Education Experiences Contribute to Cognitive Development?

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ABSTRACT: This paper synthesizes what the empirical literature reports regarding what can best be learned outdoors. The review suggests that the outdoors may be effective in stimulating critical thinking, increasing problem-solving skills, and developing concepts rather than rote memory. Little evidence was found to support claims for the superiority of teaching language development in the outdoors. The empirical literature offers qualified support to those who advocate the value of outdoor education in facilitating cognitive development in the areas of environmental education and general science, but the evidence must be regarded as tenuous and uncertain. Much of the research which has been reported falls short of the scientific standards necessary for it to make meaningful contributions to this debate.

"That which can be learned in the classroom should be taught there, and that which can best be learned in the out-of-doors should there be taught" said L. B. Sharp, the father of outdoor education (12). This paper reviews the empirical literature in an attempt to synthesize what researchers have learned regarding what can best be learned out-of-doors. Specifically the paper addresses the question "Are there some situations in which the outdoor environment is uniquely suited for improving cognitive development, so students acquire more knowledge per unit time and better understand the material?"

Reviewing research related to outdoor education is complicated by the lack of consensus as to how outdoor education should be defined. Horn (20) attempted to arrive at a definition through factor analysing AAHPER members' attitudes. He found that outdoor educators don't differentiate between environment oriented, conservation oriented, and activity oriented outdoor education. Hammerman and Hammerman (17) and Smith (44) suggest the purpose of outdoor education "is to enrich, vitalize and complement content areas of the school curriculum by means of first hand observation outside the classroom." Others, like Skatos (42) state that outdoor education is a philosophy of holistic education and learning, which views children as a whole entity, hungry for knowledge and experience.

For the purposes of this paper, outdoor education was defined as all school related academic education which takes place outdoors. This broad definition ensured that all research studies attempting to follow scientific procedures which might offer insights into the issue would be included.

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The pioneer study which attempted to empirically address this question was the Life Camps experiment 1947 (35). Two experimental groups consisting of sixty-two fifth and sixth graders, and two control groups, were used to investigate the effect of a camp program on academic growth in five major areas: interest, arithmetic, science and health education, vocabulary, and nature study. The report concluded, "In conclusion, omitting any assumptions, the test results indicate initial and final superiority of the experimental group, with many of the differences in their favor being statistically significant."

For many years, this study was cited as evidence of the value of outdoor education in facilitating cognitive development. "It established the fact that outdoor education was academically sound and could be an extension of the regular curriculum" (38). Sharp (41) writing thirteen years later, stated:

Scientific testing used in these experiments did prove that the outdoor setting was more effective for certain learnings. These results were conclusive and amazing.

However, a detailed analysis of the study's actual findings suggest that this conclusion was overly optimistic. Statistically significant gains were recorded among the experimental groups only in the areas of interest and vocabulary. However, in the latter case, while one experimental group showed a significant gain, the others showed a slight, though not significant, loss. In the other areas, arithmetic, science and health education, and nature study, there were no significant advantages. Further, "by today's standards, the experiment could be disected with some negative connotations" (38). The research design, instrumentation, and procedures certainly would be challenged today.

The suggestion that the Life Camp results were overly optimistic receives support from Huntley's (24) work. Huntley tried to replicate the 1947 study using ninety-four sixth grade boys and girls as subjects. Students were assigned to experimental, control, and paired groups. Groups were paired on the basis of sex, age, IQ, and reading age level. The control group was taught in an established classroom, while the experimental group participated in the outdoor education experiences. Both programs were taught by regular school district faculty members.

All subjects completed pre- and posttests over four curriculum areas: nature study, mathematics, science, and vocabulary. Both treatment groups were similar, prior to the intervention. No statistically significant differences were found between the groups in any of the four curriculum areas.

Subsequent to the Life Camp experiments, research has generally focused on three subject areas: environmental education, general science, and language development. The findings pertaining to each are discussed in turn.

