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Outdoor Ecology Education and Pupils' Environmental Perception in Preservation and Utilization

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ABSTRACT *This paper describes the impact of a weeklong outdoor education unit on pupils' knowledge of conservation and their attitudes towards nature and the environment. It uses a quantitative experimental approach. The weeklong education programme consisted of an extra-curricular unit in a field centre within a National Park. It followed a cognitive-emotional rationale, focusing on conservation and environmental issues within a nature conservation site. The programme effect was evaluated on a pre-test/post-test basis, assessed by questionnaire batteries. Previously published work confirmed the validity of the empirical instrument quantifying these preservational and utilitarian views of nature and the environment. To avoid short-term effects, the post-test was delayed for at least a month after participation. The programme caused both a significant positive effect on the specific knowledge level of adolescents and a shift within the scale of environmental perception. Both shifts within our pre- and post-tested variables are discussed in the context of three related studies using the same empirical survey instrument.*

KEY WORDS: *Environmental perception, environmental attitudes, preservation, utilization, outdoor ecology education.*

Introduction

Outdoor ecology and environmental education programmes typically (apart from generating factual knowledge) concentrate on promoting conservation and environmental protection. This includes increasing awareness and concern about nature and the environment, as well as shaping the relevant behaviour towards the environment and, in the long range, towards reducing human impact on nature (*e.g.*, Dunlap & Heffernan, 1975; Falk *et al.*, 1978; Lucas, 1980; Hungerford & Volk, 1990; Ryan, 1991). Environmental behaviour in particular is the goal of many educators, who often believe this to be the purpose and result of environmental education (Cortese, 1992; Smith, 1992; Bowers, 1996; Borden, 1985). Participation in field courses today is common practice in the life of many pupils, and is often assumed to be synonymous with fostering environmental literacy and with supporting a willingness to take environmental action (Ajzen & Fishbein, 1980; Crompton & Sellar, 1981; Ryan, 1991). This assumption is due either to the common belief that current environmental problems increasingly require educational

outdoor settings in order to stimulate adolescent awareness for the environment, or simply to a teaching tradition favouring field trips as part of the biological didactical repertoire (*e.g.,* Leeming *et al.*, 1995). In consequence, encouragement of environmentally more responsible behaviour in general is seen as an integral part of any serious approach. However, authors, such as Hendee (1972), fail to confirm any change in attitudes and behaviour as a result of participation in field ecology programmes. Others, such as Lucas (1980), supported by the meta-analysis of Leeming *et al.* (1993), concluded that "the primary goal of environmental education should be to encourage people to engage in more pro-environmental behaviours" (p. 8).

Measuring adolescent environmental perception is a complex field. Central problems in empirical measurement are measurability and standardisation (Sia *et al.*, 1985; Hines *et al.*, 1987; Schahn & Holzer, 1990; Blaikie, 1992; Leeming *et al.*, 1993). Various approaches have been presented to conceptualise and operationalise measurement instruments within the domain of environmental concern and awareness, of attitudes and values and of relevant environmental behaviour. Thus, a series of studies identified prevalent world views, such as the "Dominant Western World View" (Catton & Dunlap, 1980), the "Human Exemptionalism Paradigm" (Catton & Dunlap, 1978), the "Dominant Social Paradigm" (Dunlap & Van Liere 1978), the "New Environmental Paradigm" (Catton & Dunlap 1978), the "New Ecological Paradigm" (Dunlap, 1980, Catton & Dunlap 1980), the "Ecological World View" (Blaikie, 1992) as well as the revised version of the "New Ecological Paradigm" (Dunlap *et al.*, 2000). Many of these studies fail to share a common, valid scale, and none has been developed for the adolescent pupil.

Adolescent attitudes and values towards nature and the environment have in the past rarely been a focus of psychometric approaches. For instance, Leeming *et al.* (1993, 1995), in their meta-analyses, failed to identify even a single valid and reliable instrument, and hence stressed the need for better evaluation techniques. In the absence of rigorous psychometric techniques, measurement instruments remain invalid and fail to provide a reliable basis for empirical evaluation. Hence, an age-adjusted item battery employing more rigorous psychometric techniques was developed by Bogner and Wilhelm (1996); follow-up studies subsequently revised this scale via its application to six different (European) pupil populations (studies cited in Bogner & Wiseman, 2002b). Finally, using factor analyses and structural equation modelling, a scale valid for the entire European sample was constructed (Bogner & Wiseman, 1999, 2002b). This battery quantifies aspects of ecological attitudes via first-order factors and is based upon a theory encapsulating ecological attitude-sets in two orthogonal (uncorrelated) higher-order factors (values): Utilization (U) and Preservation (P) (Wiseman & Bogner, 2003). U consists of four primary factors (mostly composed of four items each): Man over Nature, Human Dominance, Altering Nature, and (negatively) Balance of Nature, while P subsumes four primary factors (also largely composed of four items each): Care with Resources, Intent of Support, Enjoyment of Nature, and Limits to Growth.

Two cross-validation studies shed additional light on our measurement approach (omitting a previously hypothesized, separate conservational factor). The first included personality variables reflecting risk-taking behaviour quantified as six primary factors: Positive Risking, Ambivalence, Thrill in Gambling, Ineffective

Control, Effective Control, and Anger Reaction (Bogner, Brengelmann & Wiseman, 2000). The analysis of the correlation matrix between the "Risk-taking" domain and that of Environmental Perception revealed two opposing profiles. The high scorer on "Preservation" is the controlled and cautious gambler, while the "Utiliser" eschews unpredictable risks, reacts with anger when risks fail, and fails to control his own risk-taking behaviour. The second study (Wiseman & Bogner, 2003) incorporated Eysenck's personality factors of "Psychoticism" (P), "Extraversion" (E), and "Neuroticism" (N), as well as a social desirability response set "Fake good" (L). "Neuroticism" was related to "Preservation" and "Psychoticism" to "Utilization," thus yielding eminently sensible correlations with external variables and confirming the validity of a two-dimensional representation of ecological values. Two uncorrelated latent traits mediating environmental values were proposed, one labelled "*immediate self-orientated gratification*" ("Utilization"), the other "*delayed other-oriented gratification*" ("Preservation"). These two higher-order factors subsume the wide variety of primary factors quantified by attitude batteries employed in the area of environmental studies (Wiseman & Bogner, 2003). Our two-factor Model of Ecological Values (2-MEV) was formalised as "*Ecological Values are determined by one's position on two orthogonal dimensions, a biocentric dimension that reflects conservation and protection of the environment (Preservation); and an anthropocentric dimension that reflects the Utilization of natural resources (Utilization)*" (Wiseman & Bogner, 2003, p. 5). The factors' orthogonality is important, permitting respondents to vary their position on one dimension independently of their position on the other. For example, the model implies no conflict between assigning high importance both to the protection of the environment and to the need to make use of natural resources. An alternative model could view Preservation and Utilization as opposite poles of a single continuum, forcing for example a respondent who supports environmental preservation automatically to reject the Utilization of natural resources. This alternative is unacceptable both on theoretical and practical grounds: compare the everyday (conflict-loaded) balance of individuals between positions towards ecology and economy.

The first objective of the present study was to evaluate a weeklong outdoor educational programme by providing a (conventional) comparison of variables, such as knowledge and attitudes before and after the intervention, that is, we examined the link between the intervention and the primary factors of our empirical instrument. Our second objective was to evaluate attitude shifts of individuals with relation to their pre-existing (pre-test) scores. Thirdly, we set out to analyse possible gender dependent effects, both before and after intervention.

Methodology

Participants

A sample of 10 heterogeneous classes was examined in a pre-test/post-test design. Classes of fifth to seventh graders were selected according the schedule of a National Park field centre (mean age about 12 years). Due to the age homogeneity of our sample, age was not analysed as a variable. None of the participating pupils had been involved in previous programmes. None of the approached classes refused participation in the evaluation process. However, since the pupils were not

informed of the post-test, some few pupils failed to participate in the second test. Complete data sets were obtained from 287 secondary school pupils. (Note that Bavarian pupils start secondary school as fifth graders.) There were roughly an equal number of boys and girls in the sample (48,8 to 51,2%).

Participating pupils rated the programme as 2.03+1.30 (*SD*) according to the German grading system: 1 = best and 6 = worst). In comparison, the pleasure of being a pupil in general yielded a mean value of 3.03 +1.54 (*SD*). The control sample consisted of 122 secondary school pupils (sixth graders); again the gender distribution was balanced. In contrast to the intervention sample, the control group did not participate in any special outdoor education programme, but attended the conventional school schedules and followed "normal" school instruction schedules, as did the actively involved treatment group between the outdoor intervention and the post-test application.

Educational programme

The residential outdoor programme was guided by the principle of original encounters with biological and ecological themes, and required hands-on involvement rather than a mere receiving of factual information. The purpose of the programme was to bring pupils into close outdoor contact with the National Park by integrating cognitive and affective factors. Incorporating intact ecosystems as units of interest, the programme was labelled "Let nature remain nature." It was developed by educators of the National Park. Detailed content information in a short synopsis is provided in Bogner (1998) and Dorn (1996). For all outdoor activities, classes were divided into subgroups of 7-10 pupils. Since a single educator team was employed throughout the season, the teacher variable (a problem in many studies in the field) was held constant for all participants.

Cognitive tasks (*e.g.*, labelling tree species, animals in dead wood or predator-prey-relationships), emotional ones (*e.g.*, 'Touch a Tree', or 'Recognising a Smell'), and interactive simulation games ('Wolves and Deer', 'Mimicry', 'Squirrels survive winter') were employed. The programme focussed upon the challenges, problems, and goals within a nature preservation area. Native and once-native animals in the 'Animal Ground' (a large fenced area) were observed, combined with learning about essential aspects of their natural biotope. Pupils were first made aware of the complexity of ecosystems, for instance, that even single trees have their own characteristics, and that forests are complex and unique entities. Subsequently, pupils were led to the conclusion that sustained conservation must include the protection of biotopes. During an all-day hike to a mountain top in the National Park, the pupils passed through a large section of dead forest, learning about population cycles of bark beetles, about simple networks within the forest ecosystem, and about the threat of air pollution (originating from distant industrial emissions), and other threats resulting from human activities, today and in the past. A specific objective of our programme was to alter the Human Dominance primary factor, unaffected in a previous study (Bogner, 1998). We therefore concentrated on the existing threat to nature even within National Parks, the reasons for the dead forest section (air pollution, bark beetle invasion, etc.) as well as on human-controlled management of nature. The reasoning behind such a specific centre of attention could be based, for instance, upon the work of Arcury *et al.* (1986), who favoured "a more focused concern of environmental education" (p. 39).

Design and empirical instrument

All pupils responded twice to an age-adjusted questionnaire containing a set of multiple-choice items (the specific items are displayed in Table 1 and Table 2). All items were scored on a 5-point Likert scale ranging from "strongly agree" to "strongly disagree," and included an "undecided/ neutral" category. A series of earlier studies cited support the instrument's validity, its reliability (Bogner & Wiseman, 1999, 2002b), and its factor structure. Administrative restrictions imposed upon school surveys permitted the collection only of gender and grade as demographic variables. The reasoning behind the one month time delay before administration of the post-test is discussed in Bogner (1998a). Nevertheless, a one-month time gap presumes the retention of positive aspects from the programme experience, disregarding potential negative effects, such as bad weather or personality conflicts (Perdue & Warder, 1981).

Knowledge was assessed by means of a Likert scale, shown in Table 1, addressing the pupils' understanding of ecology and conservation, specifically as taught in the education programme surveyed. The items selected did not assess specialised factual knowledge that pupils may not know before any instruction. The content validity of the individual items was confirmed by teachers, education specialists, and topic professionals. We regarded the possibility of learning effects produced by the repetition of the items as negligible, since (i) the time span between pre-test and post-test was almost five weeks and (ii) the pupils were unaware that they would be surveyed a second time. The possibility of random guessing (a constant problem in the application of multiple choice items dealing with knowledge) was similar in both the pre-test and post-test.

The environmental perception attitude battery was taken from Bogner and Wiseman (2002b) derived from a series of European (Bogner & Wilhelm, 1996; Bogner & Wiseman, 1996, 1997, 1998, 1999, 2002a; Bogner, 1998b) and from two cross-validation studies (see above). The battery seeks to quantify eight primary factors which we refer to as: 'Care with Resources', 'Intent of Support', 'Enjoyment of Nature', Limits to Growth' as well as 'Altering Nature', 'Human Dominance', 'Man over Nature' and 'Unbalanced Nature'; the first four form the secondary factor "Preservation", the latter four "Utilization" (Bogner & Wiseman, 2002a).

Table 1
Listing of Individual Items Measuring Factual Knowledge Assessment

(+) If there were no people, there would be forest everywhere again.
(-) Dead trees in the forest are useless.
(+) You can tell the difference between fir trees and pine trees just by touching them.
(+) You can tell any kind of tree even if you are blindfolded.
(-) The water in a creek is usually warmer than in a pond.
(+) Dragonflies need water to develop.
(+) You can tell the age of a tree without harvesting it.
(+) A handful of forest soil contains more living creatures than there are people on earth.
(+) Even a bark beetle deserves to live within an ecological network.
(-) The lynx and the wolf hunt in the same way.
(-) Hawks hunt more silently than owls.

All pupils responded twice to the questionnaire, first before they came to the educational programme, then one month after (*e.g.*, Clawson & Knetsch, 1966; Crompton & Sellar, 1981; Lisowski & Disinger, 1992; Bogner, 1998a). Compared to the pre-test, the number of respondents in the post-test was consistently lower, due to pupil absences on the key day (the pupils did not have advance knowledge of the post-testing). We avoided potential bias and acquiescence effects, since the field centre instructors were never involved with the evaluation process, and the teacher supervising the evaluation was not engaged in the education programme at the nature site. Heavy bias can be expected if a teacher administers both the educational intervention and the evaluation procedure. Although, we would have preferred the assimilation of the programme into the classroom syllabus, it was in practice not possible to integrate it. However, our method guaranteed that the team of instructors was kept constant for the duration of our survey, keeping potential variations between sessions low. The control group, not exposed to any outdoor ecology education instruction, was evaluated in a similar way to the instruction group (*i.e.*, using the same empirical instrument). A simple test-retest was employed to exclude potential learning effects resulting from responding twice to the same item battery. This design was chosen due to (i) the non-existence of "zero-standards" at nature sites, (ii) the impossibility of comparing indoor and outdoor programmes. Our results show unchanged scores in the control group, thus supporting the causal effect of the interventions, and demonstrating good test-retest reliability over a one-month time interval.

Statistical Methods

Scores on the eight primary factors were computed for each participant as the mean response of the items loading score (Bogner & Wiseman, 1999). A basic theorem in sampling theory, the Central Limit Theorem (see *e.g.*, Winer *et al.*, 1991, p. 38), permits us to assume a normal distribution for such mean scores, and hence to employ parametric statistical methods. All statistical comparisons between the pre- and the post-test factor scores were based on individual changes; that is, pre- and post-test scores were compared using paired sample tests.

The problems associated with the measurement of change, discussed in the classic text of Harris (1963), and well known to research methodologists, seem to have been largely ignored in the field of biological education. A fundamental problem in assessing change is that changes in a score may be dependent on the pre-test value. Thus, a participant scoring high on the pre-test has little room for scoring yet higher on the post-test – a participant who already possesses a high degree of knowledge before intervention cannot possess much more after it. In other words, if the change correlates to a high degree with the pre-test value, then group differences are explicable solely on the basis of the pre-test value. Hence, results based on change alone may be misleading and methodologically incorrect. Our test of gender differences, therefore, examined knowledge change by employing the post- minus pre-test difference as the dependent variable, the pre-test score as the covariate. We selected an alpha of 0.01 because of our relatively large sample size.

Table 2
Individual Item Listing of All Primary Factors
(retaken from Bogner & Wiseman 2002).

PRESERVATION OF NATURE

Care with Resources

I purposefully walk short distances rather than asking for a lift in order to protect the atmosphere.
I make sure that during the winter the heating system in my room is not switched on too high.
Whenever possible, I take a shower instead of a bath in order to conserve water.
I always switch the light off when I don't need it any more.

Intention to Support

If I ever get extra pocket money, I will donate some money to an environmental organisation.
Environmental protection costs a lot of money. I am prepared to help out in a fund-raising effort.
When I am older, I am going to join and actively participate in an environmentalist group.
I often try to persuade others that the environment is an important thing.

Limits to Growth

There are limits to growth beyond which our industrialized society cannot expand.
To maintain a healthy economy, we will have to develop a 'steady state' economy where industrial growth is controlled.
Humans must live in harmony with nature in order to survive.

Enjoyment of Nature

I have a sense of well being in the silence of nature.
I specially love the soft rustling of leaves when the wind blows through the treetops.
I really like to be able to go on trips into the countryside - for example to forests or fields.
I would really enjoy sitting at the edge of a pond-watching dragonflies in flight.

UTILIZATION OF NATURE

Man over Nature

Plants and animals exist primarily to be used by humans.
Humans have the right to modify the natural environment to suit their needs.
Humans need not adapt the natural environment, because they can remake it to suit their needs.
Mankind was created to rule over the rest of nature.

Human Dominance

In order to feed human beings, natural areas must be cleared, so that, for example, grain can be grown.
Construction of motorways and bypass roads is so important that it justifies the removal of forests and meadows.
Since mosquitoes develop in ponds, draining and reclaiming them for agriculture would be better.

Altering Nature

Grass and weeds growing between pavement stones really looks untidy.
Weeds may be destroyed, because they inhibit the full development of ornamental plants
I prefer a well cared for lawn to a wild meadow where flowers grow in an unordered way.
A real nature fan brings home beautiful and rare plants, when he/she has been out in the countryside.

Balance of Nature (negative)

We are approaching the limit of the number of people the earth can support.
When humans interfere with nature, it often produces disastrous consequences.
Mankind is severely abusing the environment.
The balance of nature is very delicate and easily upset.
The earth is like a spaceship with only limited room and resources.

Results

Participation in a week-long education programme impacted on the pupils' factual knowledge by generating a small but significant increase (3,49 + 0,55 [*SD*] versus 3,71+ 0,72 (T=5,351, df=287, p<0,001). Both scores were computed as the mean response to 11 individual items (Table 1). Note that a *higher* score indicates *greater* knowledge. Although high even before intervention, there still remains room for improvement, reflecting a cognitive learning effect over a period of one month. The relatively small knowledge increase is explicable by the fact that most Biology tests in the German secondary school system are conducted shortly after instruction. Our delayed test procedure shows a longer-lasting effect than the usual classroom tests. Prior knowledge showed no correlation with variables, such as the programme rating or satisfaction with being a pupil. A small positive relationship with the school grade in Biology (Table 3) was observed. The shift in the Preservation secondary factor correlates strongly with the knowledge shift when prior knowledge is taken into account (r=0,537; p<0,001; α=0,01).

Table 3

Correlation of Knowledge Assessment Scores (pre- and post-test) and Difference Scores of Both Secondary Factors U and P and with Special Programme Items and Grade in Selected School Subjects.

Rating/Grading	of Program	Pleasure	of Pupil Biology	Language	Maths	Foreign Language
	2,03+1,30	2,71+1,27	2,10+1,27	2,63+1,25	2,33+1,35	2,14+1,1,48
Pre-Know	-	-	0,13	-	-	-
Post-Know	0,36	-	-	-	-	-
P-difference	0,24	-	-	-	-	-
U_difference	-0,21	-	0,15	-	-	-

All eight primary factors of adolescent environmental perception yielded significant shifts (p<0,001), always occurring in the consistent direction of favouring nature and the environment. Scores on the higher-order factor of Preservation increased (Figure 1, left section), those on Utilization decreased (Figure 1, right section). Comparisons with the control group confirm the effectiveness of the programme. Differences between the pre-test scores of the control group and those of the treatment group were not significant; differences between the post-test scores were highly so.

Figure 2 relates the degree of change (the vertical axis) for the Preservation and Utilization scores to the pre-intervention scores (the horizontal axis), summarized as the regression line running through the cluster of points marking the position of each individual. Both figures show a clear regression downwards from left to right – the lower the pre-intervention score, the greater the degree of change. Furthermore, individual points cluster very closely about the regression lines, demonstrating a high degree of consistency in the positive effect produced by the intervention and the suitability of the linear regression line as a summary of this effect. Noting that the horizontal reference line in both figures represents zero change, we observe that the great majority of participants with respect to

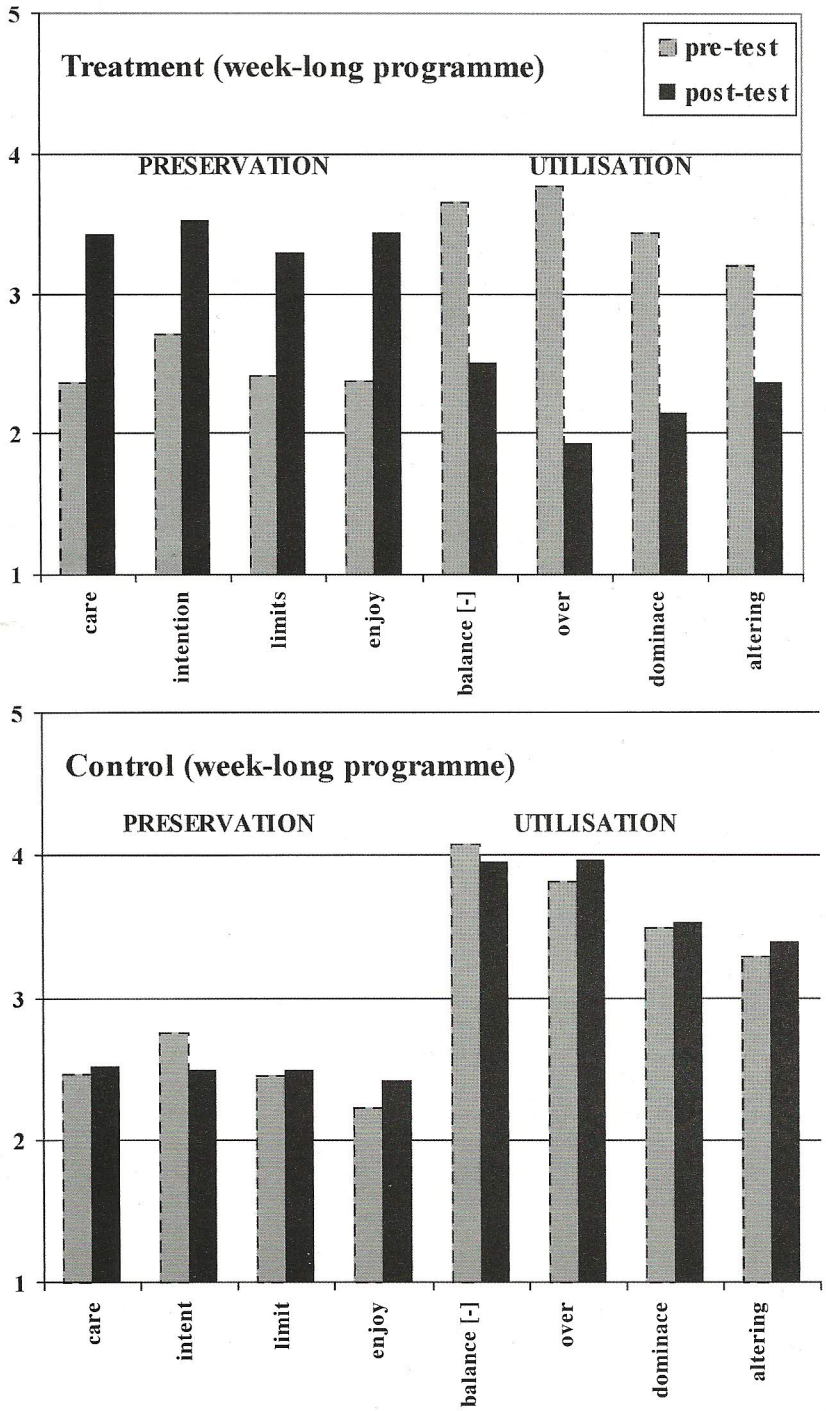

Figure 1. Pre- and post-test scoring of all (eight) primary factors covering both higher order domains: Preservation and Utilization (time difference between both tests separated by about 5-6 weeks). Upper figure (intervention programme); lower figure (control unit)

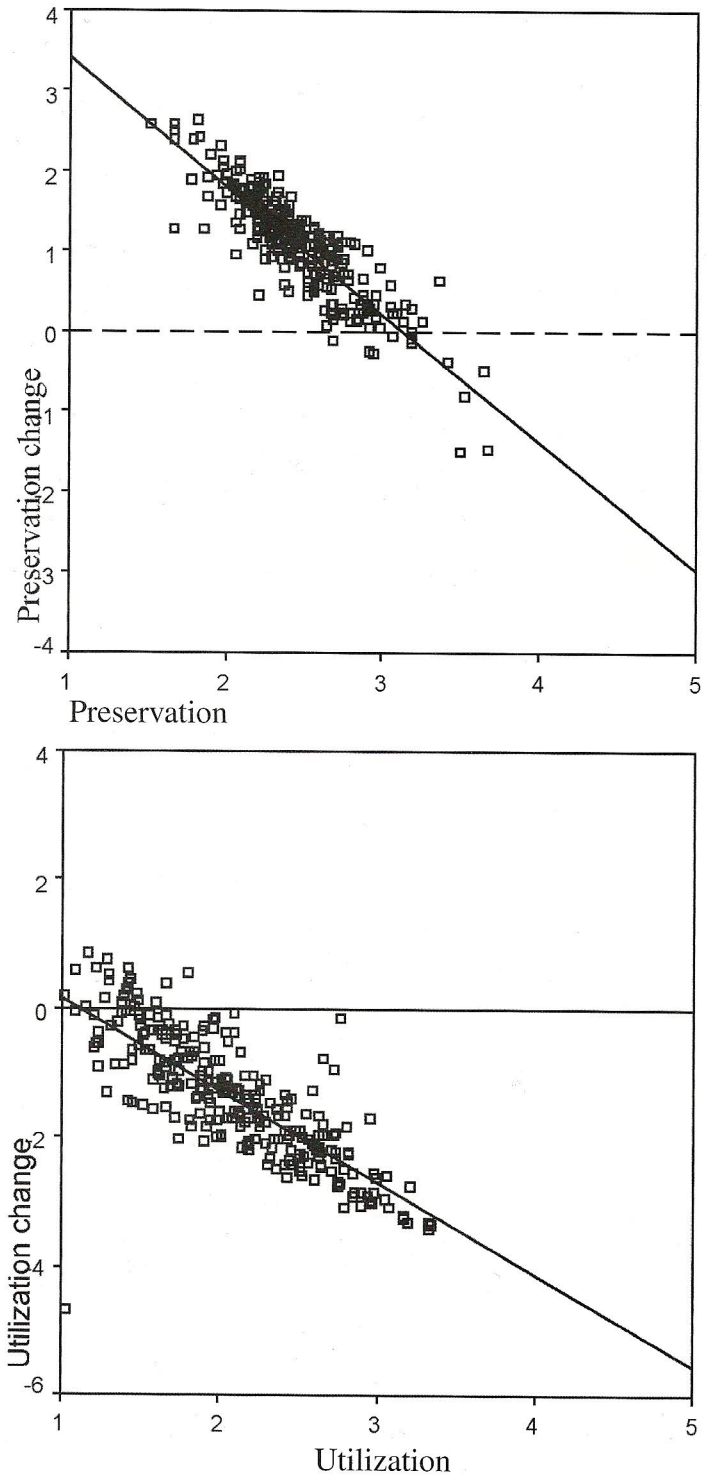

Figure 2. Relationship between the pre-test secondary factor score of Preservation and Utilization and its change due to the intervention (post-test minus pre-test scores).

Preservation lie above the line of zero change, the great majority of participants with respect to Utilization below that line. Thus, the intervention shifts Preservation scores in an even more positive direction; whereas Utilization, negative before the intervention, becomes even more so afterwards. The predominance before intervention of high Preservation combined with low Utilization scores suggests that pupils may to some degree be self-selected. Even before participation, pupils are largely pro-Preservation and anti-Utilization.

In the knowledge pre-test boys scored lower (3,39 + 0,62) than girls (3,54 + 0,48) (T=2,345, df=277,3, p<0,02). Analysis of variance comparing gender on the basis of change in knowledge, however, yielded a non-significant effect (α=.059). Employing the pre-test knowledge scores as a covariate, however, resulted in $p < .005$ (Table 4). Table 4 also displays the primary factor changes analysed for girls and boys. In general, girls tend to score lower in the utilitarian and higher in the preservational domain. In all but three primary factors (see table 4), a significant gender difference was observed, the male score being lower than the female on Preservation, higher on Utilization. Figure 3 provides clear justification for the employment of the pre-test scores as covariates. When examining group differences in these changes; change is highly dependent upon the pre-test score.

Table 4.
GLM Analysis of Gender Differences Including Initial Values as a Covariate.
Tests of Between-Subjects Effects Dependent Variable: KNOW_Difference

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	22,365(a)	2	11,183	26,923	,000
Intercept	25,587	1	25,587	61,602	,000
Pre-KNOW	20,616	1	20,616	49,634	,000
GENDER	3,286	1	3,286	7,911	,005
Error	117,960	284	,415		
Total	154,850	287			
Corrected Total	140,326	286			

a R Squared = ,159 (Adjusted R Squared = ,153)

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
GENDER	care_diff	31,940	1	31,940	7,781	,006
	int_diff	9,197	1	9,197	2,651	,105
	bal_diff	,737	1	,737	,189	,664
	lim_diff	,003	1	,003	,002	,969
	enj_diff	54,976	1	54,976	13,306	,000
	over_diff	15,731	1	15,731	7,506	,007
	dom_diff	11,082	1	11,082	5,063	,025
	alt_diff	26,736	1	26,736	6,834	,009

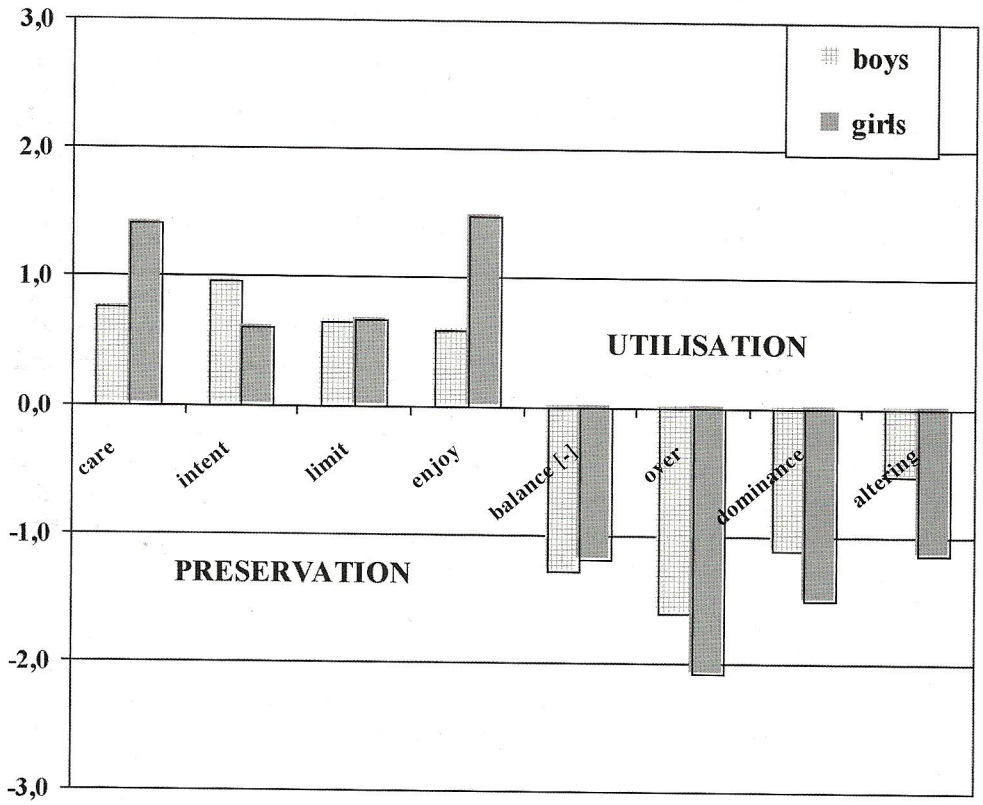

Figure 3. Split by gender of all eight primary factor score changes.

Discussion

Our analysis provides sufficient empirical support for the hypothesis that pupils in outdoor settings (with structured learning activities) move towards a high level of environmental awareness. Our residential education programme produced statistically significant shifts in selected factors of adolescent environmental perception. Without exception, all eight primary factors of our instrument (Bogner & Wiseman, 1999, 2002b) were affected by participation in a weeklong residential educational intervention. Both domains, the preservational and the utilitarian, changed significantly. The first, Preservation, understands nature as a value in itself, acknowledges the balance of nature and rejects environmentally destructive lifestyles – in short, regards our "spaceship earth" as a fragile system with limited resources (*e.g.*, Catton & Dunlap, 1978; Dunlap & Van Liere, 1978; Milbrath, 1984; Arcury *et al.*, 1986; Merchant, 1990). The second domain, Utilization, involves supporting human dominance over nature, interference with the environment, the acceptance of a nature heavily altered and exploited by human beings. Pupils in their post-test scores tended to perceive nature and environments in a more sensitive manner and to recognize that apparently unspoiled environments may yet have been influenced by human beings (Dunlap, 1980; Dunlap & Van Liere, 1984). Altogether, it is a very encouraging result that a one-school week education pro-

gramme can be so effective. This shift in attitudes and values is in line with various other studies describing residential programmes as effective in shifting individual attitude and value sets (van Matre, 1993; Dresner & Gill, 1994; Jordan *et al.*, 1986). In this context, we stress that our participants were outdoors for the entire programme.

A small meta-analysis on the basis of eighteen intervention studies carried out by Zelezny (1999) reported unclear effects of various interventions on environmental behaviour. The measurement of true environmental behaviour is hardly possible (especially with school adolescents, where restrictive administrative regulations apply, and monitoring of real behaviour is not permitted). Consequently, most, if not all, related studies monitored self-reported behaviour rather than observed behaviour. Hines *et al.* (1987) reported in their meta-analysis a preference for self-reported measures of behaviour rather than of actual observed behaviour. Subsequently, a series of studies highlighted the importance of educational interventions rather than classroom instruction for improving environmental behaviour (*e.g.*, Armstrong & Impara, 1992; Ramsey, 1993). We therefore question Cone and Hayes's (1980) critical and provocative conclusion of the ineffectiveness of educational approaches towards changing behaviour (although our study can provide data of reported behaviour only). The need to assess the effectiveness of educational programmes requires suitable empirical instruments and evaluation designs. Environmental education is generally regarded as a key element towards improving (pro-) environmental behaviour (*e.g.*, Disinger, 1982; Borden, 1985; Cortese, 1992; Leeming *et al.*, 1993). The most popular explanation of improvement in environmental behaviour is based upon the belief that education leads to greater awareness and consciousness, and hence changes the relevant attitude, which, in turn, improves the individual behaviour (Bruvold, 1973; Fishbein & Ajzen, 1974). Other authors simply regard educational intervention as ineffective in changing any behaviour (*e.g.*, Volk *et al.*, 1984; Cone & Hayes, 1980). Leeming *et al.*, (1993, 1995) undertook sizeable meta-analyses in this context and failed to find any but negligible correlation scores.

A major problem in this research field is the number of survey studies with weak or even non-existent scientific quality. Rexer and Birkel (1986), for instance, draw an interesting conclusion (that weak pupils learn better in outdoor settings), but failed to show any valid empirical basis for this hypothesis. Bolay (1998) undertook a large study in a forest centre with some hundred pupils, but again with a total lack of empirical validation. Similarly, empirical surveys of authors, such as Hedewig (1984), Rodi (1984), Scherf (1987), Rieb (1999), or Starosta (1999), failed to meet any acceptable psychometric standard in the instruments employed and, therefore, added no substantial information. The standard of their empirical instruments compares with the inadequate instruments of the late 1960's, when every (environmental) educator produced his/her own *ad hoc* instrument, with the result that there were as many instruments as there were researchers working in the field (Eysenck & Eysenck, 1969; Wiseman & Bogner, 2003). Thus, many authors presented more than dubious evidence of the "effectiveness" of their educational intervention although such batteries simply represent subjective, arbitrary item collections and fail to reach any acceptable scientific standard. Additionally, what is the value of an attempt to measure attitudes only minutes after programme exposure (*c.f.*, Bittner 2000)? Furthermore, these authors fail to provide a sound defi-

nition of values. "Values" are generally considered to consist of a set of attitudes, themselves composed in turn of sets of items (Wiseman & Bogner, 2003). Suspect, too, is these authors' entirely unsupported claim that pro-conservation actions were fostered by their interventions. Consequently, as long as the field of Biology didactics continues to permit publication of so-called empirical studies entirely lacking in scientific rigor, the scientific community will continue to question the quality of research in this field. The consistent ignorance of these authors of the relevant literature is a further impediment to credibility.

