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# Cultural Differences in the Environmental Worldview of Children

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**Abstract**

The New Ecological Paradigm (NEP) is a popular measure of environmental concern and pro-environmental orientation of adults, which has recently been modified for use with children. For this paper, we have collected questionnaires from 1586 children from three different countries and continents (i.e. Zimbabwe, Belgium and Vietnam). In this paper we will present the NEP-scores and the search for dimensionality of the scales, across the different populations, by means of factor analyses. The results indicate that there is a clear and highly significant cultural influence on the environmental worldview of children, when developed and developing countries are compared. Such differences are important for those designing and evaluating environmental education initiatives because such initiatives need to be rooted in the local specific situation – both physically and attitudinally.

**Keywords:** Environmental worldview; new ecological paradigm; NEP scale for children; cross-cultural differences

## Intoduction

Children's environmental beliefs and attititudes have been studied extensively (e.g. Wals, 1992; Bogner & Wilhelm, 1996; Barazza, 1999; Connell et al., 1999; Fien et al., 2002; Loughland, Reid & Petocz, 2002; Tuncer, Ertepinar, Tekkaya & Sungur, 2005; overview in Rickinson, 2001) but with little methodological uniformity, resulting in evidence that is less robust than that for adults. In 2007, Manoli et al. modified the NEP scale for use with children (aged 10-12, that is ISCED1 and ISCED2 level: primary education and lower secondary education), thus creating an instrument that can be applied in a wide variety of context, making results from different studies comparable. Such uniform information on children's worldviews and pro-environmental beliefs can be of great interest for policymakers, developers of environmental learning programs, and researchers interested in the development of environmental attitudes in young people.

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Pirages and Ehrlich (1974), pointed out that the Dominant Social Paradigm (or DSP) had begun to be challenged by new beliefs and attitudes. The DSP underscores endless progress, growth and abundance of resources - beliefs that are accompanied by attitudes that contribute to the environmental degradation. In the new view, nature is seen as a limited resource, delicately balanced and subject to deleterious human inference: it challenges the DSP by rejecting the anthropocentric notion that nature exists only to serve human needs. In recent decades this new worldview has evolved from basic concerns on specific environmental problems to the recognition that humans are fundamentally altering the functioning of ecosystems and their constitution (i.e. biodiversity), resulting in unpredictable and irreversible changes. In 1978, Dunlap and Van Liere named this new social paradigm or worldview the New Environmental Paradigm (or NEP). At the same time, they constructed a scale to measure the proposed shift in people's worldviews at the level of human-environment interaction. After discussion on the multidimensionality of the scale and the nature of the terminology, it was revised by Dunlap et al. (2000), to become the New Ecological Paradigm (also NEP). Both the original scale, and the revised version have been popular measures of environmental concern and pro-environmental orientation of adults. Many researchers have used the scale in a wide range of contexts to assess adults' perceptions concerning the environment (e.g. Vining & Ebreo, 1992; Bechtel et al., 1999; Corral-Verdugo & Armendáriz, 2000; Schultz et al., 2000a, b; Johnson et al., 2004; Rideout et al., 2005). While Dunlap & Van Liere (1978) found that the NEP scale measured a single dimension, other authors have found that it measures up to four dimensions (e.g. Bechtel et al., 1999; Edgell & Nowel, 1989; Roberts & Bacon, 1997; Van Petegem & Blieck, 2006).

An intriguing field of research in which the Manoli et al. (2007) scale can be used is the cross-cultural comparison of children's environmental worldview. The study of cross-cultural differences in environmentalism is currently getting more and more attention (e.g. Duan & Fortner, 2010), and diverse instruments are applied in this context. For adults differences in the worldview, assessed with the NEP scale, have been shown by different researchers (e.g. Bechtel et al., 1999; Corral-Verdugo & Armendàriz, 2000). Van Petegem & Blieck (2006) were the first to find statistical differences between the worldview of children from different cultures, using the NEP scale for children.

In this article we investigate the worldview of Belgian, Vietnamese and Zimbabwean children, using Manoli et al.'s NEP scale for children. We examined if these children held beliefs consistent with (a) the DSP, which upholds human dominance over nature and faith that progress and technology will eventually be capable of solving all problems, including an ecological crisis, or (b) the NEP, based on humans as part of nature and on limitations to growth. We also examine the cross-cultural multidimensionality of the NEP scale for children, and compare the children's responses in relation to the different dimensions. In this context, it is also important to point out the position of the three studied countries on the United Nations Development Programme's 'Human Development Index' (or HDI) which is a comparative measure of life expectancy, literacy, education and standard of living for countries worldwide and especially child welfare: Belgium is at position 14, Vietnam at 101 and Zimbabwe at 150. The Vietnamese sample is taken from children in schools in the area of the capital city, whereas the majority of the Zimbabwean children in our sample are part of a rural community. This allows us to compare the NEP scores of children from an industrialised country (the Belgian sample), an urban community in a development country (the Vietnamese sample) and a rural community in a development country (the Zimbabwean sample). Such information is of particular interest for the designers and evaluators of environmental education initiatives (Wals, 1992). If worldviews differ across cultures, then such differences should be accounted for while developing these initiatives.

Also, initiatives cannot be transferred between cultures if the prevailing worldview on which they are based or which they intend to change differs between these cultures.

## Methods

The 15-item NEP scale, revised by Manoli et al. (2007) for use with children, consists of eight items assessing an ecological – man as part of nature – view and seven items assessing an anthropocentric – man as ruler over nature – view. For example "When humans disturb nature it often produces terrible results" is an ecological item and "Humans will someday learn enough about how nature works to be able to control it" is an anthropocentric item. The scale has a five-point Likert-type scale: strongly agree (5), agree (4), agree nor disagree (3), disagree (2), strongly disagree (1) and I don't know (0). The value of the 'I don't know' was regarded as a missing value and is not included in the analysis. The mean NEP score is calculated as the responses contributing to pro-ecological conceptions for each item: for ecological items this is the sum of the categories 'strongly agree' and 'agree', for anthropocentric items 'disagree' and 'strongly disagree'. Due to this nature of the instrument, scoring high on any item contributes to a higher NEP score; scoring high on an ecological item means the studied group agrees with the item, whereas scoring high on an anthropocentric item means that it doesn't. In general, a NEP score above 45 indicates pro-ecological conceptions.

The scale was administered class-wise in English to 524 pupils in Zimbabwe between 13 and 15 years old (280 girls and 242 boys – 2 unknown) and to 449 pupils in Vietnam between 13 and 14 years old (230 girls and 212 boys – 7 unknown). In Belgium, 613 children of 13 years old (347 girls and 246 boys – 20 unknown) filled out a Dutch version of the questionnaire. In total, nine schools of general and technical education were asked to take part in the research. The schools were chosen for reasons of attainableness and willingness to cooperate. The pupils were not in a specific environmental class or program. All classes correspond to ISCED2 level. The scale was originally designed for children aged 10 to 12, we used it for older children (between 13 and 15). In previous research we tested the comprehensibility and word difficultiesof the scale for 13 to 15 year old children. No remarkable problems were reported.

The NEP is by far the instrument that has been used the most widely to study EV. A diverse array of scientists has resorted to the NEP: sociologists (e.g. Albrecht et al., 1982), psychologists (e.g. Stern, 2000), geographers (e.g. Lalonde & Jackson, 2002) and political scientists (e.g. Dalton et al., 1999) have shown the scale to be valid and useful in both the USA and in Europe (e.g. Nooney et al., 2003; Sato & James, 1999). The scale is also increasingly finding its way into African, South-American and Asian contexts (e.g. Bechtel, 1999; Tuncer et al. 2005; Korhonen & Lappalainen, 2004; Corral Verdugo & Armandáriz, 2000). These studies have shown the NEP to be a reliable and valid measurement instrument.

## Results

First we present the response frequency distribution of the responding Belgian, Zimbabwean and Vietnamese children, including the percentage agreement with the NEP perspective, i.e. the NEP scores. Secondly we will present the results of our search for dimensionality of the NEP scale, by means of factor analysis. Finally, the mean responses over the different dimensions found are compared. The fact that the scale doesn't measure one single dimension, as Dunlap and Van Liere (1978) assumed, shows that there is an underlying consistency between different items from the instrument, explaining the same

aspect of the total variance. This means that there is more to the scale than just the NEP score at itself. But to make (future) comparison possible with other research we do present and discuss the NEP scores.

*Children's worldviews*

Table 1 shows the response frequency distribution in terms of percentage of children choosing each response and the total NEP score for all three data sets. It is clear that the Belgian children are more in favour of the NEP worldview (mean NEP score 63.2) than the children in Vietnam (mean NEP score 58.9) and in Zimbabwe (mean NEP score 51.4), indicating that Belgian children display pro-ecological conceptions more than children from Vietnam, and that children from both countries display pro-ecological conceptions more than children in Zimbabwe (all $p<0.001$)

Belgian responding children score high on both types of items (mean ecological 73.3 – mean anthropocentric 56.8). Vietnamese children in our sample have a comparable ecological score (73.5) but score lower on the anthropocentric items (39.4). The Zimbabwean group scores lowest both on ecological (65.7) and anthropocentric (32.5) items.

*Dimensionality of the scale*

We used a principal-components factor analysis (PCA) with varimax rotation, showing three dimensions. This three-factor model explained a total of 37.30% of the variance in results obtained. We also used a principal axis factoring method (PAF), showing the same three dimensions, although less profound, loading less items and explaining only 22,10% of variance. In table 2 we present the results of both methods. The three dimensions arising from the analysis are: 'Limits to growth' (LIM), 'Balance of nature' (BAL) and 'Man above nature' (MAN). Using the PCA, four items (NEP 1, 9, 10 and 11) load heavily on the first component. Five items (NEP 3, 5, 7, 13 and 15) loaded on the second and five (NEP 2, 4, 8, 12 and 14) loaded on the third component. Based on the content of the items and in line with literature, we named the components limits to growth, balance of nature, and man over nature.

Table 2. *Factor Loadings in the Principal Component Analysis (PCA) of the NEP Items*

| | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Limits to growth | | Balance of nature | | Man over nature | |
| | PCA | PAF | PCA | PAF | PCA | PAF |
| NEP 1 | **.523** | **.344** | .090 | .111 | -.017 | -.018 |
| NEP 9 | **-.538** | **-.416** | .438 | .343 | .223 | .182 |
| NEP 10 | **.626** | **.473** | .130 | .140 | .143 | .113 |
| NEP 11 | **.650** | **.528** | .259 | .251 | -.080 | -.065 |
| NEP 3 | .292 | .257 | **.507** | **.376** | .075 | .008 |
| NEP 5 | -.174 | -.058 | **.515** | **.315** | -.001 | .065 |
| NEP 7 | .127 | .125 | **.498** | **.349** | -.020 | -.015 |
| NEP 13 | .055 | .085 | **.478** | **.314** | -.090 | -.061 |
| NEP 15 | .167 | .158 | **.627** | **.542** | -.085 | -.076 |
| NEP 2 | -.067 | -.047 | .013 | .007 | **.528** | .386 |
| NEP 4 | .311 | .215 | -.041 | -.005 | **.546** | **.412** |
| NEP 8 | .024 | .022 | -.109 | -.090 | **.675** | **.555** |
| NEP 12 | -.329 | -.296 | -.036 | -.024 | **.666** | **.598** |
| NEP 14 | .016 | .002 | .027 | .036 | **.567** | **.418** |
| NEP 6 | .176 | .121 | .333 | .268 | .299 | .207 |

Using the PAF, the items that load on the different factors are: LIM= NEP 9, 10 and 11; BAL= NEP 15; MAN= NEP 4, 8, 12 and 14. Although PAF might be a better method to analyse the dimensionality of the scale (since it assumes that there are more variables causing bias than included in the model), the results of this analysis are weaker and less interpretable than the PCA analysis, which at it's turn explains a larger amount of the variability and has higher factor loadings (all above 0.4). Since both methods reveal the same three dimensions and to facilitate comparison between our results and those found by other authors who also use PCA to analyse the factors (e.g.: Gambro, 1995; Furman, 1998; Dunlap & Van Liere, 2000; Rideout et al., 2005), we will base our discussion on the PCA. Item six 'The earth has plenty of natural resources if we just learn how to use them' (6) was disregarded from the NEP scores, as it didn't load sufficiently on any of the components in the factor analysis in our research. This result is in line with the findings of previous research (Dunlap et al., 2000; Rideout et al., 2005). We agree with Rideout et al. (2005) that NEP item 6 is probably misinterpreted by respondents. Cronbach alpha's were calculated for each dimension within each culture, all ranged between .65 and .87 and can constructs can thus be considered reliable measures for environmental concern.

Table 3. *Mean Comparison Between the Belgian, Vietnamese and Zimbabwean Children for the Three Dimensions. Bold Marks Significant.*

| Dimension | Mean ± Std. Error | Compared to | Mean Difference ± Std. Error | Sig. |
|---|---|---|---|---|
| Limits to growth | **ZIM** | BEL | **.13** ± .042 | .006 |
| | 3.66 ± 0.73 | VN | **.14** ± .045 | .005 |
| | **BEL** | ZIM | **-.13** ± .042 | .006 |
| | 3.53 ± 0.77 | VN | .01 ± .044 | 1.000 |
| | **VN** | ZIM | **-.14** ± .045 | .005 |
| | 3.57 ± 0.71 | BEL | -.02 ± .044 | 1.000 |
| Man over Nature | **ZIM** | BEL | **-.98** ± .044 | .000 |
| | 2.65 ± 0.73 | VN | **-.71** ± .048 | .000 |
| | **BEL** | ZIM | **.98** ± .044 | .000 |
| | 3.63 ± 0.72 | VN | **.27** ± .046 | .000 |
| | **VN** | ZIM | **.71** ± .048 | .000 |
| | 3.37 ± 0.79 | BEL | **-.26** ± .046 | .000 |
| Balance of Nature | **ZIM** | BEL | **-.33** ± .040 | .000 |
| | 3.71 ± 0.74 | VN | **-.45** ± .043 | .000 |
| | **BEL** | ZIM | **.33** ± .040 | .000 |
| | 4.04 ± 0.62 | VN | **-.12** ± .041 | .014 |
| | **VN** | ZIM | **.45** ± .043 | .000 |
| | 4.16 ± 0.64 | BEL | **.12** ± .041 | .014 |

The total NEP score was then defined as the sum of the scores of the other 14 items.To make comparison possible between the answers of the children, with regard to the dimensions, the directionality of the anthropocentric items was changed, and the score per group per dimension was calculated as the mean of all individual ecological and reversed anthropocentric items (see figure 1). The results of an ANOVA shows that there are significant differences between all countries for all dimensions: $F$(BAL)=61.6, $p$<0.001; $F$(LIM)= 6.5, $p$=0.002; $F$(MAN)=256.7, $p$<0.001. Post-hoc tests (table 3) show that all groups differ significantly from each other for all dimensions (all $p$<0.015), except Belgium and Vietnam for the LIM dimension (both $p$=1.00).

Table 1. *Frequency distributions for the NEP scale for all groups. ($N_{BEL}$ = 613, $N_{ZIM}$ = 524, $N_{VN}$ = 449, in percentages, frequency between brackets). SA = strongly agree, A = agree, AnD = agree nor disagree, D = disagree, SD = strongly disagree, ? = I don't know. BEL = Belgium, ZIM = Zimbabwe, VN = Vietnam*

| | Item | Country | SA | A | AnD | D | SD | ? | NEP-score* |
|---|---|---|---|---|---|---|---|---|---|
| 1. | We are getting close to having too many people on earth | BEL | 15.7 (74) | 26.7 (126) | 32.8 (155) | 14.0 (66) | 10.8 (51) | 21.7 (133) | 42.4 |
| | | ZIM | 42.0 (206) | 25.5 (125) | 13.9 (68) | 9.6 (47) | 9.0 (44) | 6.1 (32) | 67.5 |
| | | VN | 54.1 (243) | 29.8 (134) | 5.1 (23) | 2.4 (11) | 2.0 (9) | 6.5 (29) | 84.0 |
| 2. | Humans have the right to change the natural environment to fit their needs. | BEL | 6.8 (38) | 14.6 (82) | 27.0 (151) | 30.2 (169) | 21.4 (120) | 7.3 (45) | 51.6 |
| | | ZIM | 26.5 (132) | 21.0 (105) | 11.0 (55) | 21.0 (105) | 20.4 (102) | 4.6 (24) | 41.5 |
| | | VN | 12.2 (55) | 16.9 (76) | 12.7 (57) | 24.5 (110) | 30.1 (135) | 3.6 (16) | 54.6 |
| 3. | When humans disturb nature it often produces terrible results. | BEL | 38.3 (220) | 37.6 (216) | 19.8 (114) | 3.3 (19) | 1.0 (6) | 5.7 (35) | 75.9 |
| | | ZIM | 34.2 (161) | 29.3 (138) | 16.3 (77) | 10.8 (51) | 9.3 (44) | 9.4 (49) | 63.5 |
| | | VN | 57.5 (258) | 27.2 (122) | 6.9 (31) | 1.8 (8) | 3.3 (15) | 3.3 (15) | 84.6 |
| 4. | Human cleverness and skill will make sure that we do NOT ruin the earth. | BEL | 8.9 (45) | 16.1 (81) | 32.2 (162) | 24.7 (124) | 18.1 (91) | 16.6 (102) | 42.8 |
| | | ZIM | 24.1 (111) | 22.2 (102) | 18.7 (86) | 20.4 (94) | 14.6 (67) | 11.5 (60) | 35.0 |
| | | VN | 24.9 (112) | 23.4 (105) | 18.9 (85) | 18.0 (81) | 6.7 (30) | 8.0 (36) | 24.7 |
| 5. | Humans are greatly mistreating the environment. | BEL | 29.6 (173) | 31.7 (185) | 29.8 (174) | 6.5 (38) | 2.4 (14) | 3.3 (20) | 61.3 |
| | | ZIM | 33.4 (160) | 29.2 (140) | 12.9 (62) | 14.2 (68) | 10.2 (49) | 7.3 (38) | 62.6 |
| | | VN | 32.5 (146) | 36.3 (163) | 12.0 (54) | 8.5 (38) | 7.6 (34) | 3.1 (14) | 68.8 |
| 7. | Plants and animals have as much right as humans to live. | BEL | 62.4 (362) | 21.6 (125) | 11.4 (66) | 3.3 (19) | 1.4 (8) | 2.9 (18) | 84.0 |
| | | ZIM | 50.5 (257) | 26.1 (133) | 8.1 (41) | 8.6 (44) | 6.7 (34) | 2.3 (12) | 76.6 |
| | | VN | 55.9 (251) | 31.8 (143) | 4.0 (18) | 1.8 (8) | 2.2 (10) | 4.2 (19) | 87.8 |
| 8. | Nature is strong enough to handle the bad effects of modern developed countries. | BEL | 2.4 (13) | 5.8 (31) | 14.7 (79) | 36.6 (197) | 40.5 (218) | 11.4 (70) | 77.1 |
| | | ZIM | 13.7 (59) | 28.0 (121) | 22.0 (95) | 19.9 (86) | 16.4 (71) | 16.6 (87) | 36.3 |
| | | VN | 8.7 (39) | 9.8 (44) | 13.6 (61) | 19.4 (87) | 36.5 (164) | 12.0 (54) | 55.9 |
| 9. | Even with our special abilities humans must still obey the laws of nature. | BEL | 34.1 (183) | 45.8 (246) | 16.6 (89) | 3.0 (16) | 0.6 (3) | 11.4 (70) | 79.9 |
| | | ZIM | 58.2 (292) | 26.5 (133) | 7.0 (35) | 3.2 (16) | 5.2 (26) | 3.6 (19) | 84.7 |
| | | VN | 14.0 (63) | 24.1 (108) | 25.8 (116) | 18.0 (81) | 4.9 (22) | 13.1 (59) | 38.1 |
| 10. | The so-called "environmental crisis" facing humans has been blown out of proportion (exaggerated). | BEL | 3.8 (17) | 9.1 (41) | 30.2 (136) | 34.6 (156) | 22.4 (101) | 25.0 (153) | 57.0 |
| | | ZIM | 11.3 (41) | 21.3 (77) | 27.9 (101) | 22.4 (81) | 17.1 (62) | 30.5 (160) | 39.5 |
| | | VN | 37.4 (168) | 33.0 (148) | 14.0 (63) | 4.7 (21) | 2.4 (11) | 8.5 (38) | 7.1 |
| 11. | The earth is like a spaceship with very limited room and resources. | BEL | 12.9 (52) | 32.5 (131) | 33.7 (136) | 10.9 (44) | 9.9 (40) | 32.6 (200) | 45.4 |
| | | ZIM | 21.6 (101) | 25.9 (121) | 16.9 (79) | 16.0 (75) | 19.7 (92) | 9.9 (52) | 47.5 |
| | | VN | 57.7 (259) | 24.7 (111) | 5.1 (23) | 4.7 (21) | 2.4 (11) | 5.3 (24) | 82.4 |
| 12. | Humans were meant to rule over the rest of nature. | BEL | 2.3 (13) | 3.4 (19) | 12.4 (69) | 29.0 (162) | 52.9 (295) | 7.0 (43) | 81.9 |
| | | ZIM | 33.8 (161) | 20.0 (95) | 17.0 (81) | 16.6 (79) | 12.6 (60) | 7.1 (37) | 29.2 |
| | | VN | 4.5 (20) | 6.5 (29) | 7.8 (35) | 23.4 (105) | 51.0 (229) | 6.9 (31) | 74.4 |
| 13. | Nature is very delicate and easily harmed. | BEL | 39.2 (224) | 37.8 (216) | 15.9 (91) | 5.4 (31) | 1.6 (9) | 5.5 (34) | 77.0 |
| | | ZIM | 25.4 (117) | 28.0 (129) | 17.4 (80) | 16.3 (75) | 13.0 (60) | 10.5 (55) | 53.4 |
| | | VN | 20.0 (90) | 38.3 (172) | 11.6 (52) | 9.1 (41) | 5.1 (23) | 15.8 (71) | 58.4 |
| 14. | Humans will someday learn enough about how nature works to be able to control it. | BEL | 12.4 (55) | 24.2 (107) | 33.0 (146) | 19.2 (85) | 11.3 (50) | 26.6 (163) | 30.5 |
| | | ZIM | 37.8 (188) | 36.2 (180) | 12.7 (63) | 6.0 (30) | 7.2 (36) | 4.6 (24) | 13.3 |
| | | VN | 10.7 (48) | 23.8 (107) | 16.5 (74) | 13.8 (62) | 5.8 (26) | 29.4 (132) | 19.6 |
| 15. | If things continue as they are going, we will soon experience a major environmental disaster. | BEL | 45.6 (227) | 32.1 (160) | 18.7 (93) | 3.2 (16) | 0.4 (2) | 17.9 (110) | 77.7 |
| | | ZIM | 46.6 (219) | 23.0 (108) | 10.4 (49) | 8.7 (41) | 11.3 (53) | 10.1 (53) | 69.6 |
| | | VN | 63.0 (283) | 21.4 (96) | 4.7 (21) | 2.4 (11) | 3.1 (14) | 5.3 (24) | 84.4 |

The NEP-score was calculated as the summary positive response frequency for each item:
'SA' + 'A' for the ecological items (1, 3, 5, 7, 9, 11, 13, 15)
'D' + 'SD' for the anthopocentric items (2, 4, 8, 10 ,12, 14)

| **Mean Total Pro-NEP %** | |
|---|---|
| Belgium | **63.2** |
| Zimbabwe | **51.4** |
| Vietnam | **58.9** |

## Discussion

The objective of this study was to examine and compare the environmental worldview of children in Belgium, Vietnam and Zimbabwe. The results of this study reveal clear differences between ecological conceptions of the responding children from these countries. Belgian children in our study score highest of all three groups on Manoli et al.'s revised NEP scale for children (2005). The Zimbabwean children score lowest but still their NEP score indicates pro-ecological conceptions. The children in the Vietnamese subgroup have a score between the Belgian and Zimbabwean. Belgian responding children score high on both types of items (ecological and anthropocentric). Vietnamese children in our sample have a comparable ecological score but score lower on the anthropocentric items. The Zimbabwean group scores lowest both on ecological and anthropocentric items. Given that Belgium is a highly urbanised and developed country (HDI 14), and that Vietnam (HDI 101) and Zimbabwe (HDI 150) are both countries in development, these results suggest that children from western countries are more concerned about environmental problems than children from countries in development. In this view, the degree of development is positively correlated to pro-ecological conceptions. We might think of the basis of such a model in terms of Maslow's (1943) 'hierarchy of needs', according to which as one kind of need is satisfied another kind arises. For people in development countries the natural environment is essential for the satisfaction of survival needs. For people in western, industrialized countries it becomes a means to feelings of self-expression and accomplishment. To those whose needs lie between these two extremes the perceived significance of the natural environment might be low. Scott et al. (2003) make a similar suggestion on the differences in the relation to the environment between the rich, the poor, and those in between.

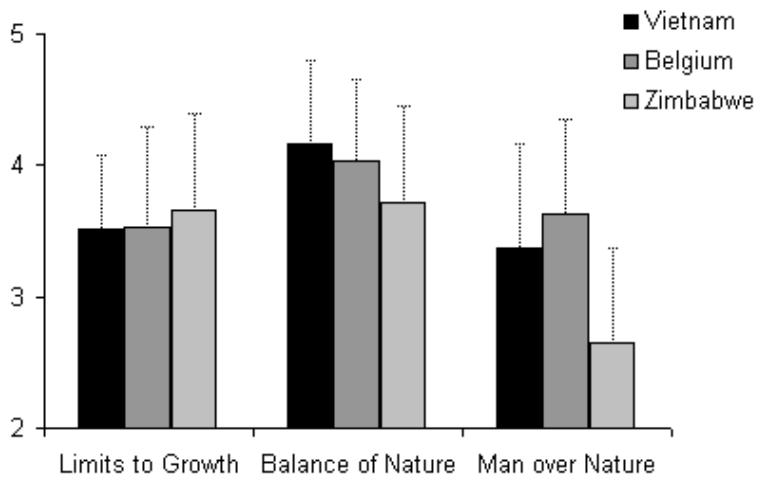


*Figure 1.* Comparison of groups per dimension. A high score indicates pro-ecological conceptions.

Knowing that the Vietnamese sample was taken from children in the area of the capital city and that the Zimbabwean respondents are part of a rural community, we could go further and suggest that in countries in development, children from urban communities have conceptions that are more environmentally orientated than those of children from rural communities. This has already been shown by Bogner & Wiseman (1997) for children in a western country (Germany). This hypothesis, which seems to be supported by the results

of our analysis of the children's answers to the questions in the NEP scale, is however too simplified and could create a negative image of the environmental worldview of children in countries in development. This observation, and the fact that more developed nations leave the deepest ecological footprints and are the driving forces behind the resource extraction and manufacturing around the world (Mckeown et al., 2002), urged us to submit our comparative data to a dimensionality analysis, looking differences at a deeper level of the scale.

Three different dimensions arose from the factor analyses we performed. Our model (with all factor loadings above 0.4 and explaining 37.30% of the observed variance) for the dimensionality of the NEP scale supports models described in previous research (Albrecht et al., 1982; Noe & Snow, 1990; Shetzer et al., 1991; Gambro, 1995; Bechtel et al., 1999; Van Petegem & Blieck, 2006). When these dimensions are included in the interpretation of the answers of the responding children, it becomes clear that there is more at hand. The answers of all three countries indicate a shared ecological perspective in which they are aware of the negative impact humankind has on nature. The Zimbabwean and Vietnamese respondents, however, also feel dominant over nature and believe they have the right to use nature for their needs. This conception is strongest in Zimbabwean children. They have faith in the problem-solving abilities of science and technology and in the strength of nature to recover from human interference. Vietnamese children display comparable environmental conceptions as Zimbabwean children, but they do believe that the earth has limited resources. The Belgian children in our research, do not share the human-dominance view. Our results suggest that responding children in the (studied) countries in development have both an ecological and a utilitarian view of the environment. This dualism was also found (for adults) in Mexican and Brazilian communities (Bechtel et al., 1999; Corral-Verdugo & Armendáriz, 2000), and is strongest in the Zimbabwean sample. Corral-Verdugo & Armendáriz (2000) suggest that in industrialized societies, acceptance of the NEP implies a clear rejection of the anthropocentric views of the DSP. Whereas, in less industrialized societies, the distinction between the two worldviews may not be as clear cut, implicating a holistic view on the human-environment relationship. The results of our research clearly support their hypothesis.

Caldwell (1990) and Chokor (1993) suggest that indigenous, non-industrialised societies tend to believe in the profound connection between humanity and nature. They find compatibility between the natural balance and the needs of humans in using natural resources. This is clearest in our Zimbabwean sample, where children are concerned with the negative human impact on the ecological systems and at the same time believe in humankind's usage of nature. The majority of the population in Zimbabwe (65%) live in rural areas where they rely directly on natural resources for their livelihoods (Chenje et al., 1998). This strong reliance on natural resources might explain the combined ecological and utilitarian view of the environment in the Zimbabwean sample. In fact, believe in the need to balance between protecting the environment and satisfying human needs fits well with many definitions of sustainable development (e.g. Goodland, 1995; Corral-Verdugo & Armendáriz, 2000).

In conclusion, our results indicate that there is a clear and highly significant cultural influence on the environmental worldview of children. This difference in NEP acceptance at the level of human-nature interaction could be explained by distinct experiences of the natural world acquired in early childhood as these significantly influence environmental concern (Korhonen & Lappaleinen, 2004). Our results suggest that the degree of development (for example measured by the HDI) of a community might be positively correlated to pro-ecological conception, but also that the rejection of the DSP by the NEP is

a phenomenon that could well only be present in western societies, whereas in less industrialised societies the NEP and DSP could coexist in a holistic paradigm.

Therefore, the model proposed above should be nuanced. Furthermore, the results of this study stress the importance of analysing the dimensionality of the NEP scale when it is used to research and compare environmental worldviews. As our research clearly indicates, cross-cultural differences in the environmental worldview of children are too subtle to be measured by the a one-dimensional NEP scale. In doing so, one might create an over-simplified and even incorrect image of the ecological conceptions of the studied group(s).

Our study has shown that environmental worldviews differ across cultures. Such differences should be accounted for while developing these initiatives. Also, initiatives cannot be transferred between cultures if the prevailing worldview on which they are based or which they intend to change differs between these cultures.

The present study is only a small part of ongoing studies in environmental conceptions of children. In further research it would be interesting to explore other cultures and contexts, as well as social and ethnic background, and educational activities.

♦ ♦ ♦

**Biographical Statements**

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# Çocukların Çevresel Dünya Görüşlerindeki Kültürel Farklılıklar

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**Özet**

Yeni Ekolojik Paradigma (NEP) çevresel kaygılarla yetişkin yanlısı çevre oryantasyonu için popüler bir ölçüdür ve son zamanlarda çocuklarda kullanmak için uyarlanmıştır. Bu makale için üç farklı ülke ve kıtadan (Zimbabwe, Belçika, Vietnam) 1586 çocuktan anket toplanmıştır. Bu çalışmada farklı popülasyonlar arasındaki NEP puanları ve ölçeğin boyutluluğu için arama, faktör analizi yoluyla sunulacaktır. Gelişmiş ve gelişmekte olan ülkelerdeki çocuklar karşılaştırıldığında kültürel etkinin çocukların çevresel dünya görüşleri üzerinde önemli etkiye sahip olduğu sonucuna ulaşılmıştır. Bu farklılıklar o tasarımı ve çevre eğitimi girişimlerini değerlendirmek için önemlidir. Çünkü bu girişimler fiziksel ve davranışsal olarak önemli ve köklü bölgesel durumlar için gereklidir.

**Anahtar Kelimeler:** Çevresel dünya görüşürü, yeni ekolojik paradigma, çocuklar için NEP ölçeği, kültürler arası farklılıklar

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# Challenges of Biodiversity Education: A Review of Education Strategies for Biodiversity Education

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**Abstract**

Biodiversity conservation has increasingly gained recognition in national and international agendas. The Convention on Biological Diversity (CBD) has positioned biodiversity as a key asset to be protected to ensure our well-being and that of future generations. Nearly 20 years after its inception, results are not as expected, as shown in the latest revision of the 2010 CBD target. Various factors may affect the implementation of the CBD, including lack of public education and awareness on biodiversity-related issues. This paper explores how biodiversity education has been carried out and documents successes and failures in the field. Based on a comprehensive literature review, we identified four main challenges: the need to define an approach for biodiversity education; biodiversity as an ill-defined concept, appropriate communication, and the disconnection between people and nature. These represent obstacles to the achievement of educational targets, and therefore, to accomplishing conservation goals as set forth by the CBD.

**Keywords:** Biodiversity education, environmental education, education for sustainable development, biodiversity awareness, biodiversity communication.

## Introduction

With the speech that launched the international year of biodiversity at the American Museum of Natural History, the Executive Secretary General of the Convention on Biological Diversity (CBD), Ahmed Djoghlaf, revealed that the 2010 target set in 2002 by the 110 Heads of State during the Johannesburg World Summit on Sustainable Development had not been met (AMNH podcast, 2010). In fact, none of the national reports submitted by the affiliated parties to the CBD were able to show that the target was achieved. Rather, they confirmed that biodiversity loss continues at an unprecedented rate (Djoghlaf, 2010). To name a few examples, the fourth National Report to the CBD from countries such as Brazil, Singapore, Canada or Kenya, showed improvement in certain areas of their National Biodiversity

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Strategy and Action Plans but none were able to fully achieve the 11 goals of the 2010 CBD target (CBD-National Reports, 2011). Different political, institutional, technical, societal and educational factors have been recognized as obstacles for the implementation of the Convention, such as lack of political will, lack of mainstreaming and integration of biodiversity issues into different sectors, institutional weakness, lack of financial and human resources as well as lack of public education and awareness, among others (CBD –COP6, 2010).

Furthermore, several surveys have been carried out in different countries since the implementation of the CBD to understand the levels of awareness on biodiversity. Many of these do not show encouraging results, suggesting that education, outreach and public awareness strategies are failing to elicit the interest and motivation needed for people to act in favor of biodiversity conservation, and that the message of the importance of sustaining biodiversity is not getting across. To name one example, results from the recent global survey conducted by Survey Sampling International and sponsored by Airbus on behalf of the Secretariat of the CBD, reveal the need for increasing the efforts to inform and empower future generations (Airbus Report, 2010). According to the survey, which was conducted in 2010 across 10 countries and sampled 10,000 children between the ages of five and eighteen, 40 percent ranked watching TV or playing computer games as a priority, compared to a mere 4 percent who considered that the environment came first. Additionally, only 9 percent ranked looking after animals as most important (CBD press release, 2010). This suggests that biodiversity education and other communication strategies have not been able to successfully permeate different sectors of society so that the general public, governmental authorities and other actors are able to take action and consider biological resources as a relevant issue that is part of their daily lives and values.

In spite of these low levels of awareness, biodiversity conservation has increasingly gained relevance in national and international agendas. International agreements such as the CBD, have been able to establish a framework to involve nations in protecting biodiversity, and organizations like the International Union for the Conservation of Nature (IUCN) or the World Wildlife Fund among others, continually work worldwide in programs and projects that seek to sustain this natural asset. According to the CBD, effective action to address biodiversity loss not only depends on strategies such as promoting the use of market incentives, establishing land-use planning policies, mainstreaming biodiversity in decision-making at different levels of governance, and involving all relevant stakeholders. It also relies on communication, education and awareness strategies to ensure that "everyone understands the value of biodiversity and what steps they can take to protect it, including through changes in personal consumption and behavior" (SCBD, 2010).

Education has been acknowledged as an important tool to achieve sustainability as well as biodiversity protection through the transformation of human attitudes towards nature (Ehrlich & Pringle, 2008). In this sense, there are great opportunities for education to contribute by helping citizens become well-informed, critical and competent, and in consequence, able to act in favor of biodiversity (Dreyfus, Wals & van Weelie, 1999). This review paper explores how biodiversity education has been practiced and examines some of the challenges and opportunities for this emerging field.

**Methods**

For the literature review, we assessed more than 70 articles available on the internet containing the terms: biodiversity education, biodiversity awareness, biodiversity outreach, biodiversity education in cities, biodiversity and education for sustainable development, biodiversity and environmental education, and biodiversity communication. Two main

search engines were used, Google scholar and Columbia University's online database CLIO (http://www.columbia.edu/ cu/lweb/). We then used content analysis to track term usage frequency, and to organize conceptual themes and topics.

**Results and Discussion**

We found less than 20 articles that contained the exact term "biodiversity education" and most of these addressed it as either Environmental Education (EE) or Education for Sustainable Development (ESD). No article provided a precise definition of biodiversity education but rather prescribed guidelines and suggestions. The majority of articles revolved around EE and ESD approaches for learning about environmental topics, including biodiversity. After a thorough review of the articles found, six main topics were identified: (1) Emergence of biodiversity on the international agenda, (2) Biodiversity as an educational theme, (3) Issues with the biodiversity concept, (4) Suggested guidelines for biodiversity education, (5) Communicating about biodiversity, and (6) the disconnection between people and nature.

*Biodiversity Agendas*

With increased realization of the need to halt biodiversity loss due to human population growth and deleterious environmental change, the biodiversity crisis became a popular discourse in conservation around the 1970s (Haila & Kouki, 1994). At the same time, worldwide recognition of the issue of sustainability emerged as a key theme of the 1972 UN Conference "The Human Environment", held in Stockholm, with the main outcome being the recognition of the necessity to pursue a sustainable development based on an economic growth and industrialization that would not cause environmental damage (Adams, 2006). Subsequent events and conferences helped to mainstream and position this idea such as the World Conservation Strategy (1980) and the Brundlant Report (1985). The latter, a report titled "Our common future", was convened by the UN to address the growing concerns about the deterioration of ecosystems and natural resources, and emphasized the need for national governments and institutions to start addressing this new target for global change. Most importantly, the commission suggested that governments should look into the prospect of agreeing to a species convention that would reflect principles of "universal resources" (United Nations, 1987).

In this respect, 1992 marked an important year for the environment and biodiversity. During the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil, a set of agreements were signed at the Earth Summit, including two very important binding agreements, the Convention on Climate Change and the Convention on Biological Diversity, the latter being signed at the time by 150 governments and which has now more than 190 affiliated parties (CBD, 2010). Both treaties sought worldwide commitment to achieving an economic development agenda that would not be driven by ecological destruction but rather by the ideal of sustaining all biological processes that support life. This in turn, it was argued, would contribute to poverty alleviation and other social and economic targets. Thus, the CBD agreed upon three main goals: the conservation of biodiversity, its sustainable use, and the fair and equitable sharing of the benefits arising from the commercial and other utilizations of genetic resources. These goals are grounded in the recognition of biodiversity's intrinsic value and the fact that it underpins ecosystem functions while providing the goods and services that sustain our life and well-being (Hubbard, 1997).

More specifically, the convention requires the affiliated parties to implement these three objectives and to have achieved by 2010 a "significant reduction of the current rate of biodiversity loss at the global, regional and national level, as a contribution to poverty

alleviation and to the benefit of all life on earth" (CBD, 2009). Recently, the tenth Conference of the Parties (COP 10) was held in Nagoya, where participants to the Conference agreed on three main inter-linked goals: a new protocol on access to and benefit sharing of the benefits accrued from the use of genetic resources, a ten year Strategic Plan (2011-2020) to meet the objectives of the CBD and that sets a new species extinction target, and a strategy to mobilize the necessary resources to increase global support for conserving biodiversity. The convention seeks to fulfill these objectives by having Parties commit to developing national programs for the conservation and sustainable use of biodiversity that can include "ex situ" and "in situ" conservation strategies, while also carrying out environmental impact assessments of proposed projects that can influence biodiversity conservation (CBD, 2010).

*Education and Biodiversity*

In terms of mechanisms to fulfill the convention's objectives, the CBD acknowledges the importance of public education and awareness as a crucial tool. Specifically, Article 13 urges the contracting parties to promote and encourage the understanding of conserving biodiversity, to procure its propagation through media and to include these topics as part of educational programs (CBD –Article 13, 2006). It also requires them to strive for cooperation among States and international organizations in developing education and awareness programs to support the goal of conserving and using biodiversity in a sustainable manner. In order to facilitate the implementation and management of the CBD, as part of the country's national biodiversity strategy (van Boven & Hesselink, 2002), the Convention has established the Communication, Education and Public Awareness (CEPA) program. Its main goal is to aid in communicating and raising awareness about biodiversity while integrating it into the education systems of all participants to the CBD.

The recognition of education as a tool to increase knowledge and awareness about biodiversity is not only acknowledged by the CBD. Environmental Education (EE) and Education for Sustainable Development (ESD) were both established as strategies to address environmental concerns through education, although each emerged at different times and from different contexts. Stapp (1969) first defined EE as a new approach, "designed to produce a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution." Parallel to the shift in thinking about how development should be accomplished and to the surge of biodiversity conservation around the 1970s, EE emerged as an important field of education dealing with the natural environment and conservation issues (Palmer, 2003). In 1968, a UNESCO Conference in Paris on Biosphere Reserves called for the development of curriculum materials on the environment, the promotion of technical training and the need to raise global awareness of environmental problems as well as to set national coordinating bodies for EE globally.

The International Workshop on EE held in Belgrade by UNESCO and UNEP in 1975, produced one of the first intergovernmental statements on EE, "The Belgrade Charter- A global framework for EE." The charter established several objectives, which included creating new patterns of behavior of individuals and society towards the environment but also supported a new form of development whereby poverty alleviation, equitable access to resources, pollution mitigation and controlled resource consumption would be sought as part of a new global ethic. Such an ethic would embrace the attitudes and behaviors that individuals and societies need in order to respond to the complex relationships between humanity and nature; which should result from a reform of educational processes (The Belgrade Charter, 1975). This vision was later supported by the Tbilisi Declaration on EE that resulted from the first global intergovernmental conference organized by UNESCO and UNEP

in 1977. The Tbilisi declaration built on the Belgrade Charter's main EE objective, which states that EE should contribute to the formation of a world population that is aware of and concerned about the environment and its problems, and that has the knowledge, skills, attitudes and commitment to work individually and collectively towards their solution.

After Tbilisi, EE evolved accordingly to the state of the art in the environmental and educational field, consequently restating its objectives, structure and breadth of action to include topics such as land-use management, endangered species and climate change education (Hungerford, 2010). New perceptions about environmental issues brought new concerns, ideas and paradigms for education. In 1983, the "World Commission on Environment and Development," also known as the "Brundlandt Commission," suggested that environmental issues were intertwined with economic and social issues. It also argued that education played a critical role in the search for sustainable living (Ulbrich et al., 2010). This resulted in Education for Sustainable Development (ESD) which evolved as a result of the new paradigm on development that later became reinforced at the Earth Summit in 1992 and subsequent conferences (i.e. World Summit on Sustainable Development in Johannesburg, 2002). As McKeown (2002) suggests, this new concept of education was not shaped by the education community itself but resulted from international political and economic forums in which ESD's conceptual framework became structured, specifically through Agenda 21 which is a comprehensive plan of action "to meet the challenges of environment and development" (UNEP, 2010) adopted at the Earth Summit in 1992. Agenda 21 reoriented education towards sustainable development and included alongside environmental education, development education. Chapter 36 of the agenda specifies that both environmental and development education should acknowledge the dynamics of the biophysical and socio-economic environment as well as human development, and encourages the need to integrate these in all disciplines, emphasizing the use of formal and non-formal methods of communication (UNDESA, 2009). Overall, ESD emphasizes the need to have a broader understanding of the interconnections between society, economy and the environment (McKeown & Hopkins, 2003).

Biodiversity education also seems to share common goals with what has been conceived as conservation education. In fact, Jacobson et al. (2006) argue that conservation education shares many goals with EE in the sense that both intend the learner to gain awareness and sensitivity to the environment, knowledge and basic understanding of the environment, attitudes that derive from a set of values and feelings of concern towards the environment that lead to its protection, and skills that allow the individual to identify and solve environmental issues. At the same time, Jacobson et al. (2006) recognize how conservation education also shares goals with ESD since both share the common goal of protecting environmental systems to sustain life while accounting for social justice and ensuring proper economic development.

*Biodiversity as an educational theme for EE and ESD*

The underlying causes of biodiversity loss come from social, economic, political, cultural, and even historical features of every society (WEHAB working group, 2002). These causes are driven by factors that range from poor governance to a lack of knowledge and awareness about the importance of biodiversity in underpinning the functioning and hence, the provision of the ecosystem services that we need for our well-being. Thus, it is evident that biodiversity loss is a multi-dimensional problem, not only having repercussions for the environment but also compromising economic growth and development, threatening livelihoods, while increasing our own vulnerability as a species.

In this sense, both EE and ESD acknowledge the relations and interdependencies between environmental and socio-economic issues and both recognize biodiversity as an important crosscutting educational theme, and as a concept that can portray such complexities. EE's approach is focused on developing an environmentally literate citizenry through pedagogical models that provide problem solving and environmental management skills, which account for social realities and that intend to change the behavior of individuals towards environmental issues (Sauvee, 1999). EE's ideals are framed within a context that recognizes the "human influences, including economic, cultural, political and social issues" (NAAEE, 2010) that affect the environment in different ways. In this sense, it considers "biodiversity" as a theme through which the learner can explore causes, connections and consequences of environmental issues such as the biodiversity crisis and how it affects us (NAAEE, 2010). Different organizations have used EE approaches to biodiversity conservation and there are also several projects that have been carried out globally through EE activities with a biodiversity focus. Projects such as "Project Wild" with an emphasis on wildlife conservation and which is supported by The Council for Environmental Education, or "Project Learning Tree" which focuses on forest conservation, are both good examples of programs in the US that intend on contributing to biodiversity conservation. The World Wildlife Fund has also used EE programs to foster wildlife conservation, as so has the IUCN.

ESD programs that use biodiversity education as a model for teaching about sustainability have also been carried out globally. For example, "The Beagle Project" (Biodiversity Education and Awareness to Grow a Living Environment) in the European Union, undertakes improving the quality of learning outside the classroom by providing the opportunity for teachers and students to take part in a project focused on monitoring the phenology of trees across Europe. The main goal is to engage students in sustainable development and biodiversity conservation. Others, such as "ESD-Educating for a sustainable future" or "SEED" in the UK, try to promote school-focused programs that deal with different environmental and sustainability issues such as biodiversity. For ESD, biodiversity depicts the complex interrelations and connections behind achieving sustainability, and so is seen as a topic that can portray key issues such as social justice, cultural diversity, politics or ethics (Lude, 2010). A recent review of biodiversity as a theme for ESD was carried out in various countries of the European Union through the workshop "Biodiversity in ESD: Reflection on school-research cooperation" held in Kassel, Germany on September 2009, with the attendance of teachers, education experts, program developers and researchers. The workshop acknowledged the importance of biodiversity as a theme for ESD through which teachers could develop the critical thinking skills needed to effectively change attitudes, beliefs and behaviors by integrating environmental, social, economic and cultural aspects (Taratsa, 2010).

Overall it seems that both EE and ESD recognize the importance of educating about and for biodiversity and they also acknowledge the multidimensional aspects of the concept. In essence, both seek the ultimate challenge of transforming society into a knowledgeable and aware citizenry that takes responsibility and that is conscious of the social, cultural, environmental and economical impacts of biodiversity loss and its effects in the future. Both attempt to create an environmentally responsible population that contributes to sustainable development (Kassas, 2002). But the question still remains whether biodiversity education is or should be founded on EE or ESD guidelines and the potential effects of such distinction for biodiversity education. These questions converge in an important debate about the relationship between EE and ESD and the role that each perspective plays in education. How do EE and ESD relate? Are they trying to achieve the same ultimate goal through different approaches?

Through a debate organized in 2000 by the IUCN in regard to ESD, participants agreed on the following four perspectives to depict EE's relationship to ESD: (a) ESD is the next generation of EE by including issues of ethics, equity and different approaches to learning, (b) ESD is a part of EE, (c) ESD and EE overlap and (d) EE is a part of ESD (Hesselink et al., 2000). A related issue to take into account in this debate is the fact that EE and ESD have both been constantly redefining their scope as well as their objectives, purpose and prospect over time, which may translate into inconsistencies when educating about a certain topic such as biodiversity (Marcinkowski, 2010). This redefining and structuring can be problematic. As Hungerford (2010) recalls, EE has tried to address a very wide range of themes and approaches in the course of its evolution which has made it very difficult for the field to have set definite "goals and standards that would support a well-thought-out and research substantive structure for EE." EE has also been accused of not being socially relevant, lacking interdisciplinary content (Hungerford, 2010), of being too advocacy-oriented and in need of professionalizing the field (Marcinkowski, 2010). On the other hand, ESD has been criticized for being based on a concept that has ethical, cultural and even conceptual issues and that might represent an anthropocentric ethic that cannot provide the basis for an integral human development, thus reinforcing the gap between man and nature (Sauvee, 1999). Additionally, different opinions from the educational sector view sustainable development as a homogenizing tendency that reduces "the conceptual space for self-determination, autonomy, and alternative ways of thinking" (Jickling & Wals, 2008) minimizing the ways in which people can be engaged into actually thinking about their relationship with nature.

*Issues with the Biodiversity Concept*

Even if biodiversity education is pursued through an EE or an ESD approach, both perspectives are confronted with biodiversity as a concept that may not be easily defined and taught. The CBD and other international agreements have put biodiversity in the spotlight, contributing to an expansion of the range of meanings and values that can be given to it (Wals, 2001). Dreyfus et al. (1999) point out political and symbolic definitions of biodiversity as well as scientific. Accordingly, biodiversity can be seen as a natural resource, as the base for sustainability, as a product of evolution or as what drives the ecosystem processes that are also essential for human well-being, among other definitions. This poses the question of how educators should deal with the continuum of meanings for a concept that is not easily referenced empirically. In fact, different education experts (Dreyfus et al., 1999; Kassas 2000; van Weelie et al., 2002) have referred to biodiversity as an ill-defined concept. Ill-defined concepts have various interpretations, are difficult to define, and are value-laden or normative as well as multi-dimensional.

In this sense, and due to the complex interrelationships that they imply, concepts such as biodiversity or sustainability do not transfer easily into people's minds (Wals, 2001). Menzel and Bogeholz (2009) suggest that the concept of biodiversity entails various challenges. First, the concept involves diversity at three different levels, ecosystem, gene and species, and not all of these levels are usually acknowledged by people, even by educators. Additionally, the reasons for and consequences of biodiversity loss surround complex ethical, economic and social issues while learners might only relate the problem to ecological issues. Finally, since biodiversity loss is a global problem that is typically exemplified by "biodiversity hotspots," this reduces the problem to certain localized areas, therefore omitting the fact that there are interactions at different levels (i.e. regional, global) that also have effects on biodiversity. These complexities may pose difficulties for both teachers and learners. On the other hand, Dreyfus et al. (1999) argue that such intricacies may actually serve as a starting point for learning about biodiversity. By "recognizing the

different political, symbolic and scientific uses" of it and exploring its different meanings, values and uses, educators can foster "critical thinking skills and respect for different ways of looking at the world" (Dreyfus et al., 1999). This implies that in order for people to understand what biodiversity is, they may need to understand what biodiversity means ecologically, culturally, socially or economically and how its loss affects all of these dimensions. In addition, people should not be excluded from the environmental/scientific literacy that can provide the basic knowledge about society and the environment, that enables people to think critically about biodiversity and what its loss entails (Kassas, 2002).

Our research indicates that biological diversity seems to be an abstract and confusing issue as a theme for education. We concur with Dikmenli and the observations of others that the lack of clarity in the limitations, ethics and assumptions of biodiversity loss is certainly part of the challenges that education faces (Dikmenli, 2010). This uncertainty leads to questioning what the objectives and guidelines for biodiversity education should be.

*Suggested guidelines for Biodiversity Education*

Most of the articles reviewed that dealt with biodiversity education addressed it either through an EE or an ESD approach. Lindemann-Matthies et al. (2009) suggest that biodiversity is a concept "suitable for ESD as it reflects the interaction of ecological, economic and social issues particularly well and requires the learner to take into account different perspectives to arrive at balanced opinions." Under an ESD approach, biodiversity education would encourage the construction of knowledge applied to solving problems in different contexts. The learner would be given the opportunity to build critical skills and to increase his/her awareness of the scientific and non-scientific aspects of biodiversity. An appropriate setting for discussion should also be accounted for (Gayford, 2000). Others have suggested the need to specify key themes that focus on different aspects of biodiversity and that serve as a framework for educators (Lude, 2010). Lude (2010) for example, centers on four main themes: diversity of ecosystems (wilderness, cultivated landscapes, urban landscapes), ecosystem services, climate change and the future, and consumption and behavior. Lindemann-Matthies et al. (2009) suggest a biodiversity education that enables people to:

- Understand the different meanings, interpretations and uses of biodiversity as well as their cultural, spiritual and economic heritage.
- Be aware of and understand the significance of biodiversity in their own environment as well as how they interact with it, and to be able to recognize how our actions have effects on it.
- Acknowledge the relationship between diversity and human well-being.

An approach to biodiversity education from an EE perspective may suggest similar guidelines. For example, Van Weelie and Wals (2002) highlight the need for enabling individuals to learn about the different interpretations and uses of biodiversity, to critique its conceptual use in environmental and political discourses and to value it in order to develop the necessary skills that allow the person to understand, construct, critique and transform their world. Only by exploring biodiversity's different meanings, values and uses will people be able to develop the critical thinking skills needed to deal with the issue of biodiversity loss. According to Dreyfus et al. (1999), it is also necessary for people to be environmentally literate and to know about how science contributes to issues such as biodiversity loss. Additionally, it should also be kept in mind that providing information is not enough to change people's behavior, which is precisely why educational programs should also take into account the public's own previous knowledge as well as their own views about biodiversity issues in order to avoid imposing dominant perspectives (Fischer & Young, 2007).

Kassas (2002) proposes five pivots to guide programs for biodiversity education. First, biodiversity education needs to embrace all the meanings associated with biodiversity but it also needs to define the scope in space and time (setting spatial and temporal boundaries) of a specific issue. The second pivot is the need for education programs to specify the perspectives to be used in their course on biodiversity that emphasize ecology and that develop an intimacy with nature. The third pivot is defining the goals and matching those with the actors'. The fourth pivot refers to having appropriate themes/sites for biodiversity education such as a school garden or a riverbank. Lastly, the fifth pivot is that of assimilation of the program whereby what was implemented to help achieve the goals is therefore monitored to ensure that all actors (learners, teachers, program planers, etc) and factors such as resources and learning sites have played a role. Alternatively, a three-year study in the Netherlands, performed by van Weelie and Wals in 1999 and which included policy-makers, environmental educators, curriculum developers, teachers, youth and NGO-representatives, came up with a six-point framework for making biodiversity meaningful. The framework comprises the following six "stepping stones":

1. Determine pedagogical perspectives and based on them, set learning goals (e.g. an ecological literacy perspective focused on ecological concepts, relationships and interdependencies).
2. Select specific themes and contexts that are complementary to overall learning goals in a certain educational setting.
3. Analyze meanings of biodiversity in different contexts using a simple working definition, for example "biodiversity represents variability in biological entities in a specific space at a specific moment in time."
4. Set concrete learning objectives that are compatible with the general learning goals and the specific themes that were selected. Wals (2001) suggests drawing the objectives from four pedagogical arguments: the emotional argument whereby personal meaning is given by reconnecting with nature through sensitization and experience; the ecological argument that leads to understanding relationships, functions and interactions; the ethical argument that deals with values, critical assumptions and taking a moral position; and the political argument whereby the person is able to debate about controversial issues while making choices and developing action competence.
5. Valuing of biodiversity through the examination of different interests and values given by different stakeholders, while contrasting these to our own.
6. Contextualizing the concept of biodiversity through the learning contexts and objectives chosen to understand biodiversity, which were determined in the previous steps.

In general, the articles that suggest guidelines for biodiversity education converge in the need for building the critical skills and environmental literacy that could eventually lead people into action towards biodiversity protection. They also highlight the need for selecting key themes that can showcase biodiversity's multiple dimensions and hence it's various uses, values and meanings.

*Communicating about Biodiversity*

In 2002, the Biodiversity Project carried out a national Survey in the US to measure American attitudes towards biodiversity. It was conducted by the public opinion firm Belden Russonello and Stewart, and interviewed 1500 adults, 18 years old and older. Poll findings revealed that 4 in 10 Americans recognize and describe the term biodiversity and 55 percent mentioned that maintaining biodiversity was important to them at a personal level.

Additionally, the top values for protecting biodiversity as well as main issues and concerns were identified. Based on these poll results, the Biodiversity Project concluded that basic literacy is needed to help people make the connection between why it is important to protect biodiversity and what actions to take (The Biodiversity Project, 2002). In another study carried out in 2007, the European Union through the Gallup Organization, performed the survey "Attitudes towards biodiversity," where 25,000 citizens above 15 years of age and from the 27 member states, were interviewed. The European Union has put legislation forward regarding biodiversity and environmental protection since the 1970s and most recently has established its Environmental Action Program for 2002-2012. Surprisingly and after more than 30 years of environmental legislation, the survey revealed that only 35 percent of the people interviewed know the term and its meaning, while another 30 percent had heard of the term but did not know what it meant. The remaining 35 percent had never heard of the term. Five percent of those interviewed mentioned that their primary source for information on biodiversity came from the school or university (Gallup Organization, 2007).

These results reveal an important challenge for biodiversity conservation and specifically for crafting communication and education strategies that can contribute to achieve the basic scientific literacy that allows people to know and understand about biodiversity. The CBD itself recognizes that the population in general is not adequately informed about the different issues related to biodiversity (CBD-UNESCO, 2001). This lack of information may be due to the scarce interest of the media on biodiversity issues, the lack of effective communication among scientists, and the lack of public interest on biodiversity. Malcom (2001) suggests that there may be a gap between the scientist's perception and the public's awareness about biodiversity in spite of a perceived informedness about environmental issues in recent times.

Mass-media campaigns and programs are usually designed to educate the public at large. Media such as television, video, radio, the Internet, and community organizations have all great potential to disseminate environmental knowledge and raise awareness (Kassas, 2000; Malcom, 2001). However, polls such as the ones aforementioned, evidence that there is still much to be done in order to reach more people. It also shows that there is a need for broader and deeper public understanding about biodiversity and why it is important to conserve it. But mere understanding about the issue does not necessarily lead to action. This is why Novacek (2008) suggests that, to attain deeper understanding and more committed stewardship of biodiversity through communication programs and strategies, it is necessary to first identify the audience that wants to be reached, including their level of understanding. Additionally, the message should be crafted accordingly to the audience as so should the mechanisms for delivering these messages.

To be more effective, communication strategies should be designed to take into account that their goal goes further than simply presenting people with information about the environment and the issues related to it (Ham & Kelsey, 1998). Communication strategies would improve their effectiveness by first evaluating the attitudes, values, and social structures of their target population, as responses generally relate to particular levels of education, economic background, cultural affiliations and religion beliefs, which will in the end showcase how willing people are to devoting time and effort to environmental protection (Novacek, 2008). Additionally, it is best to attempt to design strategies for specific groups and contexts rather than attempting to reach a wide audience (Ham & Kelsey, 1998). For example, 71 percent of the respondents for the 2002 Biodiversity Project Poll felt that biodiversity provided them with inspiration and peace of mind and several others provided reasons to protect the environment such as respect for God's work or for the future of

coming generations. These answers showcase different motivations and therefore different ways of thinking and acting towards the environment.

Another key factor in designing effective communication strategies is crafting the message. Coffin & Elder (2005) review the main strategies about how best to communicate about the effects of urban sprawl on biodiversity. Many environmental issues do not rank as a priority for people and may be easily undermined by concerns such as the economy, health care, or social security, thus making it difficult to elicit public support. Coffin & Elder (2005) conclude that in order to engage people, messages must give them a reason to care, and they must appeal to values as well as personal interests by describing the threat and by providing a solution that gives people practical steps to help and to ultimately make them feel empowered. Solutions could suggest supporting public policies or doing personal actions that may involve changing a certain behavior like driving less or consuming less plastic bags, for example. Additionally, the message should not overwhelm the public with a sense of despair towards environmental issues but rather it should try to emphasize the links between other species, habitats and human needs, highlight responsibilities and opportunities to help, use specific facts through a language that speaks to the audience, and lastly, try to make biodiversity real by drawing attention to local issues that affect people personally (The Biodiversity Project, 1999) such as the effects of sprawl or of polluting a watershed.

Once the audience is described and the message is crafted, Novacek (2008) suggests that effective linkages between the scientific community and the public need to be made through media such as news and educational programming. In general, adults mostly learn about science through television and print media, which is why it is important for the scientific community to use these channels of dissemination. Additionally, issues such as global warming and climate change have garnered widespread attention, which is advantageous in the sense that they can be used to make the connection between public concerns and biodiversity. The message used by media is important and should be educational rather than sensational or oversimplified. Internet also provides an important means of communication about scientific research results and conservation initiatives, potentially engaging different audiences and even serving as educational resources.

*The Disconnection from Nature*

"Nearly half of the world's people live in urban areas and are increasingly disconnected from nature" (Miller, 2005). This important disconnect may increase the indifference of people towards biodiversity issues. Miller (2005) argues that there has been an "extinction of experience," which stems from a cycle of impoverishment that initiates with the homogenization of flora and fauna, and continues with disaffection and apathy due to a biologically depauperate environment. In order to reconnect people and nature, Miller suggests the importance of increasing the opportunities of children to have contact with nature in cities. This is consistent with Richard Louv's opinions in his book "Last Child in the Woods" (2005). In addition, native biodiversity can contribute to a sense of place and belonging (Turner et al., 2004).

Dunn et al. (2006) refer to conservation of biodiversity worldwide as an issue dependent on urban nature, and term the phenomena the "pigeon paradox" to describe how conservation will depend on people's direct experiences with urban nature. As urbanization proceeds and urban landscapes become drastically altered, most of the biodiversity with which people relate and interact with are non-native species easily considered pests. To improve people's experiences with urban nature, Dunn et al. (2006) propose restoring native ecosystems in order to improve access to more natural landscapes within the urbanized

areas. What is interesting is that their approach does not consider education as an important tool for closing this gap, given that it could be part of an integral strategy to influence a reconnection with the outdoor world.

With important changes in the environmental and social dimensions associated with urbanization, it is important to have a citizenry that values and that has an interest in their local environment and which consequently, has the skills and motivations to act in favor of its protection. In this respect, EE strategies have been widely used as a tool to help people gain the knowledge and skills necessary to understand and deal with the complexity of environmental issues (Hungerford, 2010). Formal education strategies can increase the opportunities for bringing the learner outside of the classroom and therefore closer to nature. As Louv recounts (2005), education strategies and curricula in the US tend to emphasize learning about scientific facts and issues without prompting any hands-on experience. In fact, Louv argues that this broken bond between children and nature stems from an "overly abstract science education" that fosters a distancing rather than a reconnection between them. In addition, academic studies (Barker et al., 2005; Dillon et al., 2006) that evaluated school activities in the UK and other countries, evidence the need to increase the number of opportunities for outdoor learning by school students given the benefits in terms of increased awareness about biodiversity (Lindemann-Matthies, 2005).

In several studies reviewed by Chawla and Flanders Cushing (2007), half to more than 80 percent of the respondents identified childhood experiences of nature as a significant and predisposing experience that would eventually influence their relationship with nature. Many of the respondents mentioned family members or other role models like teachers, as well as experiences such as scouts or environmental groups, as influential to their interest for nature. Witnessing the pollution of a place that has value and reading books about nature were also mentioned as influential. It is therefore not surprising that nature activities in childhood and youth, in addition to the influence of role models, can lead to an interest and action towards nature protection (Chawla & Flanders Cushing, 2007).

Learning about biodiversity should therefore not be limited to learning facts from textbooks in the classroom. Louv (2005) as well as many others cited in this review (i.e. Dillon et al., 2006; Chawla&Flanders-Cushing, 2007; Lindemann-Matthies et al., 2009) suggest more experiential learning in the classroom. Ham and Kelsey (1998) highlight the importance of the social context of learning such as when educational methodologies are designed to foster social interactions that enable the sharing of information, the contact with nature and people, and the consequent construction of knowledge. Tidball and Krasny (2007, 2010, 2011) argue that it is important for social and ecological perspectives to be incorporated through EE programs that involve participants in community development and in hands-on activities that enhance the environment such as planting trees, urban restoration and other practices, which build stewardship and social networks, and at the same time, contribute to community well-being.

## Conclusion

### *Main Challenges for Biodiversity Education*

Overall, we find that the biodiversity educational field faces four main challenges. The first challenge entails defining the approach for biodiversity education and understanding how the nature and strategies of both EE and ESD programs can potentially influence biodiversity education. A number of educators have agreed on characterizing Environmental Education (EE) as a multidisciplinary approach of education that focuses on nature, environment and society as interdependent and inseparable entities, although it has also been argued that EE has been very environmentally focused, failing to show the synergies that lead to

environmental change. On the other hand, ESD emphasizes on the interconnections between society, economy, and the environment and has been considered a more encompassing approach by including issues of ethics and equity as well as new forms of thinking and learning (Hesselink et al., 2000). But conceptualizing sustainability and its interdisciplinary implementation can be problematic for both schools and teacher education (Summers et al., 2005). Conceptual tensions over which perspective is a more appropriate fit for education may generate problems when defining the message and approach to be used in educating about or for biodiversity, although some biodiversity education efforts claim to be a mix of activities and mechanisms from both EE and ESD.

The second challenge refers to the difficulties posed to both educators and learners in handling a concept that is regarded as ill-defined. Additionally, its multi-dimensional character relating to social, economic, and environmental interactions make it a difficult concept to transmit easily and meaningfully to learners (Wals, 1999). The challenge for educators is to help learners find personal value and meaning in a concept that does not transfer easily into their minds. Several education scholars agree on the fact that biodiversity needs to be integrated outside the box of natural sciences while prompting learners into critically exploring different meanings, uses and values of biodiversity. Integration of biodiversity as an educational theme will also depend on the conceptual framework of the educators.

The third challenge refers to the importance of reaching different and broad audiences through a meaningful message. Survey and research results on public attitudes around the world show that the message about the importance of halting biodiversity loss is not getting across. This implies that the public needs to be further engaged. Thus, the importance of conveying the correct message through non-formal education and biodiversity communication strategies that can contribute to raise awareness and motivate all levels of society. The message needs to portray the complexity of the issue without engaging into fanaticism or a sense of despair, clarifying the issue as well as the opportunities for action. Outreach efforts need to center messages around public-held values, beliefs and concerns, and they should also understand and differentiate the audience, determining the best message accordingly in order to build the stewardship needed for action.

Lastly, the fourth main challenge for education is to reconnect people and nature. Given that most people live in urban areas, where the effects of urbanization have altered ecosystems and therefore how people relate to nature, various authors cited throughout this paper (i.e. Louv, 2005; van Weelie, 2002; Lindemann-Mathies et al., 2009, 2007, 2005) have suggested that education should focus on increasing contact with nature in childhood and youth through various types of activities. This early contact has been found to predispose people to increase their interest in nature (Chawla & Flanders-Cushing, 2007).

These four issues represent some of the challenges to be overcome if the level of public knowledge, awareness and understanding about biodiversity is to be increased and targets such as those set forth by the CBD are to be met. Based on these challenges, biodiversity education should guide learners into understanding and analyzing biodiversity's different meanings and dimensions. In this way, it would enable the learners to develop critical thinking skills about biodiversity and its protection. These skills can empower learners and help them realize their potential for action according to their own interests and concerns. Finally, while addressing the four challenges enumerated above, biodiversity educational programs should emphasize experiential and social learning in order to promote a new "concern" for and relationship with nature. This viewpoint reflects a broader,

comprehensive, systemic perspective, in order for educational approaches to contribute to efforts to halt biodiversity loss.

♦ ♦ ♦

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# Biyoçeşitlilik Eğitiminin Zorlukları: Biyoçeşitlilik Eğitimi Stratejilerine Bir Bakış

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**Özet**

Biyoçeşitlilik konusundaki tartışmalar ulusal ve uluslar arası kuruluşlarca hızla önem kazanmaktadır. Biyolojik Çeşitlilik Sözleşmesi (CBD) bugünün ve gelecek nesillerin refahının korunmasını sağlamak için önemli bir unsurdur. 2010 yılındaki revize halinin gösterdiğine göre kuruluşundan yaklaşık 20 yıl sonra istenilen sonuçlara ulaşılamamıştır. Biyoçeşitlilik ile ilgili konularda halk eğitimi ve bilinç eksikliği de dahil olmak üzere, çeşitli faktörler CBD uygulanmasını etkileyebilir. Bu çalışma biyoçeşitlilik eğitim alanında yürütülen uygulamaları nasıl başarılı veya başarısız olduğunu araştırmaktadır. Kapsamlı bir literatür incelemesine dayanarak, dört ana sorunları belirledi: biyoçeşitlilik eğitimini bir yaklaşım olarak tanımlamak gereklidir; biyoçeşitliliğin tanımında sorunlar vardır; uygun iletişim ve insan ile doğa arasındaki kopukluktur. Bu engeller eğitim hedeflerinin başarısını ve bu nedenle de CBD'nin koyduğu hedeflere ulaşmasını engeller.

**Anahtar Kelimeler:** Biyoçeşitlilik eğitimi, çevre eğitimi, sürdürülebilir kalkınma için eğitim, biyoçeşitlilik farkındalığı, biyoçeşitlilik iletişimi

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# Children's Literature as an Important Tool for Education of Sustainability and the Environment

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**Abstract**

Children's literature is operated and distributed on the basis of faith, whereby if there is a place for effective links between literature and society, then it will naturally be found first in children's literature. For the most part children's literature is goal directed and amongst its targets is the assimilation of socio-cultural values. The number of study hours for children's literature in the colleges for education is very limited, and only infrequently is the educator of the future awarded broad knowledge of children's literature during her studies at the college. Currently no study program has been designated for the connection between children's literature and sustainability and its derivatives and a method of integrating this subject into the field of literature. Due to the importance of children's literature in the assimilation of values and instilling of an ideological infrastructure which will become a way of life, it is appropriate to examine the findings of literary works in literature textbooks and before this the outline of the subject in the syllabus. One should introduce environmental studies into existing subjects and introduce environmental studies as a new subject in the syllabus.

**Key words:** Children's literature, education of sustainability, education of environment, children's literature as a means of socializing

## Introduction

*Nature is the art of God (Sir Thomas Browne)*
*Nature to be commanded must be obeyed (Francis Bacon)*
*There is no forgiveness in nature (Ugo Betti)*

The ecological crises/disasters which have befallen the world have created an increasing awareness of sustainability in institution in Israel such as the Ministry for Protection of the Environment and others such as the Standards Institute, the army, voluntary organizations. In spite of the recognition by Ministry of Education and for Protection of the Environment

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urgent need to set up a working program for implementation of issues regarding the quality of the environment into the educational system. Environmental education is still not perceived as a potential subject in the school curricula. An organizing foundation which requires an innovative school model for its application is needed. Under the heading of ecology one can count 76 children's books. In particular one should note the work of Ran Levy Yamouri, which is dedicated to promoting books with an ecological orientation, some of which are written bilingually, Hebrew-Arabic. Together with the growing awareness about sustainability the question still remains: How can this subject be integrated into literature studies in teachers' training? Currently no study program has been designated for the connection between children's literature and sustainability and its derivatives and a method of integrating this subject into the field of literature.

The term ecology is one of the most focal terms in the political, social and cultural, educational and philosophical discourse in current times. The environmental debate (or ecological in the broad sense of the term) has intensified based on the fear of a man-made ecological holocaust. The environmental debate including its many derivatives is a fire in the belly of current global culture: for several the call for a green environment, for protection of nature and sustainability is a central issue in a culture observing its self-destruction, and for others this is no more than a passing fashion statement (Hotem, 2010). We wish to examine the importance of children's books dealing with nature and ecology, and whether their availability on the shelf is an action that should mediated by adults. This follows the political, educational and cultural debate between scientific approaches which aspire to discuss the preservation of nature, solely and only in functional contexts of the ecosystem and cultural approaches which adopt a normative approach as regards the protection of nature, an approach that combines social interest, aesthetic sensitivity, historical awareness and ethical judgment of man as 'a scenic mould of his native land' (Hotem, 2010). In this paper I wish to express the voice of teaching as a tool; the belief in the foundation of the next generation of agents of socialism. I wish to demonstrate how an available tool, which is also effective, can illuminate the debate in the teaching process from all its aspects.

*The Outline of Educational Policies on the Issue of Quality of the Environment*

The policy of the Ministry of Education is to deal with the subject of the quality of the environment and the subject of ecology and sustainability in general; the field of literature in particular is located within the general program. I wish to focus on books that have been written for children with the understanding that literature is an impetus for assimilation of social ethics. Therefore, it is appropriate to examine the findings of books dealing with nature conservation, particularly in the light of the memorandum which was submitted to the Education Committee (2006) and in the light of data recorded by Court and Rosenthal (2006) as regards the small number of literary works dealing with the subject of quality of the environment in school textbooks. In her study she notes love of nature and conservation of the environment as leading values. The value of the love of the people and the country appeared in 7.31% of responses relating to the important values in textbooks. In one sentence the writer summarizes the value of 'love of nature' and the value of 'preservation of the environment': "This value reinforces the understanding of the importance of the love of nature for mankind, the need for environmental conservation and the love of animals" (Court & Rosental, 2007, p. 28). However, the disparity between the treatment of it and reading about it in textbooks should be examined. As the syllabi "constitute the consolidation of the knowledge, skills and beliefs that a certain society sees appropriate to expose to the generation of students, and the methods of implementing them within diverse educational frameworks that the society establishes and makes available to the student" (Alpert, 2002, p. 28), the issue of children's literature as an additional tool in the overall process should be

examined. Also as the syllabus programming is a series of actions during which selections are made, allocations, creation and evaluation of educational outcomes and the means of achieving them, in the light of the forecast of social desires (Schremer & Bailey, 2001). Rosenthal notes that it is possible to construct the syllabus according to the educational perception and unique needs of each school or population (Rosenthal, 2006). Therefore children's literature could serve as an infrastructure for literacy, as noted by Elkad-Lehman, and Greensfeld (2008). This as in her opinion too in the teachers training system a number of unique tools have been developed for the development of awareness in the choice of literary works based on psychological, emotional, linguistic and literary considerations. Moreover, the number of study hours for children's literature in the colleges for education is very limited, and only infrequently is the educator of the future awarded broad knowledge of children's literature during her studies at the college. The lack of comprehensive knowledge and in-depth understanding of children's literature sometimes causes the mediator to be tempted to choose a text which can be 'understood immediately' – a popular text or one with simple language and content, without literary or psychological depth thus renouncing a complex and superior text from the literary aspect, which could have added worth in assimilation of values. Superior texts, which touch on the quality of the environment and sustainability, include an abundance of information in a focused field, whereby it is important to recognize not only the central concept at its foundation but rather also the profusion of terms which expand the subject. It is therefore appropriate to treat the status of children's books dealing in the subject of preservation of nature with a level of appropriate gravity. Perhaps specifically the study process which occurs outside of the formal framework will help the students understand this important value and eventually enjoy it for its own sake!

*Children's Literature as a Means of Socializing*

A book is one of the cultural programming channels as a consequence of it being the obvious outcome of the culture in which it was published. Society is, the total of the issues from which it is comprised, and its countenance is therefore the product of the individual members of the generation. Thereby also the literary work which deals with the personal and the intimate – has a social orientation. The creating individual, with all his subjective baggage, functions in a society and expresses this whether knowingly or not (Harel, 1992). Regev (1992) adds that literary works for children, during all times, reflect in one way or another ideology and the values of the society in which they are written. Regev emphasizes that children's literature was always perceived as one of the clear means for educating and training the young reader. Through the means of narrative and poem messages were conveyed that the society wished to convey. In fact, those same central values that the government and its agents wished to offer to children were emphasized so that they, when the time came, would be effective and obedient citizens. Children's literature is operated and distributed on the basis of faith, whereby if there is a place for effective links between literature and society, then it will naturally be found first in children's literature. For the most part children's literature is goal directed and amongst its targets is the assimilation of socio-cultural values. The above mentioned values refer to three points in time: past, present and future: the traditional values of the past, the valid ethics of the present and the aspiration to provide values for the children of the present with the vision that they will make society better in the future when they receive civil status (Stephens, 1992). The mimetic perception maintains that the literary work of art is a 'testimony' or a 'reflection' of the social condition - the historical national condition; it is an ideological transparency of a world-view, of the linguistic statusor the state of the art in the period in which it was written. Therefore by

means of the focused literary work on the subject one can examine the social-cultural reality, the Israeli current reality, in which way and which method reality is represented and reflected in a literary work.

On the assumption that textbooks are one of the important tools for conveying ethical messages and for structuring the social reality of the students (Apple & Christian-Smith, 1991; Helinger & Brooks, 1991), then accordingly one can also see in literature written for children an aesthetic-didactic objective, by way of examination of the cultural-ideological code of the society.

Furthermore, while literature circumvents the obstacles of the objection, it constitutes a means of bibliotherapy by training the hearts to absorb the messages that the story is conveying to its readers and listeners. As this is a mediatory method it enables observation of the heroes of the story and facilitates preparation of cognitive and emotional processing without a personal connection and as an analogy of internalizing messages. The story helps the process of acquisition of norms (in particular in children). The process of acquisition of norms is carried out within the reciprocal activity with the fellow man. The perception of intangible terms is possible only if the child has a social interaction which will lead him to experience a clash with these terms. An additional significance of children's literature is that due to the structure of the plot of the literary work, the text utilizes prior knowledge and experience in order to realize the process of comprehension (Shimrom, 1989). Therefore, stories based on familiar scenarios create a high level of interpretation. Moreover, if the texts correlate between new knowledge and prior knowledge, a process is created of encoding and of drawing conclusions over and above the text itself.

*The Contents Observed in Children's Literature Dealing with the Quality of the Environment*

Over and above the linguistic, cognitive, emotional and social objectives, the ecological story is a means of expanding global knowledge as a way of life. In the field of ecology it is important to base knowledge on the world so that the reader will appreciate what exists in it and preserve it. Preservation of nature and the landscape is not just an intangible value or a sterile statement: this value represents the creation of a quality of life corner for each individual, and within this framework will teach the reader to safeguard the resources of nature: water, land, air, sea and heritage sites.

As part of the expansion of knowledge, ecological literature explains how ecological research is trying to uncover and understand the specie of the processes taking place in the habitat from all aspects. It describes the complex validity of the environmental conditions (Cohen, 1983), such as for instance the size of the populations or the location of a certain gender in a certain place or lack of them in another place. There are some very clear phenomena: we know, of course, that fish live in water and not on land. However there are more complex and sophisticated phenomena, which cannot be identified at first glance. Another objective is the provision of knowledge about what is similar and different in the ecosystems in various places in the world (Cohen, 1983), whereby a tropical rain forest in the area of the equator is not similar to the tundra in North Alaska. What is the ruling authority in both these conditions? Is there anything shared by all the ecosystems in the world? The stories emphasise the great importance determined by the ability to forecast in advance the results of environmental changes. What will happen if the forest is cut down if it is a virgin forest? What will the ramifications be on the environment, on the organisms that existed in the forest, on the flora, on the fauna, on the soil, on the water and perhaps on the climate? Are these changes created due to human intervention in all the environmental processes? It is very important to be aware of the consequences of these changes. Poetical definitions are given in literary works to the term ecology and an abundance of terms have been revealed

which has become a dictionary of ecological terms. The reader learns to understand the difference between rehabilitation, which is the return of the land to productive use after a disruption, and reclamation which is an attempt to return the destroyed natural system to some kind of productive state or a productive state which is acceptable to the public, and the option of reusing it – not specifically an attempt to return it to its former status or necessarily to use original components. The reader learns to differentiate between restoration and repair of the entire ecosystem, about functional connections and conservation, and preservation of the natural systems which have not been harmed or were harmed relatively little. The objective of conservation is to prevent harmful situations. Furthermore, the reader learns about recycling. Literature emphasizes the factors accountable in each field, and most importantly, in addition to knowledge it becomes a tool for education of the reader to preserve the quality of the environment. Literature serves or shall serve as an agent of change (Dar, 2008), whereby with proper education and direction in the pre-schools and lower grades the children will put pressure on parents from below and on their adult environment and dictate a new code of conduct.

*So what really is the Function of Teachers' Training?*

Based on an awareness of the far reaching changes which have occurred in the world as regards ecology and the changes of the public's treatment of environmental problems and their effect on the syllabi, Blum (2006) reviews 35 years of development of syllabi on the quality of the environment in Israel. In a paper of this name he details what has occurred in the State of Israel on this issue throughout the years. Between dogma and theory he emphasizes what should be done with the syllabi to promote the subject: in his opinion, there are four ways of integrating a new subject into the syllabus of the formal education system, and in all matters relating to environmental studies, which are:

1. To renew an old fashioned subject by integrating it with environmental studies.
2. To introduce environmental studies into existing subjects.
3. To introduce environmental studies as a new subject in the syllabus.
4. To introduce environmental studies as a group into a new study field.

It is the obligation of adults to bequeath to their children and to encourage them in the love of the environment and the responsibility of preserving nature and the Earth. From Blum's paper it becomes clear that it is possible to teach quality of the environment in every discipline, however the place of literature as an integrator in this matter is absent from the paper. Due to the importance of children's literature in the assimilation of values and instilling of an ideological infrastructure which will become a way of life, it is appropriate to examine the findings of literary works in literature textbooks and before this the outline of the subject in the syllabus. The literary abundance could contribute to the introduction of the term preservation of the environment not only by a brainwashing process but rather by the tools available in literature written for children.

In conclusion, as set out by Golden (2010, p. 141), "Stories are very powerful cultural practices which are formulated by reality and at the same time contribute to its design". Therefore it is impossible to disregard the importance of literature written for children on the subject and it should be instilled as part of the teaching process. And as such it is an incentive for assimilation of values and provision of ideological infrastructure and is a means of educating to a way of life without brainwashing. The literary abundance could contribute to the introduction of environmental conservation via experience, and by a learning modifier, however these are the tools of literature. When training teachers we should instil and imbue the love of the environment and teach them how to take responsibility for

preservation of nature and the Earth and thereby to nurture the process of providing tools for those studying teaching.

♦ ♦ ♦

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# Sürdürülebilirlik Eğitimi ve Çevre için Önemli Bir Aracı Olarak Çocuk Edebiyatı

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**Özet**

Çocuk edebiyatı inançla yürütülür. Edebiyat ile toplum arasında etkili bir bağlantılar için bir yer varsa doğal olarak ilk sırada çocuk edebiyatı yer alır. Çocuk edebiyatının büyük bölümünün hedefi sosyo-kültürel değerlerin asimilasyonu üzerinedir. Okullarda çocuk edebiyatı için çalışma saati sayısı çok sınırlıdır ve çok az sayıdaki eğitimci okullarda çocuk edebiyatı ile ilgili geniş bilgi vermektedir. Şu anda çocuk edebiyatı, sürdürülebilirlik ve türevleriyle ile edebiyat alanına bu konuda entegre bir yöntem arasındaki bağlantı için ilgili herhangi bir çalışma programı tayin edilmiştir. Çocuk edebiyatının önemi bir yaşam biçimi haline gelecek değerler asimilasyonu ve ideolojik bir alt yapı aşılaması nedeniyle konunun ana hattından önce edebiyat ders kitaplarındaki eserleri incelemek ve uygunluğunu belirlemek gerekir. Var olan konuların içerisine çevre çalışmalarını tanıtmak ve çevre çalışmalarını yeni bir konu olarak müfredata eklemek gerekir.

**Anahtar Kelimeler:** Çocuk edebiyatı, sürdürülebilirlik eğitimi, çevre eğitimi, sosyalleşme aracı olarak çocuk edebiyatı

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# A Firefly Learning Module for Environmental Sustainable Development in Samutsongkhram Province, Thailand

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***Abstract***
A firefly learning module for the sustainable development proposed in this paper was developed for Thai secondary school students in the study province. A deeper connection between environment, social and economic dimensions, which lies at the core of sustainability, became the key issue for this learning module. Also an important dimension of the module was the empowerment of the students themselves. Through brainstorming and ensuring activities, students were expected to act at the local level and to develop a deeper sense of responsibility. This study aimed at to develop learning module based on both the principle of inquiry approaches and the collaboration of a community of learners. Mixed methods paradigm was employed for data collection and analysis. Four data collection techniques: classroom observations, interviews, written documents, and questionnaire were employed. The Statistical Package for the Social Sciences was applied for quantitative data analysis. The qualitative data were analyzed using open and axial coding techniques. The analyzed data were categorized to describe context of developed learning module, the students' conceptual understanding, and awareness toward ecosystems and firefly conservation. A firefly learning module was designed based on an instructional development framework of learning and communicative strategies for teaching and followed a five-step process of inquiry teaching. The study involved one-9th grade class of twenty students from one school in Samutsongkhram Province, Thailand. The results indicated that the developed learning module improved students' conceptual understanding, perceptions, and self-reported behavior toward ecosystems and firefly conservation. The results of the effectiveness of this learning module clearly showed that the students gained significantly higher score in conceptual understanding and perceptions after participating in this learning module. The results from interviews showed that the students changed from a poor to a very good level of understanding after involvement in this learning module. The results also indicated that none of the students remained at the poor level after participating in this learning module. Students' perspective toward the developed learning module revealed that most students were happy with the several educational activities and multi-tasks of the module. The results from teachers' interviews showed that all of them had positive attitudes about the learning module.

***Keywords***: Learning module, Firefly, Sustainable Development, K-12 environmental education, Mixed-method, Sense of responsibility

## Introduction

Education deals with what students know and can do and how they interact with others and what they will face in the world (Drake, 1998). The educational system has to develop not only academic and life skills, but also moral, social and personal development. The methods of instruction as well as the curriculum content have

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been changing with the times, reflecting cultural, social, and economic values and needs of communities. For example, environmental educators should pay attention on the wandering the fields and river when dealing with sense of place or sensitivity ideas (Hungerford, 2006). Moreover, educators need to work to accommodate the changing role of environment in lives.

Environmental education (EE) is gaining popularity across the globe including Thailand. It can open the students' minds to the natural existence and develop their senses of responsibility and of self dependence. It also trains them to respect the resources of the earth, as well as teaches them the obligations of citizenship. In addition, the philosophy behind environmental education is actually a combination of the philosophies behind experiential education, ecological literacy, and environmental awareness (Subramaniam, 2002). It involves teaching children through personal discovery in a natural setting, where they learn ecological principles that govern all life, as well as develop a sense of connection with the land.

Environmental education (EE) has been implemented in schools' curriculum since the past three decades, with many different forms and varieties of teaching strategies. Most environmental education for K-12 students occurs in the classroom; while teachers, curriculum designers, and researchers often neglect the outdoor learning setting (Orion & Hofstein, 1994). Development of knowledge and attitudes among the children is an important issue for environmental educators. They need to develop the environmental literacy to think about the system and promote the awareness from knowledge to actions. Nevertheless, EE is still inadequate, relatively inconsistent, and scattered in curriculum (Hungerford & Volk, 2003). EE has taken place in many venues apart from the formal school curriculum i.e., non-formal education for children, youth and adults. Orr (1992) has proposed that EE will be ineffective in advancing its own goal of creating an environmentally or ecologically literate citizenry if it continues to restrict itself within the norms of general education. The socio-economic, politics, and deeper cultural aspects of the ecological problem cannot be neglected if EE were to be effective.

During the last two decades, several research works on the connections between schooling and the global ecological crisis have been reported (e.g., Bowers, 1992; Hutchison, 1998; Orr, 1994; Smith & Williams, 1999). These topics focused on philosophical issues, concerning the purpose of education, alternative curricular and pedagogical strategies, the link between school and community, and the importance of local knowledge and trans-generational communication. For example, the study of the educational framework for vocational education which aimed to assist educators in restructuring their current practices to promote environmental stewardship revealed the challenges on teacher training in environmental concepts and teaching strategies (Arenas, 2004). A ramification of this literature is the connection between environmental perceptions and behaviors with environmental education programs in school systems.

In many Asian countries, including Thailand, EE is not taught as a distinct subject in the curriculum but is incorporated into other subjects such as science, social studies, geography, civics, live experience, and moral education (Bhandari & Abe,

2000). Therefore, EE is undergoing a reorientation away from learning in the classroom toward learning by doing outside classroom. The most efficient and effective way of solving environmental problems is to raise awareness, especially among the young. This is an important role of environmental educator to promote not only environmental awareness but also change attitudes or behaviors (Hungerford & Volk, 1990). In Thailand, the pedagogy is mostly the "chalk-and-talk" method, and learning is based on the rote method and spoon-feeding (Bhandari & Abe, 2000). As a result, students are encouraged to memorize rather than examine the problems critically. Similarly, Bureekul and Brown (2003) stated that EE in Thailand has been conducted using the traditional top-down approach of teacher-centered instruction. Thus there is a need for more appropriate teaching-learning method.

In light of the above, learning modules on ecosystems were developed to encourage students to learn through the scientific inquiry process: asking questions, analyzing data, reasoning, and formulating evidenced-based explanations. This learning module was designed to accommodate the practical limitations of time and cost. The firefly has contributed to the rapid development in tourism in the Samutsongkhram province because tourists of many home-stays have supplemented the community income with tourism-related activities, especially, by visiting the firefly habitat by motorboats. Increasingly this activity now annoys the villagers. The latter have begun to destroy some of the firefly habitat the "lumpu" trees nearby. Therefore, fireflies and their habitats were chosen as a model in this study because it is not easily to understand without participation in real-life situations. This learning module focused on developing scientific skills in data manipulation and interpretation, and aimed at enhancing students' conceptual understanding of ecological topics as reported by Novak (1998).

The developed learning module in this study was based on the collaboration of community of learners that included supervisors, local teachers, community members, environmental educators, scientists, and science educators from university according to Wenger's theory (1998). The theory of communities of practice is based on imparting "learning as social participation which is not just local events engagements but to a more encompassing process of being active participants in the "practice" of social communities and constructing "identities" in relation to these communities". This learning module should be an educational material for a sustainable development. Moreover, this learning module would make teaching and learning the most powerful instruments for bringing about the changes required to succeed at sustainable development.

In response to the challenges as mentioned above, this study aimed at developing the learning module to enhance knowledge and promote awareness toward firefly conservation, and promote students' behaviors for firefly's habitats and their ecosystems. This learning module was designed based on the inquiry approach, scientific investigation, and community-based principle. This study also concerned the impacts of the newly developed learning module on pedagogic practices and students' performance.

An inquiry approach was applied in the learning module's development and implementation. These are the learning module to learn about, in, and for environment, as suggested by Lucas (1979). This learning module is integrated the knowledge learned from school together with the knowledge gained from outside school. Through these learning modules, students will hopefully develop the suitable actions for their ecosystems.

This study attempted to develop learning module based on both the principle of inquiry approaches and the collaboration of a community of learners. In the learning module the students are made to experience a diversity of instructional activities including participating in a community of learners both within and outside their schools. The expected outcomes from this learning are (a) enhanced knowledge by which students can learn to balance environmental science concepts and practice in the community, (b) awareness of the local environmental situations, and (c) ability to take actions in conserving the environment.

**Objectives**

The objectives of this study were as follow.

1. To develop the firefly learning module for environmentally responsible and sustainable choices for lower secondary school students to improve their conceptual understanding on ecosystems, and awareness of ecosystems and firefly conservation.
2. To investigate the effectiveness of the learning module on students' achievement and perceptions.

**Research Questions**

Based on the objectives, the study addressed the following research questions:

1. Can the newly developed learning module promote lower secondary school students' conceptual understanding on firefly conservation and their local ecosystems?
2. How do lower secondary school students perceive the learning module based on their experiences of the educational activities?
3. Do students become more aware of ecosystems and firefly after exposure to the learning module?
4. Is there any change in students' behavior firefly conservation and their local ecosystems?

**Methodology**

The firefly learning module with different approaches was developed as a semester-long community-based learning module which involved the collaborative efforts of supervisors, local teachers, community members, local sages, and science educators from Mahidol University. The learning module which was developed for lower secondary school students was implemented through a variety of hands-on activities, the self-learning computer assisted instruction about firefly, extra-time exercises, and field trips.

The researchers employed the mixed-methods research paradigm (Johnson & Onwuegbuzie, 2004) to gather data to answer the research questions. Various data collection methods (triangulation) were used in order to capture the complexity of the educational study (Metz, 2000).

Based on the theoretical concepts of mixed-methods and triangulation, the researchers employed four data collection techniques: qualitative- (1) classroom observations, (2) interviews, (3) written documents and quantitative - questionnaire to gather data for the study (Patton, 1990).

During the semester-long implementation of the firefly learning module, the researchers designed the schedule for pre-test and post-test questionnaires and classroom observations. The written documents including course syllabus, teaching materials, fieldtrip reports, and student's works were collected. The interviews were also conducted as data collection. The Statistical Package for the Social Sciences (SPSS for Windows Version 13.0) was employed to analyze quantitative data collected from a questionnaire. The gathered data were analyzed with Strauss and Corbin's (1990; 1998) open and axial coding techniques. Finally, the analyzed data were categorized to describe context of developed learning module, the students' conceptual understanding and awareness toward ecosystems and firefly conservation.

## Development of Firefly Learning Module

Development of firefly learning module was implemented in following sections.

*Development of Content*

A firefly learning module was designed based on an instructional development framework of learning and communicative strategies for teaching (Leach & Scott 2002; 2003) and followed a five-step process of inquiry teaching by Beyer (1979). This learning module aimed to provide opportunities for students to learn, understand, and become aware of firefly conservation and their local ecosystems, and then take actions on firefly conservation and their habitats. The local ecosystems in Muang District Samutsongkharm province, Thailand were used as learning sites. The development of learning module comprised two main phases: brainstorming for contents of the program, and construction of the program.

*Brainstorming for the contents of the instruction*

The scope of the learning module was gathered from brainstorming through three focus group discussions with the participants: two supervisors from Educational Service Area Office-Samutsongkharm (ESAO), a local school teacher, three local sages, two science educators, an environmental educator, and two scientists. The participants expressed their feelings, opinions, and perceptions toward the existing teaching-learning process on environment at school. They discussed the factors that supported or hindered the teaching and learning, and proposed the expected learning process with pedagogical content knowledge. The proposed content and concepts of the learning module derived from brainstorming were designed to be consistent to the National Science Curriculum Standards (IPST, 2001: NRC, 2000).

*Construction of the firefly learning module*

After agreement on the content, the lesson plans for the instruction and self-learning computer-assisted instruction were designed and developed. These were done through four focus group meetings composed of a supervisor from ESAO, a local school teacher, 2 local sages, two science educators, and an environmental educator. The local teacher who was involved in the study used the knowledge and skills acquired from teacher training workshops as well as opinions from focus group meetings to generate the lesson plans under researchers supervision. The list of teaching-learning activities was generated after the first meeting and revised several times through the process of brainstorming to improve the quality and relate with the ad-hoc events.

The developed lesson plans of firefly learning module was assessed for content validity by three experts and three teachers, and revised according to their comments. Before firefly learning module implementation, a pilot trial was conducted in lower secondary school with 10 students in 8th-grade.

*Development of the self-learning computer-assisted instruction about firefly*

While construction of the firefly learning module, the self-learning computer-assisted instruction about firefly was also developed to be used in this learning module. The 5Es model, derived from constructivist consideration (Bybee, 2003), was applied for the self-learning computer-assisted instruction. The first step was engagement, by stimulating questions in each topic to encourage students to explore the knowledge on firefly. In the second step on exploration, the students explored and verified their own knowledge through the content of the self-learning computer-assisted instruction about firefly. The following step on explanation provided them with opportunities to integrate knowledge to answer formative questions and exercises. The elaboration step is the closure for retention of information and concept as well as to move the student toward application of what they have learned. In the final step is on evaluation that occurs in all four parts of the learning cycle, the students were encouraged to assess their understandings by doing exercises at the end of each topic. The reflection of learning is the abilities of the learners to construct their own knowledge and to develop the suitable actions for their ecosystems.

The developed self-learning computer-assisted instruction about firefly has been assessed for content validity and graphic appropriation by three experts including a science and technology educator, graphical expertise, and a science teacher. The self-learning computer-assisted instruction about firefly was revised according to their comments and suggestions. Before firefly learning module implementation, a pilot trial was conducted in lower secondary school students with 10 $8^{th}$-garde students.

*a) Learning module Components*

A firefly learning module was designed as a semester-long program using local ecosystems as learning resources that students learn about, in, and for their local ecosystems. The program was composed of learning objectives, instructional

materials, lesson plans, teaching-learning activities, learning through the self-learning computer-assisted instruction about firefly, and the evaluation of students' conceptual understanding of ecosystems and awareness toward ecosystems and firefly conservation.

**Investigation of the Effects of the Firefly Learning Module**

The mixed-methods research paradigm (Johnson & Onwuegbuzie, 2004) was used to gather data and analyze data. The data included true-false questions and interview on conceptual understanding of ecosystems, firefly and firefly conservation, questionnaire on perceptions and self-reported behaviors toward firefly conservation. The data were collected both before and after participation in the learning module. In addition, the written documents on concept maps, reports, and classroom observations were also used.

***Data collection***

Questionnaire, adapted from Musser and Malkus's (1994), were used to obtain information on knowledge, perceptions, and self-reported behaviors toward ecosystems, firefly, and firefly conservation both before and after the program. The questionnaire comprised three parts: 1) 15-true-false questions, 2) 5-point Likert-scales on perceptions ranged from 1 (strongly disagree) to 5 (strongly agree) and 3) 5-point Likert-scales on self-reported behaviors ranged from 1 (never) to 5 (always). The internal consistencies of the questionnaire on perceptions and self-reported behaviors using Cronbach's alpha coefficient were 0.83 and 0.85 and the reliabilities were 0.85 and 0.87, respectively.

Ten randomly selected students were interviewed on conceptual understanding of the ecosystems and perceptions on local ecosystems and firefly conservation both before and after program participation. The researcher asked questions in a variety of formats and compared responses as an internal check for self-reporting bias. Each 30 minute semi-structured interview was audio-taped, noted, and transcribed for further analyses using open and axial coding techniques according to Strauss and Corbin (1990; 1998).

The written documents on concept maps, field/laboratory records, drawings of local ecosystems, and reports were collected.

***Data analysis***

*Analysis of questionnaires:* The quantitative data on pre-test and post-test of the questionnaire were analyzed using the paired t-test. The Statistical Package for the Social Sciences (SPSS for Windows Version 13.0) was used for quantitative analysis. The questionnaires were collected, coded, and analyzed. The significance at $p < 0.05$ was used for mean separation and comparing the students' awareness toward ecosystems and firefly conservation before and after participating in the learning module.

*Analysis of interviews:* The transcribes from the interview on perceptions on local ecosystems and firefly conservation were categorized into four levels using the scoring rubric: poor (almost all answers do not show any concerns about the local

ecosystems and firefly conservation), fair (some or all answers show that students seem to be aware about local ecosystems and firefly conservation), good (most answers show students' concerns on local ecosystems and firefly conservation), and excellent (all answers show students' concerns on local ecosystems and firefly conservation).

*Analysis of written documents:* The holistic scoring rubrics technique was applied to analyze the concept maps, reports, and interviews. They were categorized into three levels of conceptual understanding: poor, fair, and good conceptual understanding.

**Results**

*Learning Module Overview*

The activities of firefly learning module were designed as a 15 two-period unit and self learning using the self-learning computer-assisted instruction about firefly. The activities were based on the community-based education that students not only learned from and with local environment, but also for their local community. The learning module composes of unit overview, learning objectives, instructional materials, activities, and assessment of students' conceptual understanding and awareness toward ecosystems and firefly conservation. The activities were listed in the chronological order, which was the order of the time that it occurred and complexity. Early activities were designed to engage students into the curriculum. Then, the activities were conducted for students to develop the knowledge and perceptions on local ecosystems needed for the entire learning module.

*Instructional materials*

The instructional materials in this curriculum were textbooks, students worksheets, the self-learning computer-assisted instruction about firefly, test kits for measuring chemical properties of water (pH, dissolved-oxygen, nitrate, ammonia), and equipments for measuring firefly population, habitats, and distribution. The self-learning computer-assisted instruction about firefly composes of the introduction (get to know firefly), firefly and lighting, how firefly lives, interesting firefly, firefly profits and conservation. Each topic provides students with opportunity to learn about firefly. Figure 1-3 show some screens of the self-learning computer-assisted instruction about firefly.


*Figure 1: Topics of the self-learning computer-assisted instruction about firefly*

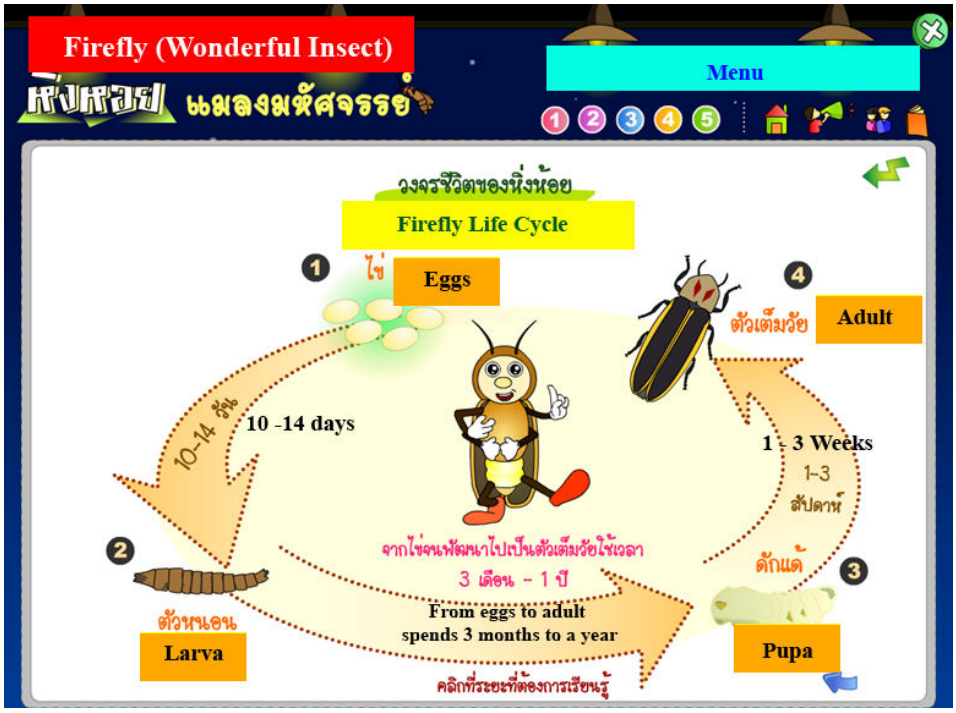


*Figure 2: Firefly Life Cycle*


*Figure 3: Ways to Conserve Firefly*

*Implementation of Firefly Learning Module*

The teaching-learning activities were conducted following the developed lesson plans (Table 1). The study involved one-9th grade class of twenty students from one school in Samutsongkhram Province, about 500 meters from the canal. The students' achievements are at the low level (GPA 2.35 ± 0.23 (on a standard 4.0 grading system). All participants are completely volunteers and anonymous, and they are free to withdraw from the program at anytime. For ethics and respect for human rights, the participants' names were given pseudonym. The details of actual educational activities of a Firefly Learning Module are described in chronological order.

*Engagement*. The class started with engagement of the students into the class by brainstorming on the meaning of environment, natural resources, and ecosystems. Each student constructed concept map on ecosystems. Then, they discussed on their interested field trip topics. The next activity was hands-on activity which was an introductory exploration on ecosystems and firefly and its importance. The students were encouraged to discuss and draw conclusion by themselves. Then, a lecture on local ecosystems and firefly by local sages was arranged for students.

*Exploration*. The exploration stage continued with planning and designing field trip activities in classroom by brainstorming. For field trip, each group of 5-6 students planned and designed for the activities and sampling areas to investigate the environment of local ecosystems and firefly tourism under teacher's guidance. The topics of the student's reports were species and number of plants in local

ecosystems, species and number of fireflies in local ecosystems, species and number of mollusks in local ecosystems, physical and chemical properties of water resources, and water quality of local water resources. Students were encouraged to design their own plan for data collection and analysis. Nevertheless, they presented the plans to the class and discussed for the most appropriate schedule, with the supports from teacher as consultant.

*Practicing*. Before field trips, students were required to practice the water quality measurement by using the test kits for pH, dissolved oxygen, nitrate, ammonia, as well as, Secchi disc, meters for measuring water depth. Students were given opportunity to go to local sage's house to attend the lecture on the importance of firefly, the relations of firefly and ecosystems, firefly conservation methods, tourism on firefly and management. Students also made minor field trip on the river bank around the local wisdom's house. Then, students discussed, summarized, and presented the lesson learned to the class.

*Exploration (Field Trips).* Four field trips within three months were conducted. During field trip, each group of students observed and recorded the data according to their interests and plans. Students measured water quality including pH, dissolved oxygen, nitrate, and ammonia by using test kits. The physical properties of water were also measured, i.e., tide, general appearance, width, depth, turbidity, temperature. The surveying of tourists and local community people were conducted to study about firefly tourism and management.

*Explanation (Data Analyzing)* . After the field trips, each group of students analyzed the data and prepared group report with guidance about the techniques from teacher. Students consulted local sages, experts, and used other resources including additional books, textbooks, journals, the self-learning computer-assisted instruction about firefly, and websites. During this activity, teacher encouraged and facilitated students to discuss and share their ideas among group members. The students also discussed the possible actions that should be done for taking care of the local ecosystems and firefly.

*Evaluation*. At the end of the learning module, students displayed their work as posters, reports etc in front of the class which were subsequently presented at exhibition organized by the research team. The students and teachers from other schools, local sages, district educators, and local people were invited to attend this exhibition.

***Table 1: Teaching-learning Activities***

| Scope of contents | Teaching-learning Activities | Week | Time (hours) |
|---|---|---|---|
| 1. Our Ecosystems | - Brainstorm about the environment, natural resources, and ecosystems: working in group of five or six<br>- Discuss and present to the class<br>- Each student construct mind map on ecosystems | 1st | 2 |
| 2. Firefly status | - Work in group of five or six on the worksheet "Firefly Status in Samutsongkhram" | 2nd | 2 |

| Scope of contents | Teaching-learning Activities | Week | Time (hours) |
|---|---|---|---|
| | - Discuss and compare the situation in the past and present in group then share in class | | |
| 3. Environmental problems and actions | - Watch video about "Firefly"<br>- Work as pair and discuss on questions "What is (are) environmental problems on firefly?"<br>- Present to class<br>- Discuss and summarize the lesson learned | 3rd – 4th | 4 |
| 4. Environmental problems and actions | - Lecture by Local Sages on local ecosystems and firefly conservation<br>- Discuss and summarize the lesson and present to the class | 5th | 2 |
| 5. Explorer 1 | Plan and design activities<br>- Provide objectives of the field trips by teacher<br>- Brainstorm on the interesting factors<br>- Divide students into group according to their interests<br>- Each group of students plan and design the field trips and sampling areas to investigate firefly habitat and status under teacher's supervision<br>- Present their own plans to the class<br>- Generate the schedule for field trips and report the progress | 6th | 2 |
| 6. Explorer 2 | - Learn how to use basic equipments for explore firefly habitat and status in class and schoolyard | 7th | 2 |
| 7. Learning with local sages 1 | - Lecture by local sages on firefly and conservation<br>- Minor field trip around the local sage's house | 8th | 2 (local community) |
| 9. Learning with Local sages 2 | - Discuss and summarize the lesson learned and present to the class | 9th | 2 (in school) |
| 10-12 Firefly Exploration in community | Three field trips for investigating the firefly habitat, ecosystems, and status | 10th-12th | 12 (extra time) |
| 13-14 Data analysis and generating report | - Each group of students analyze the data, discuss, and generate group report | 13th, 14th | 4 |
| 15. Reporting | - Each group of students present their report to the class<br>- Discuss for the possible actions for firefly conservation | 15th | 2 |
| 16. Exhibition | - Students presented their results to local community | 16th | 2 |

Note: During the semester, students learn the concepts of firefly using self-learning computer-assisted instruction about firefly

*The Effects of the Firefly Learning Module*

The effects of the firefly learning module were evaluated by various data sources: questionnaires (pre-test and post-test), four true-false questions, interviews on

conceptual understanding of ecosystems and firefly conservation. The data were collected both before and after participation in the class. In addition, the written documents on concept maps, reports, and classroom observations were also collected and analyzed for triangulation. The results of student's achievements of each measure are shown as follow.

*Students' conceptual understanding*

The conceptual understanding of local ecosystems and firefly conservation was analyzed using true-false questions, concept maps, reports, and interviews both before and after learning module participation.

***Table 2: Pre-test and Post-test Analysis of Students' Conceptual Understanding of Ecosystems and Firefly Conservation by Using the Four True-false Questions (n=20)***

| Item | Pre – test* Correct answer (%) | Post – test * Correct Answer (%) |
|---|---|---|
| Q1: Components of river ecosystems are only animals and plants. | 2.2 | 70.0 |
| Q2: Firefly eats the leaves and mollusks. | 20.6 | 56.0 |
| Q3: Ecosystems compose of living and non-living things and there are relationships among them. | 22.5 | 68.2 |
| Q4: If the aquatic plants are doubled, fireflies will have more food for living. | 67.8 | 92.0 |

*Pre-test and Post-test*

An analysis of the pre-test and post-test four true-false questions is shown in Table 2 as percentage of correct answers. For the pre-test, 2.2% of twenty students gave correct answer about components of the ecosystems: animals and plants were mentioned (Q1). Twenty percent (20.6%) of students gave the correct answer about firefly's roles in ecosystems (Q2). The 22.5% of students who provided correct answer Q3 shows that students overlooked the relationship among components of ecosystems. However, 67.8% of students gave the correct answer to Q4 about firefly tourism and conservation. When compared to the post-test, the percentage of correct answer increased extensively in Q1, i.e. from 2.2% to 70%. However, these percentages increased to a lesser extent in questions Q2, Q3, and Q4, i.e. 2.72, 3.03 and 1.36 folds respectively. Paired t-test analysis showed a significant difference in percentage of correct answers between pre-test ($M$=1.09, $SE$=0.064) and post-test ($M$ =2.65, $SE$=0.081) in all questions ($p<0.05$) as analyzed by the paired t-test. The results clearly show that the students gained significantly higher score after participating in the activities of the firefly learning module.

***Table 3: Pre- and Post-test Scores of Students' Conceptual Understanding of Local Ecosystems and Firefly by using the 15-true-false Questions***

| Item | % Correct answers* | | Difference | *p* |
|---|---|---|---|---|
| | Pre-test | Post-test | | |
| Q1: Water pollution problems in our area are caused by industries more than communities. | 15 | 80 | +65 | ** |
| Q2: Water quality can be improved if people have enough knowledge. | 60 | 75 | +15 | - |
| Q3: Produce the souvenir from firefly is a good idea for firefly tourism. | 30 | 40 | +10 | - |
| Q4: Drain the wastewater directly into the river will help aquatic animals' growth due to increase of nutrient. | 30 | 50 | +20 | - |
| Q5: Throwing garbage into the river is not a cause of water pollution. | 40 | 55 | +15 | - |
| Q6: Firefly tourism does not affect the ecosystems and water quality. | 55 | 60 | +5 | - |
| Q7: If we put more chlorine into tab water, water quality will increase. | 65 | 65 | 0 | - |
| Q8: The increasing of tourists is a cause of environmental degradation. | 40 | 50 | +10 | - |
| Q9: Using long-tail boats for firefly tourism is not good for the environment. | 55 | 65 | +10 | - |
| Q10: Avoiding resorts or home stay construction and expansion near river is one of the methods for wastewater control. | 55 | 75 | +20 | ** |
| Q11: There are fifty percents of water in the world for human living. | 35 | 75 | +40 | ** |
| Q12: We can throw any foods into the river as much as we can because aquatic animals can eat them all. | 5 | 95 | +90 | ** |
| Q13: Wastewater means the water that does not have enough oxygen for fish to breath. | 0 | 85 | +85 | ** |
| Q14: Firefly is an indicator of water quality. | 60 | 95 | +35 | ** |
| Q15: If people living upstream throw the garbage into the river, our environment will be affected. | 35 | 100 | +65 | ** |

* Results from 20 students are presented as percentage of correct answer.

** $p<.01$

Table 3 shows percentage of correct answers, difference, and statistically significant results of paired t tests comparing pre- and post- assessment of 15-true-false questions. The paired t-test of the fifteen questions showed a significant increase in percentage of correct answer in all items tested. The percentage of difference between the pre- and post-test ranged from 5% to 95%. A striking difference was observed in questions 12 (90%) and 13 (85%) which represented the cause and meaning of water pollution. Sixty-five percent increases was observed in pre and post test of both questions 1 and 15 thus suggesting that students had clearer understanding of the relationship between community, industrial activities and water pollution.

***Table 4: Number of Students at Different Category from Interview I and Interview II of the Ten Randomly Selected Students***

| Topics | Category* | Number of students (%) | |
|---|---|---|---|
| | | Interview I | Interview II |
| 1. Structure of ecosystems | 1 | 6 (60%) | 0 |
| | 2 | 4 (40%) | 7 (70%) |
| | 3 | 0 | 3 (30%) |
| 2. Recognition of firefly's roles in the ecosystems | 1 | 7 (70%) | 0 |
| | 2 | 2 (20%) | 7 (70%) |
| | 3 | 1 (10%) | 3 (30%) |
| 3.Activities of firefly conservation | 1 | 6 (60%) | 0 |
| | 2 | 3 (30%) | 6 (60%) |
| | 3 | 1 (10%) | 4 (40%) |
| 4. Tourist's roles to conserve the ecosystems | 1 | 8 (80%) | 0 |
| | 2 | 2 (20%) | 7 (70%) |
| | 3 | 0 | 3 (30%) |
| 5. Student's roles for firefly conservation | 1 | 8 (80%) | 0 |
| | 2 | 2 (20%) | 7 (70%) |
| | 3 | 0 | 3 (30%) |

Note: the levels of understanding increase from category 1 to 3

*Interviews*

The interview results as shown in Table 4 concerning ecosystems and firefly conservation indicate that 60% of students changed from poor level to very good level of understanding after participating in the learning module. Similar changes were observed on the other two topics on relationships among the firefly tourism, firefly conservation, and roles in firefly conservation, although the percentage of increase was somewhat smaller in the latter topic. It should be noted that none of the students remained at the poor level after participating in the learning module.

*Concept Maps*

The results on concept map of students on ecosystems and firefly conservation were significantly different after participating in this learning module. The holistic scoring rubrics increased from 24.8 to 56.5 from 60 points. The overall results indicated that students gained much better conceptual understanding on ecosystems and firefly conservation in several aspects indicating that most students achieved the objectives of the learning module.

Results from group of students' concept maps on the ecosystems and firefly conservation were used for probing further the students' conceptual understanding of ecosystems and firefly conservation. Almost half of the group (47%)were categorized at the good level indicating that students understood the overall concepts of ecosystems and firefly conservation but still had a few errors in

relationship between the concepts. About 25% of students were in the excellent level indicating ability to understand the whole concepts and have a clear picture of realtionship between the relevant concepts. About 20% of the students were in the moderate level indicating that they were able to understand concepts, albeit lacking in sufficient clarity which resulted in incorrect links. However, 8% of students were scored at the fair level of understanding after participating in the learning module.

The analysis of group reports using scoring rubrics of the six components shows thatthe highest average score were in the scope of study (3.75) and results (3.75) while the lowest score were in the title and introduction (2.51). Other components of objective(s), materials and methods, and discussion were also at the excellent quality (Score was 21 to 23). The results revealed that most groups generated very good reports which contained all components with correct descriptions, although the quality of the title and introduction were not as good. Analysis of the reports showed that students were able to summarize and discuss results from their observations, field trips, laboratory experiences, and correctly transfer their experiences into proper sections of the report. During the report development, students used the various resources provided. This was a good practice that students could generate good reports from using not only the textbooks but also local sages, science educators, and science educational researchers.

*Students' Awareness toward Ecosystems and Firefly Conservation*

The students' awareness toward ecosystems and firefly conservation before and after participating in this learning module indicated that there were significant increases in students' awareness in all 15 items tested. The means increased from 36.85 to 54.30. The overall results indicated that students behaved much better toward ecosystems and firefly conservation in all aspects.

***Table 5: Students' Awareness toward Ecosystems and Firefly Conservation before and after Participation in the Program***

| Items | Before | After | Different | *p* |
|---|---|---|---|---|
| 1. Tourism is a cause of wastewater problem. | 1.85 | 4.20 | 2.35 | ** |
| 2. Water pollution affects the firefly tourism. | 1.80 | 3.65 | 1.85 | ** |
| 3. My family and I have ever saved the firefly. | 2.90 | 3.85 | 0.95 | ** |
| 4. Take care the water resources can help firefly to live longer and reproduce more fireflies. | 2.45 | 3.55 | 1.10 | ** |
| 5. To improve water quality is a waste of time. | 2.85 | 3.95 | 1.10 | ** |
| 6. Everyone should be responsible for water quality and firefly conservation. | 2.70 | 3.60 | 0.90 | * |
| 7. Firefly will not be extinct because there have a lot of firefly in the community. | 2.70 | 3.85 | 1.15 | ** |
| 8. Government should have strict regulations for punishment of the environmental destroying people. | 2.75 | 3.95 | 1.20 | ** |
| 9. Local people should do something for environmental and firefly conservation. | 2.30 | 3.55 | 1.25 | ** |
| 10. Monitoring of changes in environmental and firefly | 2.65 | 4.05 | 1.40 | ** |

| Items | Before | After | Different | *p* |
|---|---|---|---|---|
| population is the responsibility of the government officials not the citizen. | | | | |
| 11. Law abandon is related to environmental problems. | 2.20 | 3.55 | 1.35 | ** |
| 12. We have to take care of the firefly as soon as possible. | 2.75 | 4.15 | 1.40 | ** |
| 13. We should educate children and people about environmental problems and firefly conservation. | 2.90 | 3.70 | 0.80 | * |
| 14. Local community should be continuously involved in environmental problem solving and firefly conservation. | 2.85 | 4.25 | 1.40 | ** |
| 15. Disseminating knowledge on environmental awareness is a good strategy for protecting environment. | 3.40 | 4.00 | 0.60 | * |
| **Total** | 36.85 | 54.30 | 17.45 | ** |

**Note:** 5-point Likert scale ranging from strongly agree (score 5) to strongly disagree (score 1), * $p$ <.05 ** $p$ < .01

Table 5 presents statistically significant results of paired t tests comparing pre- and post-assessment of 15-Likert Scale questions. The 20 participants had an average difference from pre-test to post-test awareness scores of 17.45 ($SD$ = 4.27), indicating the participating in the program resulted in a highly significant increase in awareness levels, $t(19) = -18.262$, $p = .001$ (one-tailed).

After participating in this program, the responses indicate that the twenty students more aware on the ecosystems and firefly conservation. The excerpts showed that students realize the important of ecosystems and firefly, they also indicated that they aware about their activities which will not disturb the firefly. The interviewing results from ten students also revealed that students' awareness changed toward a good level after participation in this learning module. The excerpts taken from interviews showed students' awareness toward ecosystems and firefly conservation as following.

> Student#2: "… *I have ever killed the firefly larva because I didn't know what it looks like. After learning about firefly's life cycle, I am very happy because I kept two of them. I promise I will not kill them anymore …*"
> Student#5: "… *I told my parents what I have learned from school. We have to care and cure our environment and firefly …*"

*Students' Self-Reported Behaviors toward Ecosystems and Firefly Conservation*

The results on self-reported behaviors toward ecosystems and firefly conservation were significantly higher after enrolling in the learning module. The means increased from 33.7 to 58.2. However, there were no significant changes in score of two items (items 9 and 14) between before and after participation in the learning module. The overall results as shown in Table 6 indicated that students behaved much better toward ecosystems and firefly management in several aspects.

***Table 6: Students Self-reported Behaviors toward Ecosystems and Firefly Conservation before and after participation in the program***

| Items | Before | After | Different | *p* |
|---|---|---|---|---|
| 1. Tell other people not to throw garbage into the river. | 2.35 | 3.20 | 0.85 | ** |
| 2. Clean the road by sweeping the garbage into the canal. | 2.75 | 4.20 | 1.45 | ** |
| 3. Keep the larva of firefly | 2.80 | 4.05 | 1.25 | ** |
| 4. Participate in the conservation programs. | 2.60 | 3.65 | 1.05 | ** |
| 5. While brushing the teeth, turn off tap water. | 2.70 | 4.70 | 2.00 | ** |
| 6. Tell the parents about firefly life cycle. | 2.20 | 4.05 | 1.85 | ** |
| 7. Write the board for the tourist about eco-tourism. | 1.75 | 3.25 | 1.50 | ** |
| 8. Consider water level in the utensil during dishes washing. | 2.35 | 3.65 | 1.30 | ** |
| 9. Don't throw garbage into the canal. | 2.55 | 2.90 | 0.35 | - |
| 10. Don't pour wastewater after clothes washing into the river. | 2.05 | 3.10 | 1.05 | ** |
| 11. Inform government officials, when you see someone destroy water quality and firefly. | 2.90 | 4.55 | 1.65 | ** |
| 12. You help people in firefly conservation. | 3.00 | 3.75 | 0.75 | * |
| 13. You are willing to join the environmental conservation projects. | 2.45 | 3.70 | 1.25 | ** |
| 14. Help communities in cleaning the water resources and communities. | 2.65 | 3.15 | 0.50 | - |
| 15. You have joined the project on cleaning water resources. | 2.70 | 3.40 | 0.70 | * |
| Total | 33.70 | 58.20 | 17.50 | ** |

**Note:** 5-point Likert scale ranging from always (score 5) to never (score 1)
* $p$ <.05 ** $p$ < .01

Table 6 presents statistically significant results of paired t tests comparing pre- and post- assessment of 15-Likert Scale questions. The 20 participants had an average difference from pre-test to post-test self-reported behaviors scores of 17.50 ($SD$ = 9.13), indicating the participating in the program resulted in a highly significant increase in self-reported behaviors levels, $t(19) = -8.563$, $p = .001$ (one-tailed).

After participating in this learning module, the responses indicate that the twenty students more behave on the ecosystems and firefly conservation. The excerpts also showed that students have done something for ecosystems and firefly conservation. The interviewing results from ten students also revealed that students' behaviors changed toward a good level after participation in this learning module. The excerpts taken from interviews showed students' awareness toward ecosystems and firefly conservation as following.

> Student#7: "*... Before I participated in this program, I don't want to participate in any conservation campaign. But after learning about firefly and ecosystems, I would like to do something for our ecosystems …*"

> Student#9: "… *I posted the signboard at the backyard for telling the tourists to conserve the river and fireflies …"*

*Students' Perspectives on the Learning Module*

The students' perspectives on the learning module revealed that most students were happy with the several educational activities and multi-tasks of the learning module. These teaching-learning activities including the out-of-classroom activities have met their interests. Most importantly, there was much improvement in relationships not only among teacher-students but also students-students. They noted that the teaching-learning activities provided opportunities for students to participate, discuss, share ideas, and learn with classmates, teacher, and local sages. They reported less discomfort in speaking in front of the class and in the exhibition. They reported increased ability to think creatively, engage in group discussion, lead a group, work with classmate and community people and experts, and communicate with others.

Surprisingly, all randomized ten students had positive feedbacks toward the learning module. The following are excerpts from the interviews and self-reflection journal toward the learning module and teacher.

> Student#3: "…*Teacher encouraged us to think and understand by giving the examples of things around us. We had good opportunities to learn from field trips and from local sages…"*
> Student#4: "…*I love to learn from the firefly CAI, I like the pictures…"*
> Student#7: "*... Teacher made me more enthusiastic on working and expressing my ideas. Now, I dare to think, speak out, and do many things that I've never dare to do it before… I realized the importance of collaborative learning …"*
> Student#8: "… *I gained more experiences in learning both inside and outside classroom. I had opportunities to train myself in several things during the program. It is a worthwhile learning experience. I realized that we all have to take care of our environment, starting from ourselves …"*
> Student#9: "…*I don't like to learn from the textbooks, I love these activities…"*

However, there were some drawbacks about the learning module. The main obstacles were time consuming and budget constraints. Another problem was in students themselves, most of them lack the skills used in the field trip such as, sampling of specimen, keep data record, including ware quality measurement. They need to spend extra time for studying and practicing before the field trips. At the end of the exhibition, the students also expressed their sincere thanks to the local sages, community people, teachers, parents, in supporting and encouraging. Three schools have adapted the learning module in their schools. The two local sages and other community people were satisfied with the program and expressed their willingness for further supports.

*Teachers' Perspectives toward the Learning Module*

Interviews with the three teachers after implementation of the unit showed that all of them had positive views about the learning module. They mentioned that this learning module is very different from the traditional lesson plan and is very encouraging. They were impressed by the activities and instructional materials that stimulated students to explore and manipulate data and to construct the concept of

interrelationships within the ecosystems and firefly conservation by working in group. They stated that the learning module was suitable for the lower secondary classes especially for schools which have similar circumstances. They expressed their willingness to continue using this learning module in their classes and it should not pose any problem to their colleagues in implementing it.

**Conclusions**

The Firefly Learning Module improved students' conceptual understanding, perceptions and self-reported toward ecosystems and firefly conservation. The results of the effectiveness of this learning module clearly showed that the students gained significantly higher score in conceptual understanding and perceptions after participating in this learning module. The results from interviews showed that the students changed from a poor to a very good level of understanding after involvement in this learning module. The results also indicated that none of the students remained at the poor level after participating in this learning module. Students' perspective toward the Firefly Learning Module revealed that most students were happy with the several educational activities and multi-tasks of the module. The results from teachers' interviews showed that all of them had positive attitudes about the learning module.

**Discussion**

The Firefly Learning Module was developed through collaboration among community members both in and outside the school context. This learning module can be seen as a mean for situated learning based on participation and interaction among communities. This study established a culture in community, one in which local people, local teachers, science educators, science educational researchers, students, and local sages hold expectations for engaging together in the learning process.

This learning module involved asking guiding questions to direct students' investigations and field trip exploration, students learned about firefly through self-learning computer-assisted instruction, students gathered the data and analyzed the data according to their plans, students interpreted the data and construction their poster to present to the public at the end of semester. In this learning module, students were encouraged to ask questions throughout the learning sequence, in which they did ask more intelligent questions, generate fruitful ideas, and finally develop their own understanding and behaviors on ecosystems and firefly conservation (Ausubel, 2000). This present study is also accordance with several previous findings that guided-inquiry approach which indicated as an valuable tool for teaching (Woods, 1989; Kolb, 1984; Beyer, 1979; NRC, 2000).

This learning module is similar to several other studies (Gatt *et al*., 2007; Beyer, 1979) in that students were given examples to derive the relationship between concepts and to integrate their understanding with other concepts and propositions. In all these studies, including ours, the students had the chance to learn the subject matter in such a way that knowledge was not received as in the

traditional top-down approach, but was constructed by them (Kolb, 1984; Beyer, 1979).

The students fulfilled the five-step activities of learning module which is "guided-inquiry approach" (Beyer, 1979: NRC, 2000). The students have gone through the process of inquiry since students should be able to do science, produce the meaningful explanation, and connect to the natural world. This study is in accordance with several studies that guided-inquiry approach is valuable for teaching complex topics (Woods, 1989; Kolb, 1984; Beyer, 1979; NRC, 2000). In this study, the students accomplished the specific learning objectives of the learning module as reflection the abilities in manipulating data, generating questions, and communicating, discussing, and generating explanations to the public according to Beyer (1979) and NRC (2000) concepts. This present study also confirmes that the inquiry approach helps students to learn the concept using the guided questions and data (Duit & Glynn, 1996) and provides the opportunity for sharing the experiences to others, and passing the ideas to the other in group discussion process (Gilbert & Priest, 1997).

Results from students' perception both from the questionnaire and interviews suggested that this learning module revealed that is one of the effective means for learning about ecosystems and firefly conservation. Questionnaire results revealed that students did like both the content and activities of the learning package. They also enjoyed working in groups. They realized that collaborative learning and guided-inquiry help them understand ecosystems and firefly conservation concepts. However, the students had less positive attitude toward teacher support when compared to the group activities (Lucas, 1979). This is not surprising since it is well established that students claim to learn from peers more than from teacher. About 15% of the students seemed not to like this kind of learning environment, not even guided-inquiry; they were more comfortable with the old way of spoon-feeding without having to think or express them. The students did not realize that they could not gain knowledge on environmental changes just from lecture and textbooks according to the study by Bureekul and Brown (2003) and Balster *et al*. (2001). The teachers had positive attitude toward this learning module (interviewing results). They were willing to try this learning module in their schools, with large numbers of students and limitation of time, especially, with the underprivileged students of rather low scholastic achievement.

Although, this study was conducted with a limited number of participants and no attempts to infer for all students in different contexts, the results show that the understanding can be developed through simple investigation within the current shortcomings in schools in many countries including Thailand. In addition, these activities can also be implemented in other levels because it is simple but can nevertheless be planned in a scientifically investigative way. In this particular study there was no traditional teaching done but students still developed their own understanding according to Hungerford and Volk (1990). We hope this present study will inspire more teachers to adapt and adopt the similar activities in the schools.

The community members in this study have experienced the community of learning. This study has also shown the important of learning cycle through inquiry process learn through the scientific inquiry process: asking questions, analyzing data, reasoning, and formulating evidenced-based explanations. This learning module gave students a chance that students have potential to influence the extent and manner through participating in community as suggested by Tompkins (2005). Results from these findings suggest that the participants in this learning community have been experiencing within the combination of local schools, local communities, university, workplace, and local sages. The results in this study reveal that the developed learning community has provided opportunities and places in which students have been able to develop their understanding, perceptions, and in a supportive and challenging environment according to Hungerford and Volk (1990).

This particular study presents the possibility that school curriculum conducted through community participation can play a vital role in promoting community involvement from the beginning. These findings are encouraging because the students can develop their conceptual understanding, share their learning and have perceptions toward ecosystems and management with their classmates, teachers, and local sages according to Musser and Malkus (1994), Wenger (1998), and Tompkins (2005).

In this learning module, the local environment was used as educational resources to provide students to develop environmental literacy and promote awareness from knowledge to actions which is in accordance with those of Orion and Hofstein (1994). It is also corroborated by the place-based education as described by Sobel (1996). The place-based learning connects to the experiential learning, constructivist, outdoor education, indigenous education, and environmental education (Gruenewald, 2003; Tompkins, 2005).

The statistical analyses of the pre- and post-test on students' perceptions and self-reported behaviors toward ecosystems and firefly conservation showed significant increase in perceptions as well as in self-reported behaviors. The students also made some interesting shifts in their stances as illustrated in the comparisons of interviews before and after program participation. Upon analyzing the qualitative data, the results supported the importance of incorporating communities of practice with the learning module on ecosystems and firefly conservation (Wenger, 1998; Arenas, 2004; Bowers, 1992; Hungerford & Volk, 1990; Gruenewald, 2003). A significant increase in students' perceptions indicates the importance of the teaching strategies that provided the students with the firsthand experiences necessary to develop a conceptual understanding of ecology concepts and the perceptions toward their local environment. The results of this study are also corroborated by the concepts in the studies of Orion and Hofstein (1994) and Sobel (1996).

In this study, some of the factors that may facilitate the learning on local ecosystems and firefly have been highlighted. Several activities influenced the students to initiate discussion both inside and outside the classroom. The hands-on activities such as monitoring water quality, or working with local sages, are not only

interesting and joyful but they also have a powerful influence on students' interest and awareness of local environmental issues. These students are more likely to discuss and share their interests and concerns with their classmates, teacher, and local sages in the community. Focusing on local ecosystems and firefly conservation issues related to tourism in the local ecosystems as illustrated in this study helps the students to learn and make the connections with the real world according to the studies of Tompkins (2005). In addition, this learning module also enhanced the students' sense of ownership (Sobel, 1996). Our findings reinforce the importance of including an action component in the learning module. Providing positive experiences that students can have an influence on their own local environment not only helps to overcome the action paralysis identified by Uzzell (1994) but is also likely to lead to meaningful and relevant discussions with community people regarding environmental issues and the need for community action (Orion & Hofstein, 1994; Sobel, 1996).

The results of this study provide strong support for the views expressed by Lave and Wenger (1991), Drake (1998), Wenger (1998), and others that learning and interacting with the nature can provide insight into students' perceptions on the natural world. The local environment is used as educational resources to provide students to develop environmental literacy and promote awareness from knowledge to actions as described by Orion and Hofstein (1994). However, this learning module is time-consuming and uses up resources in the form of time, money, and man-power. However, this study attempted to unfold the challenges in developing and implementing the environmental education program by community involvement. This can be seen as the stakeholders' interest in school teaching that provides students more ways of learning based on principles for situated learning (Lave & Wenger, 1991).

The learning module on ecosystems and firefly conservation in this study can be seen as a mean for situated learning based on participation and interaction among community members both in-school and outside the school context. This study also corroborated by Resnick's studies on the interaction with stakeholders outside school to provide teachers to work more situation-specifically and construct relations with the community, and as embodying competencies relevant for activities (Resnick, 1987).

This study has shown that learning can both contribute to, and be brought through the observing, measuring, identifying, and solving of environmental problems. In Wenger's theories of communities of practice the educational practitioners, novices, stakeholders, and experts have to involve in the encompassing process as active participants of social communities to share knowledge and skills (Wenger, 1998).

Throughout this learning module, students explored the local ecosystems composed the river hydrology and biology, tested water quality, firefly study using assisted instruction about firefly, and calculated a standard water quality, identified plants and fireflies found in their local ecosystems. The learning module provided the opportunities for students to gain experiences in interacting with community

people, researchers, and teachers that could lead to trust, mutual understanding and shared the practices as Wenger (1998) states as social aggregation for learning.

**Educational Implications**

Like most countries, environmental education is not taught as a distinct subject (Bhandari & Abe, 2000). The developed learning module was designed through community involvement, although it was only a small part of the participants' everyday work, it indicates that using local environment as a learning resources are challenged for teachers, community people, and students. This study will inspire the teachers in others countries to change their learning style using local environment as lerning resources. This study, however, was conducted on too small a scale to permit conclusions on a more general level, but there are indications that when students learn more about their own environment, learn about how community people think, and practice with community people, they can understand their own environment and ecology concepts more easily (Orion and Hofstein, 1994). Approximately half of the students participated in this learning activity conveyed messages to their parents and relatives about their learning and what they found including firefly tourism and management to conserve fireflies in their local areas. This finding suggests that teachers may be able to widen the perceptions of both students and parents by consciously considering this issue in planning of the learning module.

Results from this study on the advantages of the learning module should enable teachers to adopt them as part of the local curriculum as encouraged by the government. This study, however, still have some limitations such as the experiment was tried on one group of twenty rural students with low socio-economic status. Similar experiments should be tried on other more privileged ones. Perhaps a higher number of students with different backgrounds should be involved especially those that live in the urban areas.

The overall findings in this study offer an alternative to traditional teaching: the teachers' roles need to be changed to support and facilitate the broadening and organization of the students' ideas of the ecosystems. This learning module can be a good supplement to teaching in the classroom to enhance students' understanding of the ecosystems and ecology concepts. This study could be an example or alternative for teachers and educators who will design the hands-on activities, learning units, learning module, and curricula in schools. This study shows the involvement of different extent collaborative efforts from local sages, teachers, science educators, science educational researchers, and other community members.

The development of learning module in this present study is an example for promoting environmental literacy and environmental education communities. However, this learning module was implemented in 9th grade class; the results indicated that this learning module can be continuing implement in the secondary school and the college educational level in Thailand and the other countries.

The results of this study also present the involvement of teaching children through personal discovery in a natural setting, where they learn ecological

principles that govern all life, as well as develop a sense of connection with the land for the young people.

♦ ♦ ♦

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# Çevresel Sürdürülebilir Kalkınma için Ateş Böceği Modülü Samutsongkhram İli, Tayland

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**Özet**

Sürdürülebilir kalkınma için bir ateş Böceği öğrenme modülü Thai ili lise öğrencileri için geliştirilmiştir. Çevre ile sürdürülebilirlik temelinde yatan sosyal ve ekonomik boyutlar arasındaki derin bağlantı, bu öğrenme modülü için önemli bir konudur. Ayrıca modülün önemli bir boyutu da öğrencilerin kendilerini geliştirmeleri olmuştur. Beyin fırtınası ve düzenli faaliyetler sayesinde öğrencilerin yerel düzeyde hareket etme ve daha derin sorumluluk duygusunun gelişmesi beklenmiştir. Bu çalışmada soruşturma ilkesi yaklaşımları ve öğrenenlerden oluşan bir grubun işbirliği ile öğrenme modülünün geliştirilmesi amaçlanmıştır. Verilerin toplanması ve analizinde karma metot paradigması kullanılmıştır. Verilerin toplanması için sınıf gözlemi, görüşme, yazılı doküman ve anket olmak üzere dört veri toplama tekniği kullanılmıştır. Nitel verilerin analizinde The Statistical Package for the Social Sciences (SPSS) kullanılmıştır. Nitel veriler açık ve eksenel kodlama teknikleri kullanılarak analiz edilmiştir. Analiz edilen veriler, geliştirilmiş öğrenme modülü, öğrencilerin kavramsal anlamaları, ekosisteme yönelik farkındalık ve ateş böceği korunması olarak kategorize edilmiştir. Çalışmaya Taylant'ta Samutsongkhram ilinde bulunan bir okuldan yirmi 9. sınıf öğrencisi katılmıştır. Sonuçlar, geliştirilen öğrenme modülünün öğrencilerin kavramsal anlama, algılama, ekosistemler ve ateşböceği korunması yönünde davranışlara arttığını göstermiştir. Bu öğrenme modülünün etkinliğine yönelik sonuçları açıkça öğrencilerin bu öğrenme modülü katıldıktan sonra kavramsal algıları anlamada yüksek puanlar kazanmış olduğunu gösterdi. Görüşmelerden elde edilen sonuçlar öğrencilerin öğrenme modülünden sonra kötü olan anlayışlarının çok iyi bir seviyeye çıktığını göstermiştir. Bir başka sonuca göre öğrencilerin hiçbiri bu öğrenme modülü katıldıktan sonra kötü seviyesinde kalmamıştır. Geliştirilen öğrenme modülünde ki konu çeşitliliği ve eğitim faaliyetleri öğrencileri mutlu etmiştir. Öğretmenlerle yapılan görüşmeler sonucunda hepsinin modül hakkındaki tutumların olumlu olduğu sonucuna varılmıştır.

**Anahtar Kelimeler:** Öğrenme modülü, ateş böceği, sürdürülebilir kalkınma, K-12 çevre eğitimi, karma metot, sorumluluk duygusu

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# Creative Approaches to Environmental Learning: Two Perspectives on Teaching Environmental Art Education

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**Abstract**

Environmental art education is growing in popularity in college and university programs as the arts begin to play a more prominent role in environmental and sustainability education. As this emerging field of study is an interdisciplinary endeavor that draws from the more established fields of visual art education, and environmental education, environmental art education offers a means to increase the pool of potential learners to those in the arts and sciences, as well as diversify learning to ensure that it is memorable and authentic. This article describes two different approaches to the design of courses in this emerging field from the perspectives of both science and art educators, in hopes of providing direction on the development of curricula and pedagogy in environmental art education to other educators.

**Keywords:** Environmental education, environmental art education, eco-art education, visual arts, course design

## Introduction

Developing new courses is a process that many of us in academia come to simultaneously love and despise. We enjoy the challenge of choosing appropriate content and pedagogy for a course, but recognize at the outset the long hours that go into preparing reading lists and devising engaging learning activities for our students. This is especially true in a new field of study where there is little established or accepted curriculum, and no textbooks to guide the way. Having just undertaken this challenge in the development of new courses in environmental art education, this article offers an opportunity to share the processes and results from two distinct perspectives as we teach in post-secondary settings in two different countries. While our subject area was similar, our starting points couldn't have been more different, as one of us hails from the sciences and the other from the arts. Our

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hope is that a comparison of how our courses in environmental art education developed may help provide direction and reflection on the development of curricula and pedagogy in this emerging field for other educators.