Environmental Education

This section of the paper examines those reported studies that used experimental research methods to gain insight into whether outdoor education does or does not contribute to the learning of environmental concepts. Peck (36), using a pretest/posttest, control group, and experimental design, compared the effectiveness of outdoor, indoor, and combined outdoor/indoor settings for meeting specific environmental education objectives. Subjects in the study were tenth grade biology students. His sample was comprised of a control group \( n = 84 \) and three experimental groups. The experimental groups consisted of an outdoor group \( n = 37 \), which was taught for five consecutive school days entirely out-of-doors; an indoor group \( n = 55 \), which received instruction totally inside the classroom for fifty minutes for five successive school days; and a combination \( n = 31 \) group, which was taught for fifty minutes for five consecutive school days in the classroom, and in addition, participated in a three day outdoor experience similar to that of the outdoor group. Instructors for the program were certified North Carolina teachers employed as instructors with the Ecological Education Program.

The control group consisted of three subgroups of high school biology students. Each corresponded to one of the three experimental groups. Students in the control group attended their regularly scheduled classes between pretesting and posttesting, and received no instruction from ecological education staff. One subgroup of control students had five consecutive school days between pre- and posttesting, the second subgroup had eight consecutive days of classes, and the third subgroup had ten days of classes between tests. Thus, each subgroup corresponded to the time involvement of one of the experimental groups.

The instrument used for evaluation was the "Environmental Achievement Test." This consisted of multiple choice questions designed to ascertain students' abilities to correctly respond to factual and conceptual questions pertaining to their environment. Analysis of test results revealed that the outdoor group did significantly better than the control group and the other two experimental groups. The results suggested that the outdoor context was most successful for teaching environmental education. The indoor and combined indoor/outdoor programs did not produce such substantial gains in knowledge.

In a similar study, Howie (22) also compared the efficacy of teaching environmental education in outdoor, indoor, and a combined outdoor/indoor setting. A fourth group was used as a control and was not exposed to any of the environmental education treatments. The
483 students were randomly assigned by intact home rooms to the four groups. Howie used advance organizers with the indoor and combined outdoor/indoor groups. Advance organizers were a set of classroom experiences designed to provide advance introduction to specific concepts. These classroom experiences consisted of ten, one hour or less, sessions which focused on providing students with factual information rather than application of content. A strong emphasis was placed on broad conceptualization and related vocabulary. This was intended to provide students with a cognitive framework so the pieces of information they would encounter in the outdoor environment could be anchored in their memory and later retrieved when necessary. The outdoor treatment lasted two days and was structured so it would facilitate guided discovery of the concepts presented in the classroom set of advance organizers.

Howie analyzed how each treatment group responded to questions reflecting the students’ abilities to conceptualize and apply information. The posttest specifically developed for this study consisted of thirty questions. Fifteen were drawn from basic environmental concepts, and the other fifteen were concerned with the application of experiences to each of those areas. The posttest was administered the day following completion of treatments.

Results revealed that the experimental groups scored higher than the control group in every case. This was true for conceptualization and application subsection scores as well as for the total scores. There was little difference between the three treatment groups in the application scores, but there were differences in their conceptualization scores. Students in the combined indoor/outdoor group who were provided with advance organizers were better able to conceptualize than those students who did not receive advance organizers. When compared on a cognitive scale, the indoor/outdoor experience was superior to both the indoor classroom treatment and the outdoor discovery method of learning, with respect to gains in total development and ability to conceptualize environmental education principles. The findings of Howie’s study suggest that students must be formally prepared in the classroom, prior to an outdoor experience to receive maximum benefit from the experience.

While Peck (36) and Howie (22) were concerned with the relative utility of outdoor and indoor settings, Hosley (21) compared the relative impact of two different methodologies for teaching environmental education. One-hundred fifth grade students were selected at random from four-hundred students currently participating in an Environmental Education Program. They were assigned to one of four experimental groups (n = 25). The first group served as a control group; the second group received instruction which employed a three session slide-tape presentation termed Audible Multi-Imagery (AMI); the third group received a field experience, and group four was exposed to a combination of AMI and the field experience.