Cognitive achievement

It is a clear message of this present study that outdoor education may increase cognitive achievement scores although generating (additional) factual knowledge may not be a primary goal of many field centre education programmes. This goal is especially important, since most of the current threats to ecosystems go well beyond the traditional knowledge of adults and adolescents. Therefore, a certain level of knowledge improves the individual potential to understand the ecological crisis and associated environmental problems, and to recognize the complex networks within an ecosystem. Moreover, individuals may fail to recognise the value of a section of an ecosystem or even a species, unless they were aware of it beforehand and had developed a relationship towards it (Weilbacher, 1993). Modern educational approaches do not generate factual knowledge purely by a passive reception of meaningless labels, as may have been the case in some classic taxonomy classes (Crisci *et al.*, 1993). Generating knowledge must be an active (and sometimes hands-on) process and it should ideally take place where pupils can investigate species in their natural environment. Pupils' knowledge of ecological and environmental issues is widely assessed as their understanding of specific issues (Ramsey, 1993). Consequently, a solid individual cognitive base is commonly accepted of providing a sound foundation for attitudes, and that is why most instructional outdoor approaches incorporate a substantial science background as a primary prerequisite.

The general conviction that a solid science foundation may eventually lead to issue awareness, to an establishment of favourable values, as well as to appropriate behaviour has a long tradition (*e.g.*, Fishbein & Ajzen, 1974; Eagly & Chaiken, 1993; Ramsey, 1993; Bogner & Wilhelm, 1996). Environmental education, therefore, in its early years concentrated on an accumulation of relevant knowledge in the hope of influencing the attitudes and values. However, this simplified assumption of the overall importance of so-called knowledge factories was questioned due to the daily experience of educators and teachers (Hendee, 1972; Ramsey & Rickson, 1977; Borden & Schettino, 1979). Similarly, survey studies often showed no, or merely a small, relationship between knowledge, attitudes, and values (see the meta-analysis of Hines *et al.*, 1987). Although such a result does not necessarily indicate a lack of correlation, it may simply raise doubts about the selection and computation of knowledge variables. Processing knowledge variables cannot build upon a consistent psychometric tradition as it is the case in the personality sector. Each researcher has collected a series of items and summed responses with no proof of validity or reliability of the scale. Kaiser (1999), therefore, casts doubts upon these scores simply on the basis of the operationalisation of the items involved, which

very often had nothing to do with interventional content.

A general knowledge variable covering information of daily life may not reflect the everyday life of pupils or the focus of a specific education programme (*e.g.*, Arcury & Johnson, 1987). This type of factual knowledge is often surveyed within all pupils of a region in spite of huge variations between the sub samples. Authors like Gigliotti (1990), for example, conclude that "we seem to have produced a citizenry that is emotionally charged but woefully lacking in basic ecological knowledge" (p. 9). Further studies have questioned the validity and reliability of the knowledge variable itself in the field of environmental and ecology education (Barry, 1990; Kaiser, 1998; Kaiser *et al.*, 1999). In various studies the correlation of knowledge with attitudes and values explains a minimal common variance at a low single-digit level (see Hines *et al.*, 1987; Kaiser 1999). A recently published study, where the specific knowledge content of a specific programme was surveyed, reported a substantial correlation explaining 26% of the common variance (Bogner, 1999). A major explanation for such a high score (contradicting most previously published studies) might reside in the method of computing the knowledge variable, either selecting a set of items addressing specific programme contents or "general" knowledge. The present study supports the need to focus on the first of these approaches, providing a close relationship between the programme and the knowledge achieved, but simultaneously pointing to the importance of prior knowledge.

We generally label individuals as environmentally illiterate, when they understand neither concepts of ecology and environment nor personal impacts on and relations to the environment. Every judgement and decision we make necessarily involves an environmental component, and, nowadays, the few years of schooling are no longer sufficient to equip a person to cope with life-long environmental requirements. However, acquiring knowledge about environmental and ecological issues provides no gain in understanding. Addressing issues in isolation from others ignores the complex interrelationships within ecosystems and with the distinctive role of human life within the ecological framework. The need to overcome the increasing threat to species and the fragmentation of natural systems, in combination with that to conserve biodiversity, cannot be taught by transferring cognitive factual knowledge alone.

Gender

Environmental perception demonstrates a discriminatory, dichotomous pattern for gender (*c.f.*, Bogner & Wiseman, 2002b). Boys tend to score higher in the utilitarian domain and hence to support the exploitation of nature and environment, and to value nature insofar as it satisfies human needs. Girls, on the other hand, tend to score higher in the preservational domain with a commitment to value nature in general. They score high, too, in enjoyment of nature (perhaps a reason for the preservation). Such dichotomies are consistent with previous studies (*e.g.*, Borden & Schettino, 1979; Arcury *et al.*, 1986; Bogner & Wilhelm, 1996). The gender role may be determined by different socialisation processes establishing different social roles. Self-identification may provide different impacts within the complex network interacting on behaviour. We would, therefore, expect gender differences in attitudes towards natural resources and conservation.

Most educators are aware of existing disadvantages for girls in science education. This present study confirms that biology classes, too, evince such gender differences, although biology is widely regarded as a 'soft' subject compared to the other science disciplines (Baker & Leary, 1995). Equity strategies may identify field courses as very successful in overcoming the gender dichotomy due to its preference for small groups, for cooperative learning strategies, for problem-based strategies, for participatory investigations, and for hands-on activities rather than working from a textbook. Gender is often represented as a discriminator at the level of school-relevant knowledge; this is also the case within the special ecology and natural history area where girls tend to score higher than boys. Acquired (factual and conceptual) knowledge in the outdoor ecology education field is often understood as an indicator of educational success, adding certain new aspects to the cognitive domain. Our education programme (which dealt with nature and environmental issues) was apparently able to add appropriate information originating in the selected programme itself. However, we should not read pre-post-test results through so-called 'gender equity alert glasses.' Of course, gender differences within our pre-test scores are apparent and they remain in the post-test. However, even the before the intervention high-scoring girls were able to increase their scores still further.

