in Middle School, High School and Environmental Science Textbooks

Issue	Average % in MS books	Average % in HS books	Average % in ES books	Average % in all books
Armed conflict/war	0.00	0.02	0.09	0.02
Wildlife manag.	0.45	0.36	1.17	0.07
Invasive sp.	0.00	0.02	0.76	0.09
Dist. of water res.	0.10	0.0	0.47	0.10
Marine pollution	0.14	0.00	0.50	0.11
Mineral res. depletion	0.11	0.06	0.53	0.12
Solid waste disp.	0.18	0.03	0.44	0.13
World hunger/food	0.05	0.04	1.18	0.16
Haz. chem.	0.13	0.07	0.88	0.17
Biodiversity red.	0.04	0.02	1.88	0.22
Hab. destruction	0.09	0.02	1.85	0.24
Land use	0.40	0.00	0.68	0.24
Ozone depletion	0.16	0.31	1.41	0.33
Acid rain	0.30	0.31	1.20	0.38
Extinction	0.24	0.16	2.44	0.42
Nuclear stuff	0.48	0.31	0.97	0.42
Water quality	0.44	0.07	1.97	0.42
Energy consumption	0.25	0.14	2.85	0.46
Pop growth	0.28	0.09	3.14	0.48
Human health	0.07	0.12	4.14	0.51
GCC	0.23	0.18	3.58	0.54
Air pollution	0.62	0.31	2.85	0.68
Soil dest/erosion/des.	1.08	0.11	2.53	0.74

Discussion

From the results of the two studies, it is apparent that many science teachers are interested in EE. This study also confirmed earlier studies results that science teachers` attitude toward EE is positive (Gayford, 1998; Ko & Lee, 2003; Plevyak et. al. 2001). It is also provided

some important ideas of how much information is available about EI in grades 6-12 science textbooks.

It has been reported that teachers` conceptions about a subject discipline help them to present it (Anderson, 1989) and also influence students` learning and attitudes towards that particular subject (Thomson, 1984). Based on the findings, 32 teachers out of 44 have taken EI classes. Yet, the extension of teaching EI in the classroom was low. Nevertheless, teachers reported that they would like to teach EI in their classrooms (Table 5). This may be because even they have provided EI classes in their programs most colleges and universities have not institutionalized their commitment to EE in the ways that they have to reading, science, and special education, among others. It is therefore important to institutionalize teacher programs in EE (McKeown-Ice, 2000).

Teachers use textbooks about 95% of the time and they do depend on the content of their textbooks to guide them (Chiappetta, et al., 1991). In this study, there is a relation between the information about EI in textbooks and teaching those issues in the classroom. War technology was the least covered topic in textbooks (Table 6) and according to survey data war technology gained the least interest by teachers (Figure 1).

Environmental education offers contexts that might increase involvement and motivation in science education. But EE does not usually occupy enough curriculum time to allow such issues to be contextualized and discussed (Dillon, 2002). In this research, “teaching science standards takes all class time” was one of the most important barriers for the teachers (Table 3). Ko and Lee (2003) obtained similar results that lack of class time and preparation time were perceived as the greatest barriers. Lack of instructional materials (M= 4.65, SD= 1.95) and inadequate textbook coverage (M= 4.65, SD= 1.95) were also major barriers. This study also

supported the idea that little information is available in the textbooks concerning the EE (Table 6).

The finding from the study, however, were subject to the some limitations. First, due to time constraints researchers reached a limited number of teachers. Second, students` current conditions and their preferred conditions regarding EI were tested from teachers perspectives. There were not students subjects. Third, because of resource constraints, a limited number of textbooks analyzed. Despite these limitations, the study provided an initial understanding of science teachers` perspective of EE and some implications for development of environmental textbooks in the future.

Conclusion

From the results of this study it is apparent that many science teachers are interested in EE. The teachers here were science teachers, but it would be a mistake to assume that these teachers represented the majority of science teachers.

EE offers an opportunity to learn not only science subject matter but also introduce social and cognitive skills (Dillion. 2002; Hart, 2002). But what we know from research in EE is that not much EI provided in schools (Chiappetta, et. al.1991; Gardella, 1993; Hart, 2002). One of the main goals of science education is that students leave the schools to have an ability to critically analyze and evaluate issues (AAAS, 1989). However, science education alone is not capable to do that (Gayford,1998). It must be integrated with social issues. Therefore, EE can foster social responsibility for students. Students can effectively act as citizens using the values and skills with EE. Environmental education is a way to teach science which is integrated with social issues. From the results of earlier studies and current study, we know that teachers are

willing to integrate EE in their science classrooms. So, the next step might be to find the ways to achieve it!

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Appendix II

Text letter _____ Book title_____ Case(s) _____ ENC #_____

Authors _____ Publisher _____ Date_____

Edition #_____ Total pages _____ Total chapters _____ Level _____

Environmental issue content

Issue	Index pages Tally, count, 0	Glossary 1 or 0	Content pages Tally, count, 0
Ozone depletion			
Global climate change			
Energy consumption			
Acid rain			
Air pollution			
Marine pollution			
Mineral resource depletion			
Soil destruction, erosion & desertification			
Biodiversity reduction			
Extinctions of plants and animals			
Armed conflict, war technologies			
Nuclear reactors & waste disposal			
Human health & disease			
Population growth			
World hunger & food resources			
Land use			
Solid waste disposal			
Hazardous chemicals			
Habitat destruction			
Invasive species			
Water quality			
Distribution of water resources			
Wildlife management			

Other information:

Specific chapters devoted to EI:

Ancillary activities: