CHILDREN'S EXPERIENCES WITH VEGETATION ON SCHOOL GROUNDS, THEIR BOTANICAL KNOWLEDGE AND ENVIRONMENTAL DISPOSITIONS.

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ABSTRACT

This enquiry evaluates the impact of 21 junior school landscapes in England on botanical knowledge and environmental dispositions in 8 to 11 year old children (N = 845).

Children's past experiences with vegetation and present experiences on school grounds are measured in detail, correlated with their botanical knowledge and environmental dispositions, and presented in regression models including a number of additional variables. The results indicate that both past and present experiences make a small, but significant contribution to the development of botanical knowledge and environmental dispositions and that the school landscape can be an educational resource for environmental education.

INTRODUCTION

This study is an attempt to bring together three different perspectives: the post-occupancy evaluation of institutions with differing attributes, the search for attributes in the environment which may contribute to specific developmental outcomes, in this case academic achievement and environmental dispositions, and the quest to bring nature into the design of spaces for urban children.

The study's premise is that the developmental process of the child can be influenced by characteristics of the physical setting, without claiming it to be the major influence (David & Weinstein, 1987). According to Wachs (1987) this stage 1 question whether environment is relevant to development has been answered in the affirmative and stage 2 questions searching for specific attributes in the environment are now indicated (Hunt, 1979; Wachs & Gruen, 1982). The specific attributes under investigation are the natural, vegetative elements on school grounds.

LITERATURE REVIEW

The physical environment of school children has been researched extensively (Gump, 1978; Kurtz, 1978; Rivlin & Weinstein, 1984; Gump, 1987). Almost exclusively it is equated with the indoor school environment (for reviews see George, 1975; Weinstein, 1979). By contrast, the outdoor school environment in which children wait before and after their lessons, play during breaks and lunch hours, and spend their physical education classes has rarely been evaluated from the developmental standpoint.

To consider this open space an educational resource or outdoor laboratory for biology and environmental education is the logical extension of John Dewey's call for an 'experience curriculum' in education (1938). Such a use has been demanded in England and Germany since the sixties (Countryside Commission, 1965; Schools Council, 1974; Winkel, 1985). Today the number of schools actively engaged in establishing natural areas on their school grounds is growing.

The potential to shape children's awareness and response to their environment through this daily contact had long been recognized by R. Moore in his Project WEY, the Washington Environmental Yard in Berkeley (1974, 1978, 1986). Although WEY was designed to accommodate the play needs of children, the recreational and aesthetic needs of the community, and the curricular needs of education simultaneously, there has not been a systematic attempt to measure its impact compared to school yards less well endowed.

However, children's experiences in two related environments have received attention: playgrounds and outdoor education at camps, field centers or other sites away from school.

Numerous observational studies evaluating <u>playgrounds</u> concluded that facets like children's degree of control over their environment (Bengtson, 1973), complexity of layout (Schneekloth, 1976), manipulability (Nicholson, 1971; v. Ryzin, 1978) would be preferable from a developmental point of view. Most of these desirable traits on playgrounds could be achieved by imaginative use of vegetation. But typically vegetation as an attribute was not considered, nor was a specific developmental outcome measured and it was not the school playground, but neighborhood playgrounds, which were subject to investigation with the emphasis on the recreational rather than educational aspect. For instance of the numerous, creative playgrounds illustrated in 'Children's Play Spaces' only four are in school yards (Rouard & Simon, 1977).

Reviews of research on <u>outdoor educational experiences</u> conclude that the out-of-doors provides a more stimulating learning environment for relevant fields of study, if the outdoor education experience is of sufficient duration (Crompton & Sellar, 1981; Backman & Crompton, 1984). After an experimental study comparing indoor with outdoor environmental education Howie (1974) recommended a combination of classroom preparation with outdoor experiences. Similarly, a direct comparison of teaching environmental education in a 'classroom only' setting and a 'combined classroom plus practical application' in Israel found the combined method more useful to the student (Blum, 1982).