Comparisons were made of each group’s performance using a retention test which measured knowledge of environmental concepts. Results revealed: 1) students who received instruction through AMI scored as high as students instructed by the field experience; 2) students who received AMI scored significantly higher than students who received no instruction; and 3) students in the combined group scored significantly higher than all other groups.

In a similar study, Glenn (14) compared the effectiveness of field trips to observe local geologic features, with in-class viewing of 35mm color slides of those same geologic features. The sample was comprised of high school juniors and seniors. Of three sub-groups, one participated in field trips, one remained in the classroom to learn from the color slides, and the third was a control group which did neither.

Evaluation consisted of three tests. On the “Test of Ability to Form Hypotheses,” only the group taught with the color slides scored significantly higher than the control group. Both field trip and slide groups scored significantly higher than the control group on the “Test of Ability to Make Observations.” Neither group scored significantly higher than the control group on the “Cornell Initial Thinking Test.” In view of these results, and with awareness of the practical problems involved in field trips, Glenn concluded that classroom teaching with the aid of 35mm color slides was a preferable approach to using field trips.

Goldsbury’s (15) study did not relate to environmental concepts but it did address the issue of the relative utility of field trips and the use of classroom visual aids. He used three groups of third graders. One group took trips to a food warehouse, dairy plant, and ice-cream plant; a second group was exposed to the trips locally prepared slide-tapes of those trips; and a third group received both the slide-tape and the direct field experiences. Pre- and posttests revealed that on two of the field trips, the students receiving the combination treatment made significantly greater gains in most of the tested areas, while in the third instance no clear pattern of differences emerged. Goldsbury concluded that the combination of field trip and slide-tape experience appeared to best facilitate total learning. However, if comparisons are based solely upon the facts and concepts to be learned, then slide-tape presentations of the information are likely to prove as effective as field trips.

Peters (37) concluded that cognitive understanding and concept development in environmental education may be as effectively developed by visual aids as through field trips. Sixty high school students were randomly assigned among two groups. One group toured three different
facilities while the other group viewed Sim-Tour sound film simulations of the same places. These films were made during earlier trips. A factual recall test and a concept principle questionnaire were given to each group after completion of the field trips. Although no significant differences were found between the groups on either test, Peters suggested that the ideal situation would be to blend field trips with the visual aid program because they would serve as complimentary reinforcers.

Keown (29) in his investigation used sixteen boys and sixteen girls as subjects, selected on the basis of achievement in previous science courses and an essay explaining why they would like to participate. Three extensive field trips, each focusing on a particular environmental concept, were conducted over the two week period of the study.

Subjects were evaluated by means of pre- and post-taped interviews; a fifty question, multiple choice test on principles; and through a questionnaire which was sent to the students' parents. For the multiple choice test, high school students who corresponded in age, sex, and academic background served as the control group. No significant differences emerged between the pre- and posttest scores of the control group, but significant differences were recorded between the pre- and posttest scores of the experimental group.

Morton (34) investigated the influence of a winter interdisciplinary outdoor education program on a sample of middle school students' knowledge about the outdoor environment. The study employed a pre- and posttest non-equivalent control design. Subjects were not randomly selected. The Millward-Ginter Outdoor Attitude Inventory (MGOAI) was administered to 254 subjects (experimental group = 167; control group = 87). The experimental group attended a residential camp while the control group remained in the regular classrooms during the course of the study.

One week prior to students attending the camp, both groups received Form A of the 25 item MGOAI. One week after returning from camp both groups received form B of the 25 item MGOAI. Results revealed a significant increase in the experimental group's scores between pre- and posttests. In contrast, the control group had gains in the wrong direction.