Other results on the basis of the same empirical instrument

Because both the designs and the empirical instruments employed are identical, only the samples and the educational programmes differing, a comparison of the outcome of previously published studies is justified (Bogner, 1998, 1999, 2002). All programmes employed outdoor settings and lasted for at least four days. While three previous studies revealed only a subset of our primary factors affected, this present study showed effects in all primary factors involved. All three previous studies and the present study examined the hypothesis that participation in residential education programmes enhances environmental perception. The field programmes in question covered ecological aspects of a complex ecosystem (study-1), conservational elements focussing on endangered birds (study-2), and environmental protection as well as conservational problems (study-3). Using a two stage sampling design in a pre-post-treatment evaluation (post-test delayed for a one-month period after participation) all participating pupils (N=333 [study-1]; N=226 [study-2]; N=151 [study-3]) responded twice to the same questionnaire (whose primary and secondary factorial structure had previously been developed on the basis of a large (N=4500) European sample (see Bogner and Wiseman, 1999, 2002b). The pre-post-test study showed significant differences in up to four of the five primary factors. However, when a change in preservational and/or utilitarian preferences was observed, the shifts occurred as an increase of preservation and a decrease of utilization. No effect was observed with the pre-post-tested control groups.

The factor scores derived from the pre-test and post-test questionnaire of the experimental group yielded shifts in two (study 2 and 3) and four (study-1) of the five primary factors (p<0.001). The factors involved were primary factors of the utilitarian and the preservational primary factor set. However, clear differences occur within the three studies. Firstly, the study-1 in a German National park (N=333, Bogner, 1998a) focussed on a nature face-to-face experience, yielding the encou-

raging result that long-term variables, such as 'Care with Resources', were affected; a one-day alternative with similar settings failed to affect the variables tested (Bogner, 1998a). Secondly, study-2 within Swiss schools focused on a conservational programme featuring an endangered migratory bird (N=226, Bogner, 1999): Programme participation yielded a shift in two preservational primary factors but none in the utilitarian factors. Finally, study-3 (N=151, Bogner, 2002), an extra-curricular educational unit with a cognitive outdoors emphasis, focused on regional environmental protection problems including structured and participatory learning activities. Programme participation resulted in shifts in the utilitarian factor, but none in the preservational factor.

The Bogner study of 1998a was undertaken in the same nature centre as the present study, and employed the same instrument with a very similar education programme. The 1998 study showed a shift in four of the five primary factors, leaving "Human Dominance" unaffected by the programme participation. We, therefore, shifted the programme content in the present study towards a more wilderness-oriented approach, and specifically incorporated the dead forest section into the programme. Human impact was especially highlighted by the widespread forest decay within a huge (500 ha) section of the National Park - still a major local issue. Apparently, highlighting this specific issue additionally influenced a variable, which had previously been unaffected.

Conclusion

Outdoor ecology education represents the sunny side of science education largely due to its fieldwork potential that provides an essential key for incorporation of hands-on-practice and encountering nature via different sensory channels. It may also provide a convincing response to the urgent need within biology education to shift away from a materialistic and atomistic worldview, and its epistemological paradigm towards an ecological approach with its network thinking and its sense of identification of background pattern. Residential ecological education certainly provides settings, which, for instance, affect participants' self-esteem, interpersonal relationships, outdoor skills or values and attitudes, apart from the ecological and environmental context of our survey. This underlines the simple fact that educational programmes are complex and interdisciplinary issues. Participation in field courses does not confine pupils to national curricula with their strict and often inflexible frameworks, and provides active participation, in contrast to the frequent passivity in classroom environments.

Ecology education in field centres has gained importance in the last decades both as an area of study in its own right, and as a component of biology education. Additionally, evaluating field courses has increasingly been seen as necessary to justify the huge amounts of school time and money spent, as well as to yield a tool for the improvement of outdoor programmes. Although our approach represents only a portion of a more complex mosaic of environmental perception, our 2-MEV model subsumes widely divergent batteries, each with its own primary-order structure, yet all yielding the same two orthogonal higher-order factors of Preservation and Utilization As soon as valid and reliable batteries for the quantification of the 2-MEV are available, we can monitor the efficacy of programmes, and replace less efficient sub-units. Of course, education programmes must meet a variety of chal-

lenges. Complex ecological and environmental issues are often confusing issues for pupils. However, pupils must understand the anatomy of ecological issues including their environmental dimension. The effects of educational programmes may be diluted by numerous other demands on teacher and pupils. Therefore, some authors have blamed evaluations of environmental education for producing a biased estimate of the potential of those programmes to produce change (Armstrong & Impara, 1992).

Education is seen as the most important key for a successful transformation towards higher preservational preferences. Ecology and environmental education must provide the young with appropriate tools for achieving effective citizenship, so that they can adapt with the need of coping with environmental threats to our existence. However, nobody in the educational sector expects a precise forecast of intervention effects on participating pupils. Consequently, we prefer the use of verbs such as "support" and "indicate" rather than the strict and final verb of "proof." Nonetheless, by virtue of our psychometric procedures, we provide data, which we could use, for instance, for explaining (and intervening with) educational efficacies. Nevertheless, we should regard empirical data with caution when we draw (final) conclusions. Our study presents a promising account of the value of an ecology programme towards pupils' values and attitudes. Summarising all potential and measurable impacts of an intervention unit, it highlights substantial shifts in knowledge and values of pupils, and provides evidence of the long-term effect of such shifts (for instance, over a period of six months). Our study also points to the importance of the emotional ingredients of outdoor ecology education that go well beyond the potential of the classroom; and last but not least, to the imprint effect in the life of a young person that may essentially influence decisions in professional life. Altogether, our data point to a substantial potential within the affective and cognitive development of adolescents which outdoor educational intervention may support.

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