In a nationally representative sample of American science teachers Keown (1987) noted that 16% never used the outdoors and the majority of the classes use outdoor resources fewer than three times a year. Factors restricting the use of the outdoors as a teaching resource were in order of importance: financing the travel, class size too large, lack of support from administration and few local sites of interest. The school landscape, if developed as a teaching resource, would alleviate most of these difficulties.

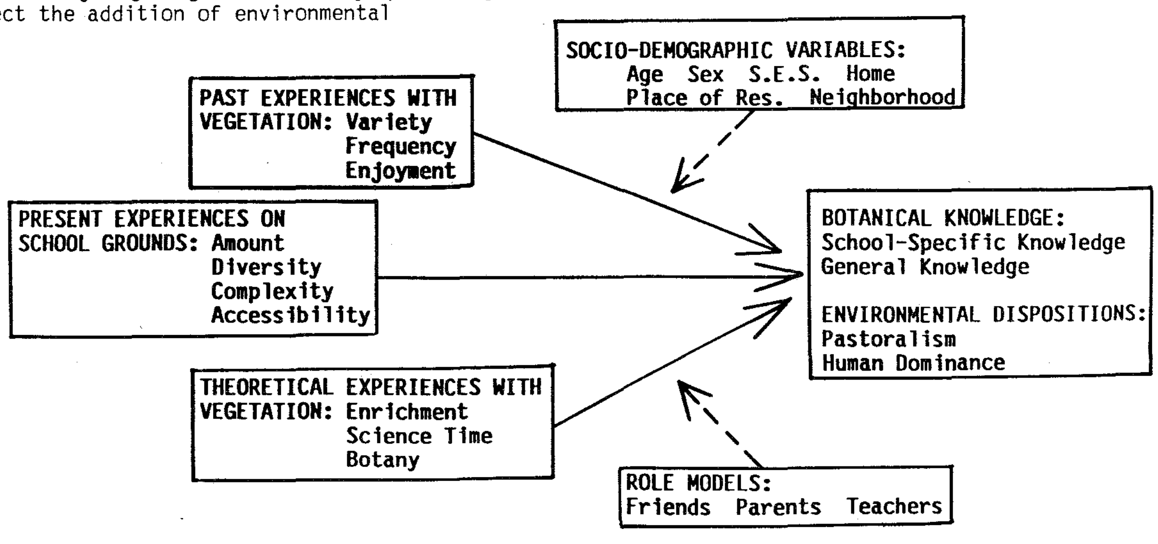
Apart from its potential role as source for environmental knowledge, contact or experience with the natural environment has been cited as a sine qua non for concern for the environment (Hart & Chawla, 1980). Experiences with natural systems do not simply provide information, they can also evoke emotions and convey values. After carefully tracing children's development as a process of original confusion between the self and the world, followed by increasing differentiation, toward an ideal goal of a mature sense of interrelatedness of self and world, they hypothesize that "biological experiences form a most important basis for the development of an environmental ethic" (1980, p.278).

Reviews of studies of environmental concern and its correlates have found inconsistent patterns. Van Liere and Dunlap found negative associations between expressions of concern and age; they suggest that these positive attitudes among the younger generation may partially reflect the addition of environmental education to the curriculum (1980). By way of confirmation Jaus found that just two hours of education with regard to conservation, pollution and recycling resulted in significantly more protective attitudes to nature in the treatment group as opposed to the non-treatment group (1984). Similar results had been obtained by Gifford, Hay & Boros (1982) and Benjamin, Moeller & Morrison (1977). Despite frequent speculation of positive effects of direct involvement with nature over a longer period (Horvat & Voelker, 1976; Burgh, 1977; Perdue & Warder, 1981) there is a scarcity of factual information about any antecedents to environmental concern.

Meanwhile the measurement of environmental attitudes in children has progressed from diverse, individual attempts (Horvat & Voelker, 1976; Benjamin, Moeller & Morrison, 1977; Weigel & Weigel, 1978; Jaus, 1984) to reliable scales of CERI, the Children's Environmental Response Inventory (Bunting & Cousins, 1983, 1985). Two scales of this 8-scale instrument measure environmental dispositions, which can be taken to express the degree of a child's concern for the environment: 'Pastoralism', the enjoyment of the natural environment in an intellectual and aesthetic fashion, and 'environmental adaptation', a belief in man's right to use technology to adapt and dominate nature, here re-named 'Human Dominance'.

In England the number of school grounds with environmental areas has grown sufficiently to allow a post-occupancy evaluation of their impact on children's development. Four particular aspects of the school landscape were assessed: the amount and the diversity of vegetation, the complexity of environmental features, and the accessibility of vegetation.

Since children's experiences with vegetation do not only occur on school grounds, their past experiences with vegetation were measured with regard to variety, frequency, and enjoyment (Harvey, 1989). A schematic model of the hypothesized interrelations is outlined below. Not all measured variables can be discussed in this paper.



METHODS

Wherever possible multiple methods were employed. Physical measurements of school grounds were combined with a survey of teachers and students.

The physical measurements consisted of detailed site plans of the school landscapes, based on Ordnance Survey maps and coupled with complete inventories of all vegetation on the sites and all features of environmental relevance, like wetlands, ponds, butterfly gardens, bird tables, greenhouses etc..

The plans were rank-ordered by six independent judges, all faculty members of the Department of Landscape Architecture at the University of Wisconsin-Madison, for the amount and diversity of vegetation according to the plant inventories and the complexity of environmental features according to presence or absence of 16 additional features recorded on the site plans[1]. Information from teachers about school policy regarding access to the school grounds was used as a weight, multiplied with amount of vegetation, to arrive at a measure for accessibility of vegetation.

The survey of teachers and students was undertaken with two separate questionnaires, a short teacher questionnaire concerning the school practices and a lengthy one for the students. The student questionnaire contained a mixture of open-ended and multiple-choice botany questions from established achievement tests[2], a cognitive map of their school landscape, and 2 standardized attitude scales to measure environmental disposition from the 'Children's Environmental Response Inventory" (Bunting & Cousins, 1983 & 1985), as well as demographic information and an inventory of past experiences with vegetation.

The participating schools were selected on the recommendation of county planning departments in eight counties in the south of England with the aim of maximum between setting variance with regards to vegetation on school grounds. Extreme cases, i.e. schools with a great deal of vegetation and schools with very little vegetation, were overrepresented. To avoid a biased sample with "leafy' middle class schools and "asphalt jungle type" schools in working class areas, middle class schools with little vegetation and working class school with a lot of vegetation were selected on purpose.

At each school one class of 8-9 year olds and a second class of 10-11 year old children were interviewed in October 1986. The questionnaire was administered by systematic group interviews of about 1 hour's duration to 995 eight to eleven year old students. 15.1% of questionnaires were incomplete. The results are based on the analysis of the remaining 845 completed questionnaires.

FINDINGS

The sample was evenly divided by sex: 425 girls and 420 boys. The ages varied from 8 to 11 with the largest proportion at age 10 (47.3%) and 9 (34.4%). Socio-economic status of students, measured by weighting students' type of home with teacher's estimate of social class of school catchment area, was normally distributed.

The 21 schools were drawn from 10 different locations, from small villages to the inner city. 49% were combined Junior and Infant Schools, 39% were separate Junior Schools and the remainder were Middle schools. There were four Church of England and one Roman Catholic school. Five schools had a large percentage of immigrant children. School size varied from 150 to 775 students (mean 327) with the potential area available for play per student ranging from 5.6 to 100.3 m^2 (mean 35.8 m^2).

Four dependent variables will be examined here: general botanical knowledge (1), measured through standardized test items, and school-specific botanical knowledge about vegetation on the school grounds (2) which was derived from the mental maps the children drew of their school landscape. The environmental dispositions measured with two 22-item Likert-type scales from the Children's Environmental Research Inventory were Environmental Adaptation, here re-named 'Human Dominance'(3) and Pastoralism (4).

These four dependent variables are significantly correlated with one another: for school-specific knowledge and general botanical knowledge the Pearson correlation coefficient was $r = .450$, Human Dominance was negatively related to Pastoralism ($r = -.416$) and general botanical knowledge was associated negatively with Human Dominance ($r = -.506$).

It was hypothesized that students from 'developed' school landscapes and with rich experiences with vegetation in their past would score higher on the first three dependent variables and lower on Human Dominance.