Use of the outdoors for effectively teaching environmental education concepts has a long history of advocacy (40, 8, 18, and 28). The empirical findings are mixed. Some of the studies reported here provided empirical evidence to support this advocacy. The findings of Peck (36), Keown (29), and Morton (34) all suggest that students learn environmental concepts more effectively in an outdoor context. However, Howie's (23) results suggest that combining indoor and outdoor learning may be a more effective approach, if the indoor setting is used to prepare students for the outdoor learning experience. His findings are endorsed by those of Hosley (21) and Goldsberry (15) who reported that students receiving both the field group experience and a pre-field slide-tape presentation scored higher than groups receiving either of these treatments independently. Glenn (14) did not incorporate the use of both visual aids and field trip in his experiment and, in contrast to other researchers, concluded that classroom teaching with good visual aids was as effective as field trip experiences in facilitating cognitive development.

In conclusion, the findings suggest that effectiveness may be greatest if the outdoor experience is preceded by an indoor experience which provides a cognitive framework into which pieces of information likely to be encountered outdoors can be fitted.

**General Science**

It has been advocated that outdoor experiences are a superior vehicle for facilitating cognitive learning of general science, (13, 4). For example, Smith et al. (44) suggest that "most of the science fields may be enriched and comprehension increased through carefully selected outdoor experiences."

In an effort to substantiate such claims, Roller (39) conducted evaluations in 1967 and 1968 at the Land Between the Lakes Outdoor Recreation Center, with fourth, fifth, and sixth grade children. Roller conducted similar evaluations in both years using a control and an experimental group. In 1967 the experimental group consisted of forty-seven children and eight consultants giving a ratio of approximately 6:1. Both groups were tested prior to the one week outdoor experience, and again immediately upon completion of the program. The instrument used for evaluation consisted of sixty-nine questions. Roller reported that students in the experimental group averaged 17.9 points higher on the posttest, while the control group averaged 5.6 points higher on the posttest.

In 1968, fifty-eight children and six consultants undertook a similar one week experience at Land Between the Lakes. The pretest, now expanded to include seventy-five questions, was administered to both experimental and control groups. Posttest analysis indicated that the control group gained 6 points, while the experimental group gained 32 points.

While this evidence appears convincing, it is important to note that students in the outdoor experience were exposed to the material for a whole week, while students in the control group undertook only normal course work and were not offered the same intensive exposure. Thus, the gain could be attributed to differential exposure to the material rather than to the outdoor context in which the teaching took place.

De Blanc (11) used a pre- and posttest experimental design to examine how participation in an outdoor education program influenced the science achievement of high school seniors. A total of 479 students were in-
volved in the study; 285 in the experimental group, and
174 students from a different high school who were used
as the control group. While the experimental group par-
ticipated in twelve science short courses offered at an
outdoor education center over a five-month period, sub-
jects in the control group did not take part in the program.

The evaluation instrument used in this study was the
"Metropolitan Achievement Test: Science Concepts
and Understanding Science Information." Analysis of
results indicated that students in the experimental group
achieved significantly higher score increases than did
students in the control group.

Kaplan (27) used a pre- and posttest experimental de-
sign to investigate the effectiveness of resident outdoor
education program on the ability to recognize and iden-
tify living organisms, and relationships between them.
Fifth and sixth grade students, who were divided by
class into experimental and control groups, served as
subjects for the study. The experimental group con-
sisted of one fifth and one sixth grade class that attended
an outdoor school. Both groups took part in the pro-
gram. The control group (one fifth and one sixth grade
class) experienced regular classroom instruction over the
same material during the study time period. A projective
instrument, developed by the investigator, was
administered to both groups as a pre- and posttest. Stu-
dents’ responses to the instrument were divided into two
categories, with each student receiving two scores; one
for the total number of acceptable objects identified and
the second for the identification of relationships. Sub-
jects in the experimental groups significantly increased
their scores on both dimensions from pre- to posttests
but these increases were no greater than the increase in
scores recorded by students in the control groups.