**Theoretical Background**

Environmental art education is an interdisciplinary endeavor that draws elements from the more established fields of visual art education, science education and environmental education, amongst others. Sometimes referred to as eco-art education, it fosters the kind of transdisciplinary learning argued for by environmental educators by integrating knowledge, pedagogy and narrative from the visual arts, sciences, outdoor education, and environmental education (Orr, 1994; Palmer, 1998; Zakai, 2002). This is done as a means of developing awareness of and engagement with environmental concepts and issues such as interdependence, systems-thinking, biodiversity, conservation, and sustainability. It can also offer opportunities for artistic forms of environmental activism for students of all ages by encouraging the development of creativity alongside cross-curricular learning in pursuit of the higher goal of sustainability (Hansen, 2009).

Environmental art education is growing in popularity in college and university programs as the arts start to play a more prominent role in 'greening' and sustainability efforts in society as a whole. In part, its growing presence recognizes that all disciplines need to play a role in improving environmental literacy in post-secondary learners, as well as the general populace; developing this is considered by many educators to be essential to the continued existence of human life on this planet (Orr, 1992; Őzden, 2008; Smith & Williams, 1999; Thomashow, 1995). While science educators have taken a lead role in the past in developing new ways to broaden and deepen environmental learning, researchers in that field (Leeming, Dwyer, Porter & Cobern, 1993; McBeth & Volk, 2010; Tal, 2010; Talay, Gűndűz, & Akpinar, 2004) freely admit that progress has been limited in actually creating what Short (2010) describes as "a citizenry that is capable of understanding the complexity of environmental issues and participating in their resolution" (p. 7).

With forty years having passed since the first Earth Day and major global environmental issues still in need of resolution, the environmental education community is currently grappling with its proper place in the environmental movement (Marcinkowski, 2010; Potter, 2010; Strife, 2010). To that end, environmental educators are also seeking more innovative and aggressive ways to create and deliver issue-focused, environmental education curriculum that addresses the interdisciplinary nature of environmental problems (Hicks & King, 2007; Hungerford, 2010; Song, 2008; Turner, 2008; Zakai, 2002).

We both believe that bringing the arts to the table as allies in this undertaking offers alternative ways to reach learners who may not have been reached by the more traditional cognitive approaches of science education. Bringing art's powerful ability to engage audiences with multiple dimensions of an issue to environmental education not only increases the pool of potential learners from those in the sciences to those in the arts and sciences, but it also diversifies the types of learning that might take place, increasing the likelihood that the learning will 'stick' with a wider range of students (Dunaway, 2009). As the need for more arts-based, affective approaches to environmental education has been echoed by many others (Adams, 1991; Graff, 1990; Graham, 2007; Gurevitz, 2000; Lindholdt, 1999; McGibben, 2005), it is clear that environmental and sustainability education needs the arts more than ever as the human race struggles to find creative and innovative solutions to the immense environmental challenges we face in the 21st century.

Despite our background, knowledge and experiences in environmental education, developing new courses in environmental art education proved to be a huge challenge for both of us. At each of our respective institutions, environmental art courses were new to the departmental offerings, so there were no existing syllabi to guide the way in our course development. Fortunately, we shared one major advantage – institutional support. Ryan was working in the Natural Science Faculty at Purchase College in New York state, and received encouragement both from his home department and the college administration to explore arts-enriched ways to engage students in dialogue about their scientific understanding of environmental problems. Hilary was in the Fine Arts Faculty at Concordia University in Montreal, and her department welcomed her efforts to create art education courses focused on environmentalism to contribute to a growing social movement of people concerned about the quality of the environment (Norton, 1991).

The literature provided few precedents to draw on. While there had been descriptions of colloquia in eco-art education for adults (Birt, Krug and Sheridan, 1997; Neperud, 1997; Savva, Trimis & Zachariou 2004; Stankiewicz and Krug, 1997; Turner, 2008) and workshops (Anderson, 2000; Holmes, 2002; Keifer-Boyd, 2002), there is little in the literature describing the construction of curricula for post-secondary students in this area. The one exception to this is Rosenthal (2003), who argues for pedagogy that conceptually and experientially supports a systems approach to eco-art learning at the college level. She actively encourages systems thinking, systems practice, team building, collaborative practice and project assessment as her core pedagogical strategies; this was done purposefully as a means to promote her conception of best practices in eco-art (Rosenthal, n.d). Although framed within the terminology of systems theory, her pedagogical approach is similar to that recommended by other scholars (Garoian, 1998; Krug, 2003; Neperud, 1995) in that it focuses on inquiry-based, collaborative learning that promotes interconnectivity.

These references were familiar to Hilary as she started to develop her courses, and informed her course development, but not so with Ryan. As a science educator unfamiliar with the eco-art education literature, he instead partnered with Heather Saunders, a practicing artist and trained art historian as well as the Fine Arts librarian at his college. This provided him with a willing collaborator to support his curriculum development, and an entrée into arts-based learning approaches. As his college is supportive of interdisciplinary courses that foster collaboration between faculty members in the arts and sciences, his partnership proved to be a rewarding outcome of the course, as multiple perspectives were incorporated from the outset.

**Description of Courses**

Even though we had yet to meet, we started with similar overall learning goals for our students: to develop an appreciation of the roles artists play in positive environmental change; to provide an entreé into learning about environmental issues; and to acquire skills needed to critically comprehend and analyze environmental artworks. But because each of us were starting with different backgrounds and theoretical perspectives, available resources, and student interests, we pursued different approaches for achieving these similar goals.

Hilary had a head start with the latter goals, as her large class of undergraduate students came from the Art Education and Fine Arts programs at the university. Many had prior knowledge in art history and art-making, and were comfortable in interpretive discussions. However their knowledge and comfort level with the arts was balanced by the lack of even a basic knowledge of environmental issues for many students; for them, discussions and readings about the environmental crisis was eye-opening and disturbing. As the course

was presented in the context of a fine arts program, students' expectations were for an art course focused on the environment, rather than an environmental studies course with an arts focus. This dictated that the course content center more on the arts, rather than science concepts, sitting at odds with many traditional approaches to learning about environmental issues (Turner, 2008).

In contrast, about three-quarters of Ryan's small class were majoring in one of the social or natural sciences, with the minority majoring in the arts. Anticipating a classroom heavily skewed by students with formal training in scientific analysis, but little in artistic analysis, Ryan and Heather developed the course with the assumption that most of these students would also have little basic preparation or literacy in the arts. Ryan's biggest fear soon became that his treatment of the various media and techniques discussed in the class would have to be so rudimentary, that the quarter of his students who were majoring in the arts would take little away from the course and might ultimately withdraw. However a carefully crafted student survey reassured him that that his major-based assumptions about the starting points of the students was not an accurate descriptor of their level of preparedness to critically engage with the course material. In fact, due to the self-selected nature of this elective course, all of his students shared a previous interest (and in many cases) an existing background and comfort level in the arts not evident on their transcripts. As a result, during reviews of student work throughout the semester, it was nearly impossible to discern the art majors from the science majors.

Given Ryan's partnership with Heather, who had a deep knowledge of art history, they chose to organize their environmental art course via a four-pronged, media-based approach. The first prong was lecture-based and was intended to introduce the basic skills necessary to understand environmental issues, interpret artworks and achieve basic literacy in the different disciplines of the visual arts. The second prong was field-based and provided students with the opportunity to explore and experience first-hand the ways in which artists attempt to engage with environmental issues. The third prong was writing-intensive and required students to think critically about the artworks and artists they encountered. Finally, the fourth provided students with the opportunity to practice the concepts they learned by creatively expressing their own environmental message through an artistic medium of their choice.

For Ryan and Heather's course, this approach resulted in a variety of assignments. Students honed their analytical skills by writing three short critical analyses of environmental artworks, writing reflective journal entries about field trips and visiting artist lectures, and completing a comprehensive final exam. As a culminating project each student also had to create an individual piece of environmental art that incorporated reclaimed materials in some way. The class ended the course by working collaboratively to organize their work for a public exhibition in the campus library, providing students the opportunity to develop a theme, promote an exhibit, and learn curatorial stewardship skills as they cared for and displayed the pieces.

While similar in its goals of providing an entreé to learning about environmental issues, critically viewing art connected to the social movement of environmentalism and sharing their learning collectively, Hilary's approach was restricted by the logistics of the course. She had seventy students in a lecture hall on Monday nights in the winter term, making it difficult to include art-making or field trips in the syllabus. This course offered an introduction to environmental art education by focusing on the work of environmental artists; discussing key readings from the related literature; and exploring the history of and current approaches to environmental education. Environmental issues and challenges

were discussed in relation to specific artworks, but the artworks, rather than the issues, were the starting point. The content was delivered via lectures, class discussions, guest speakers, student presentations and a field trip to the Montreal Bio-Dome (a museum/zoo that recreates four distinct ecosystems with living tableaus of plants and animals). The latter, a site typically focused on science education experiences, helped to introduce the class to science–based concepts such as the features of ecosystems and biomes, balancing the artistic focus of the course.

Students were encouraged to bring their creativity to their assignments in Hilary's course, despite the physical limitations of the lecture space they were working in. They did write a critical analysis of one of the assigned readings, and enjoyed the interactivity of a 'Web of Life' treasure hunt at the Bio-Dome. However they situated their learning individually in the creation of an environmental self-portrait (connecting to an environmental issue of personal interest and analyzing the work of eco-artists working on it). This was followed with a collaborative project that had them design and implement eco-art learning experiences for their communities. What resulted was a variety of innovative projects that raised awareness about environmental concepts or issues, from snow sculptures with primary students, to eco-art walking tours of the city, even sessions on natural dyeing and jewelry-making with chicken bones! Due to their creativity, these student presentations were a highlight of the course as they bolstered students' confidence in learning about and taking action on environmental challenges in their communities.

Informing both of our courses were frameworks for exploring environmental learning and eco-art practice. Hilary used the work of Collins (2003) which conceptualized eco-art practice as lyrical expression, critical engagement and transformative action as a base, relating it to learning in, about and for the environment. This helped students to understand the varying 'shades of green' that eco-art making and learning can take (Inwood, 2010). In contrast, Ryan's course focused on artists' adoption of SOLE (sustainable, organic, local, & ethical) materials in their creations (Powell, 2009); the interaction of natural forces in the creation of artworks (as in kinetic sculptures); and the incorporation of the land in place-based art-making (as with Earthworks). Students also referenced the 2003 Cincinnati Contemporary Arts Center exhibit catalog "Ecovention" (Spaid, 2003) as a touchstone for discussions about how artworks can address the environment by creating positive ecological conditions, as with trans-species and restorative works that have a healing effect on environmental challenges. We both drew on web resources in this work, particularly on the useful listing of environmental artists and readings at www.greenmuseum.org.

**Student Response**

Certainly the shared goals of the Concordia students (in terms of their common department) made them an easier crowd to choose course material for, and many were vocal about their enjoyment of the course. Students noted that they were unaware of environmental art before coming to the course, and were pleased to be able to green their own practice as artists and art educators, even if in small degrees. As many in this class were practicing artists, they were frustrated with the lack of an art-making component (sadly impossible given the lecture format decided by the university) as they had been inspired by the artworks they had seen and wanted to try making their own. There was a growing recognition that they needed to deepen their learning about environmental issues, and surprise that they could do this by studying artworks (rather than science textbooks). Their enthusiasm for the field trip to the Bio-Dome was palpable; many had never been there before, and were happy to reframe the value of this 'science' site as a possible

resource in future for art education. After this trip, there was a disappointment that they couldn't go on more field trips to explore the natural and built environments of their own city (though few wanted to venture outside in the frigid temperatures of Montreal winter nights to do so!) But the component they seemed to enjoy the most was the collaborative learning project that allowed them to try out their own ideas about eco-art education with learners in the community. While some worked with children and others with fellow students, many were thrilled at their first attempts and eager to try teaching in this area again. At the end of the course, they spoke of the increased confidence they had with taking their own students into a range of environments (built or natural) to inspire art-based learning, as well as their realization that art education could (and should) play a more active role in positive environmental change.

At Purchase College, the most popular component of the course was the opportunity to act upon the inspiration students received by creating and exhibiting their own piece of environmental art. Students expressed gratitude for being given an opportunity to explore aspects of an environmental issue on their own and to express their personalized understanding of it on a public platform. Students also enjoyed the opportunity to talk personally with practicing environmental artists; arts majors enjoyed the opportunity to glean advice from a positive example of success, whereas science majors enjoyed the opportunity to hear artists explain the approaches they took to artistically expressing their understanding of environmental issues. All students commented positively on the class-trips to outdoor art parks, made possible by the small class size. These unconventional "museum" spaces caused the students to experience art in a new way and helped to expand their views about art. Finally, students universally appreciated the co-instructed nature of the course; every student evaluation commented positively on the benefit they received from receiving the course content from the perspectives of both an artist and a scientist.

**Challenges**

As a scientist, Ryan experienced a number of challenges in his efforts to effectively teach a class about art, most of which seemed to stem from the inherent bias his training has given him towards a linear and categorical representation of the world. This reductionist predisposition made it difficult to present course materials in a manner that accurately reflected a field of study as fluid and dynamic as the arts. He struggled to accommodate the discrepancies that often exist between the intentions of eco-artists and the outcomes of their artworks, as well as the resistance of many artists to accept a categorical classification for their works. At the same time, he felt quite comfortable interpreting science of environmental problems and landscape histories often depicted in indirect and sometimes unintentional ways by artists (Gaynor & McLean, 2008).

Ryan's struggle with the multidisciplinary nature of the course material was echoed administratively, as he dealt with the logistical problems of working across two different faculties. Having two instructors reporting to different academic departments with different levels of resource support proved frustrating and took more preparation time than initially planned, affected their use of campus facilities as well as the purchasing of course supplies. While this didn't prove to be a permanent barrier to conducting the course, it did increase the time and energy spent on course preparation and delivery.

Given her background in art history and art education, Hilary was more comfortable with the history and fluidity of eco-art, and enjoyed sharing artwork with her students that was new to them; many were unaware of artists' involvement in raising awareness of or ameliorating environmental problems. However her challenges came more from an internal dialogue around balance: how best to balance the needs of the seemingly

disparate fields of the visual arts, environmentalism and education? She struggled to ensure that interdisciplinary connections were clear, while at the same time worrying about giving too little or too much attention to one area at the expense of the others. Certainly her students needed a deeper background in the science of environmental issues, yet it felt as if there was never enough class time to do this justice, and students' assumptions about science-based learning put up some road blocks. She felt constrained by the pre-existing structure of the course; the classroom location and timing limited the flexibility of the types of learning activities that could be included, running counter to active student participation. Certainly having access to a studio space as a class would have allowed for a more dynamic approach to the material, and supported students' preferred learning styles.

**Recommendations**

While we both experienced conceptual and administrative struggles in the implementation of these environmental art education courses at two different post-secondary institutions, we learned a lot in the process of development about how to improve these for future iterations of the courses. As a result, we recommend that colleagues attempting to wade into the waters of environmental art education consider the following seven recommendations.

- Take an exploratory approach.

Integrating two or more disciplines requires new connections to be made between fields of study, a time-consuming task with a steep learning curve that requires the instructor(s) to consider their own assumptions and those of their field of study. Often this means stepping outside of your comfort zone, developing learning materials from scratch, and creating unique interdisciplinary assignments. A partnership model, like that of Ryan and Heather, ensures both disciplines have a knowledgeable advocate to create a balance in the course material.

- Lay clear groundwork.

When introducing new material, be sure to reframe each subject for your students within the disciplines of art history and education, as well as environmental science and education. Though we instructed different mixes of students with a variety of backgrounds, we both found that taking the time to highlight the connections art works make between these disciplines provided students with the context necessary for them to acquire a toe-hold for assimilating this transdisciplinary material into the paradigm of their home discipline.

- Give opportunities to create.

Include an art-making component as an assignment to channel the inspiration students will feel from environmental artists. Hilary's students lamented the absence of this component and Ryan's students reveled in its incorporation for good reason. Ryan found this creative endeavor established a sense of ownership over the material and ultimately the environmental issue being addressed.

- Create space to share.

Use group work and collaborative activities to explore the material together. Many of the "aha" moments both Hilary and Ryan observed in their students occurred when their peers shared connections about art works they did not previously see themselves. These free and open interpretive discussions not only foster peer-transfer of key concepts, but can also emphasize the importance of interdependence and collaboration in creating a fuller

understanding of environmental issues. Similarly, having students work collaboratively on group projects, be it activities, lessons or exhibits, makes new learning in the area seem less intimidating. Hilary found that risk-taking and creativity became more prevalent in the context of group-based learning.

- Get out to the "gallery".

Though logistically impossible for Hilary's class, Ryan's evaluations unanimously expressed appreciation for getting to experience many of the pieces in-situ. This is especially important for those environmental works that are essentially place-based. While image-rich lectures can convey some of the key concepts, the gravity of many works is not fully felt outside of their intended exhibition spaces. If logistics prohibit the class traveling, seeking opportunities to bring physically tangible pieces into the lecture room for up-close inspection can serve as a good surrogate.

- Learn deeply about a few environmental issues.

Have students learn more deeply about a few environmental issues in depth over the semester, rather than try to get a grasp on a broad range of environmental issues, as there are just too many different environmental concepts to cover effectively in one course. Ryan found by focusing each lecture around a specific issue, and repetitively illustrating how different artists have addressed the subject through their own unique approaches to be an effective means of conveying deeper discussions about the mechanics of various environmental problems. Hilary discovered that letting students select their own issues for deeper investigation ensured that they had personal investments in the issues, leading to more engagement with the assignment.

- Encourage reflective writing.

Incorporate an activist theme into some assignments so that students start to understand how art can be used to bring about positive environmental change on a personal level. Both Hilary and Ryan found that by providing students with an opportunity to internalize their experience with different artworks and environmental subjects, their students wrote reflectively and forcefully about the need to personally adopt more sustainable environmental lifestyles.

**Conclusion**

During a time in which environmental educators working in higher education are seeking new and more effective ways to convey complex environmental issues, the field of art education offers an innovative and alternative way to reach students. In our two pilot courses, undergraduate students responded positively to the development and enrichment of their understanding of environmental issues through discussions of contemporary art movements. By incorporating dynamic, reflective, and participatory opportunities for students to engage with the material, both Environmental Studies and Art majors related very positive experiences with this transdisciplinary material. This suggests that future classes in the subject can be successfully adopted into the curricula of both art and science programs and delivered by both science and art faculty.

♦ ♦ ♦

**Biographical Statements**

**Dr. Hilary Inwood** currently teaches at the Ontario Institute for Studies in Education at the University of Toronto. Her research focuses on developing environmental literacy through art education in school and community settings. Her work extends beyond classrooms to include school gardens, outdoor education centers, parks and galleries. For more information or to contact, visit www.hilaryinwood.ca.

**Dr. Ryan Taylor** is an Assistant Professor of Environmental Studies at Purchase College – SUNY. His research focuses on the spatial dynamics of anthropomorphic landscape modifications and the public policies that encourage them. His work regularly involves him with regional-scale natural resource management, ecological restoration, and public planning efforts. His interest in environmental art has developed from regular exposure in this capacity to environmental artists and their works. For more information or to contact, visit openscholar.purchase.edu/ryan_taylor

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# Çevre Öğrenmesinde Yaratıcı Yaklaşımlar: Çevresel Sanat Eğitimi Öğretimi Üzerine İki Perspektif

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**Özet**

Sanatın çevre ve sürdürülebilirlik eğitiminde öne çıkmasıyla çevresel sanat eğitiminin okullarda ve üniversitelerdeki programlarda popülaritesi giderek artmaktadır. Bu yeni alan disiplinler arası bir uğraş olduğundan ve görsel sanatlar eğitimi ile çevre eğitiminin daha önceleri gelişmiş olmasından dolayı çevresel sanat eğitimi bilim ve sanattaki potansiyel öğrenci sayısını arttırmak ve öğrenmeyi çeşitlendirmek, kalıcı ve otantik yapmak için bir araçtır. Bu makale hem bilim hem de sanat eğitimcilerinin bakış açılarıyla gelişen bu alana ait iki farklı yaklaşım anlatılmaktadır. Araştırma diğer eğitimciler için çevresel sanat eğitiminde müfredat ve pedagoji gelişimine yön vermesi umuduyla yapılmıştır.

**Anahtar Kelimeler:** Çevre eğitimi, çevresel sanat eğitimi, eko-sanat eğitimi, görsel sanatlar, çalışma deseni

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