This was born out by the results. Table 1 shows a relation between the amount of vegetation on the school grounds and students general botanical knowledge. More students from highly vegetated school grounds had high scores for general knowledge than students from schools with little vegetation. Similarly more students from undeveloped school grounds had low general knowledge scores than students from developed grounds.

The difference was more pronounced with regard to school-specific knowledge about vegetation (Table 2). Students, who experienced a lot of vegetation in their school landscape, more frequently included the correct amount of vegetation in their cognitive maps (as compared to the site plans drawn by the author), they drew it at the approximate locations more often and they added the correct plant names (almost exclusively the names of trees).

Table 1
Amount of Vegetation on School Grounds and General Knowledge of Botany (Row percent)

Amount of Veg.	General Knowledge of Botany low	-	med.	-	high
low	20.2	28.3	26.2	13.7	11.6
medium	13.5	28.9	34.2	15.1	8.2
high	7.6	20.3	29.4	24.6	18.0
N =	107	216	239	166	117

The environmental attributes measured were not independent of each other. Amount of vegetation was highly correlated with diversity of vegetation (r=.963), complexity of environmental features (r=.857) and accessibility of vegetation (r=.896). Accordingly the results for diversity, complexity, and accessibility of vegetation crosstabulated with the two knowledge variables looked almost identical to Table 1 and 2.

The results for the environmental dispositions indicate that students from schools with vegetated landscapes tended to have higher scores for Pastoralism, which means that they agreed with statements like "I really enjoy nature" or "I like places where there are lots of plants and trees". They also scored lower on the scale for Human Dominance over nature, which endorses statements like "People should be able to cut down trees whenever they want to" or "I am glad that man can change nature". Table 3 gives the mean scale score for the groups of schools which the judges ranked low, medium, and high for complexity of environmental features. It shows a steady decrease in the Human Dominance scores, as one progresses from the less complex to the complex school grounds, and conversely a steady increase in the Pastoralism scores.

Table 2
Amount of Vegetation on School Grounds and School-Specific Knowledge of Botany
(Row percent [3])

Amount of Veg.	School-specific Knowledge of Veg. low	-	medium	-	high
low	21.0	35.4	21.0	8.0	8.9
medium	16.1	16.5	24.0	20.4	14.5
high	7.5	12.0	31.0	23.2	24.3
N =	115	170	225	154	152

When comparing these scores to those obtained by Buntings and Cousins (1985) with a Canadian sample of children, grade 4 to 10, their mean score for Pastoralism of 86.06 (S.D. 12.02) is almost identical to the mean of 87.072 (S.D. 11.672) for this sample from England. But the Human Dominance mean of 56.72 (S.D. 10.15) is higher than the one obtained in Canada. Since the score for Human Dominance declines somewhat with age and the Canadian sample included older children, this shows remarkable consistency of the scales across cultures.

Table 3
Complexity of Environmental Features on School Grounds and Students' Environmental Dispositions

Complexity of Env. Features	Environmental Dispositions Human Dominance Mean	S.D.	Pastoralism Mean	S.D.
low	60.33	8.40	81.68	12.11
medium	57.83	10.03	87.31	10.44
high	54.28	10.27	90.01	9.96

Pearson correlation coefficients summarize the relationships between the four attributes of school grounds and the four dependent variables in Table 4. All the correlations obtained are statistically significant at the $p < .01$ level of significance.

Among the four dependent variables school-specific knowledge of vegetation is the most highly correlated with attributes of the school grounds. For general botanical knowledge the correlations are lower across the board, and for Pastoralism they are the lowest. As hypothesized Human Dominance is negatively related to all four environmental attributes (Table 4).

Table 4
Pearson Correlation Matrix[4]
Relations between Environmental Attributes of School Grounds, Botanical Knowledge, and Environmental Disposition

Knowledge/ Dispositions	Environmental Attributes: Amount	Divers.	Complex.	Access
School-spec. Knowledge	.373	.357	.367	.369
General Knowledge	.215	.224	.293	.215
Pastoralism	.157	.170	.208	.202
Human Dominance	-.232	-.250	-.266	-.212

Human Dominance N=796, for Pastoralism N=388

Among the four natural attributes measured, complexity of environmental features has a slight edge, it achieved the highest correlations with general botanical knowledge, Pastoralism, and Human Dominance. Only for school-specific knowledge does the amount of vegetation matter slightly more than complexity of environmental features.

Apart from the physical attributes on the school grounds, the children's prior experiential history with regard to vegetation was considered important for the formation of environmental attitudes and knowledge. An 18 item battery of questions established the children's variety of experiences, frequency and enjoyment of experiences with vegetation (Harvey, 1988, 1989).

Students' **past experiences with vegetation** were significantly related to all four dependent variables (Table 5). In particular, the variety of past experiences seemed to be positively associated with school-specific and general knowledge and negatively with Human Dominance, while the appreciation of past experiences, i.e. the degree to which students enjoyed their past experiences, was the most important factor for Pastoralism. Again, all three aspects of past experiences measured were negatively correlated with Human Dominance.

As both past experiences and the actual experiences with vegetation on the school grounds are associated with botanical knowledge and environmental dispositions, the question arises as to the relative importance of these factors in explaining the variance in the dependent variables. Accordingly multiple regression analyses were undertaken with the addition of demographic factors (sex, age, S.E.S., type of home, place of residence, and socio-economic status of neighborhood) and the reported views of the students' role models (parents, friends, and teachers).

Table 5
Pearson Correlation Matrix
Relations between Past Experiences with Vegetation, Botanical Knowledge, and Environmental Dispositions

Knowledge/ Dispositions	Past Experiences with Vegetation: Variety	Frequency	Appreciation
School-spec. Knowledge	.266	.221	.157
General Knowledge	.308	.242	.193
Pastoralism	.304	.317	.359
Human Dominance	-.283	-.240	-.197

N = 794, for Pastoralism N = 388

The analyses resulted in regression equations for the four dependent variables, which are summarized in Table 6. These four equations are attempts at multivariate models for the development of environmental dispositions and botanical knowledge. The multiple R^2 at the bottom of the table represents the percent of the variance in the dependent variables explained by the models. The multiple R^2 range from 25.1% to 17.4%.

As far as the demographic factors were concerned, only age and the socio-economic status of students explained additional variance. General and specific botanical knowledge obviously improved somewhat with age, and children with higher socio-economic status had better general botanical knowledge, scored higher on pastoralism and lower on Human Dominance.

Among the reported role models, the views of friends were important for Pastoralism, those of parents for Human Dominance, but negatively so, and teachers counted in the development of school-specific knowledge of vegetation. Lastly, general knowledge depended to a small degree on 'enrichment', a category measuring the frequency with which the teachers provided instruction outside the classroom.

Table 6
Multiple Regression Analysis
Beta Weights and Multiple Correlation Coefficients for General and School-specific Knowledge, Pastoralism, and Human Dominance

Predictor Variables:	Criterion Variables: Spec. Knowl.	General Knowl.	Pastor-alism	Human Dominan.
Attributes:				
Amount	.376	--	--	--
Complexity	--	.217	.190	-.182
Past Exp.:				
Variety	.186	.249	--	-.215
Appreciation	--	--	.320	--
Theor. Exp.:				
Enrichment	--	.076	--	--
Demographic:				
Age	.242	.197	--	-.085
S.E.S.	--	.119	.127	-.147
Role Models:				
Friends	--	--	.175	--
Parents	--	--	--	-.114
Teachers	.134	--	--	--
Multiple R^2	**.251**	**.228**	**.231**	**.174**

DISCUSSION AND CONCLUSION

Inasmuch as this study provides evidence of a relationship between environmental attributes of the school grounds and the cognitive and affective development of children, it raises policy questions regarding the implications for the future planning of school landscapes.

As a caveat, statistical significance is not to be confused with real life importance. Before basing any action on the result of significant differences, it is wise to consider the size of effect and the variance explained. The percentage of variance explained by the multiple regression models is low for all four dependent variables. But then no major influence had been expected.

The educational process is cumulative after all. No one factor, but a combination of physical, social and psychological factors determine the efficacy of the educational process. It is further mediated by the personality of the child, the organismic specificity as Wachs calls it (1987). None of the organismic, psychological variables could be included in this study; especially troubling is the lack of information on IQ's or educational achievement. As only a fraction of these potentially relevant factors appear as variables in the models, it can be considered important that they explain some of the variance.

Secondly, the importance of variables found to impinge on educational efficacy increases with the ease with which they can be manipulated. Results that show correlations between educational achievement and sex, socio-economic status or IQ, for instance, further our understanding and may improve our prediction of educational success, they do not give us a tool to actively influence the developmental outcome through design.

By contrast, all the environmental attributes of the school grounds measured for this study can be manipulated relatively easily. The one factor which seemed to account for most of the variance in the dependent variables was the complexity of environmental features. The more environmentally complex school grounds, not necessarily the most vegetated, offered the more effective learning experiences for the students in this sample as far as general botanical knowledge and the two environmental dispositions were concerned. This reinforces results obtained by developmental researchers who consistently report a positive relationship between variety and complexity of experiences and subsequent development (Wachs & Gruen, 1982).

This finding should be reassuring to schools with crowded and mostly hard top school grounds without possibilities for expansion. Many of the features contributing to the complexity score in this study were small enough to be incorporated in cramped conditions, like bird feeders, container plants, log piles, pets, compost heaps etc.

While diversity of vegetation did not contribute to explaining any additional variance, the amount of vegetation was associated with school-specific knowledge of vegetation. The reader may consider this self-evident. However, an equally plausible hypothesis could have claimed that vegetation as a relatively constant stimulus in the environment 'washes out' sensation and is subject to sensory adaptation, or that vegetation does not constitute the minimal perceptual change in an environment for it to be noticed. The results show that vegetation was relevant to the purpose and the activities of the subjects, they did indeed notice it.

Students' past experiences with vegetation are manipulable too, although not by teachers and schools so much as by parents. Especially by providing a stimulating variety of experiences with vegetation parents can be effective in improving students' knowledge base and in decreasing their score on the Human Dominance scale, while Pastoralism depended on the question, whether students had enjoyed their past experiences. Concerned parents will find it easy to provide varied experiences, but may be not quite as easy to guarantee that their child will enjoy the contact with vegetation.

Lastly, the question of relevance: so what, if botanical knowledge and environmental dispositions are slightly improved by the development of school landscapes? Botany is only a minor part of biology, frequently neglected in comparison to animal-related topics. In most American grade schools it is not part of the curriculum at all and in English Junior schools it is more often a means rather than an end in itself.

The answer is twofold: First it provides some empirical evidence in support of the quest to incorporate nature into the lives and play spaces of urban children (USDA Forest Service, 1977; Moore, G. et al., 1985; Moore, R.C. et al. 1987). Designing school landscapes with complex environmental features and diverse and accessible vegetation is not just an exercise in aesthetics; it is an educational resource which has largely been overlooked hitherto.

Secondly, the importance of the results hinges on the relation between botanical knowledge and environmental dispositions. The philosophy underlying the introduction of environmental education and its dissemination throughout the curricula aims at the development of attitudes which help students acquire a set of values and feelings of concern for the environment as well as the motivation and commitment to participate in environmental maintenance and improvement (Engleson, 1985). A high score in Pastoralism and a low score in Human Dominance over nature can be considered operationalizations of the environmental ethics underlying environmental education. Any contributions toward the development of such attitudes, such developmental outcomes, are therefore to be welcomed.

FOOTNOTES:
1. Items contributing to the complexity score were: Nature trail, meadow (long grass area with wild flowers), wetland, pond, plants in containers, bird tables and boxes, butterfly garden, greenhouse, animals in cages, compost heap, dead tree, hide-out for wildlife

observation, logpile, tree nursery, stile, play structures.

2. The items used were from MEAP, the Michigan Educational Assessment Program for grade 4 and 7, Science Form C; from NAEP, National Assessment of Educational Progress, the Third Assessment of Science, released exercise set; and APU, Assessment of Performance Unit, Department of Education and Science, London.

3. Percentages do not add up to 100, because 29 of the 845 cognitive maps could not be reliably coded.

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