Wise (49) compared the effects of three different
methods of science instruction: direct experience in the
outdoors; outdoor classroom instruction; and indoor
classroom instruction. To determine their different ef-
fcts he measured three different dimensions of the
cognitive domain: comprehension; acquisition of knowl-
dge; and subsequent observations made by the student
in the outdoor settings. A pretest, posttest, post-posttest
experimental design was used but a control group was
not included in this study.

Three classes of fifth graders, each containing 29
students, were selected randomly from each of three
schools. Thus, there were 261 subjects in the study. Sub-
jects and teachers were randomly assigned to the treat-
ment groups.

The science content taught was organized into three
areas: soils, trees, and temperature. One week was al-
located for the teaching of each of the three study areas.
All treatments lasted about 40 minutes and were given at
approximately the same time of day. The outdoor
classroom group used the same teaching procedures and
materials as the indoor classroom group. The only dif-
ference between the direct outdoor experience and the
classroom groups was that subjects in the direct outdoor
experience used materials found in their natural outdoor
context, while the other two groups used only some
natural materials brought into the classroom. Lessons
were similar in length with most requiring forty
minutes. Lesson plans were pretested prior to use in this
study.

All students were pretested, immediately posttested,
and tested again three weeks after completion of the
program. The evaluation instrument, developed by
Wise, was an achievement test consisting of 60 multiple
choice questions. While Part 1 of the achievement test
was designed to measure recall/knowledge, Part II was
designed to measure comprehension of content. The
same test was used as a pretest, posttest, and again to
evaluate retention. When submitted to the Kuder-
Richardson 20 Reliability Formula, a measure of inter-
nal consistency, the test demonstrated a reliability of
.90. Individually, Parts I and II demonstrated Kuder-
Richardson 20 co-efficients of .84 and .82 respectively.
Each week during the study students were also asked to
record any outdoor observations made during after
school hours regarding the science studied.

Pretest scores revealed no significant difference be-
tween groups prior to treatment. Analyses to determine
the effects of the three treatments on knowledge/recall,
comprehension, and retention showed that those sub-
jected to the outdoor direct exposure treatment scored
higher on both the posttest and post-posttest, and for
both the knowledge/recall and comprehension parts of
the test, higher than the other two treatment groups.
However, the higher scores were not significantly
higher than the scores of the other two groups. Analysis of stu-
dent observation sheets did indicate that the outdoor
direct experience group recorded significantly more out-
door observations related to the science content studied
than the other groups.

Another study comparing the efficacy of indoor and
outdoor education was conducted by McNamara (33).
He investigated whether or not two laboratory en-
vvironments, one indoor and one outdoor, would pro-
duce significantly different results in overall achieve-
m ent, critical thinking and achievement on individual
concepts of eighth and ninth grade earth science students.

The subjects were thirteen groups of ninth grade
science students with approximately twenty-five stu-
dents in each group, and two similar sized groups of
eighth grade science students. The study lasted ten
weeks. The classes were divided randomly and evenly in-
to control and experimental groups. Both the outdoor
and indoor groups studied Unit I of the Earth Science
Curriculum Project (ESCP) textbook. The control
group undertook all classroom activities, including the
laboratories, totally indoors, utilizing prepackaged in-
structional materials. The outdoor groups undertook
similar activities totally indoors, but their laboratory sessions were held outdoors utilizing resources in the outdoor environment.

The "ESCP Achievement Test" was used to assess overall achievement; the "Cornell Critical Thinking Test" was used to evaluate critical thinking; and a "Concepts Test" evaluated achievement on individual concepts. All student groups were pre- and posttested with each of the test instruments, except for the Concepts Test which was administered only as a posttest. Analysis of achievement test scores indicated that the environment in which the laboratory experiences were held had no significant effect on total achievement. Analysis of the critical thinking test scores indicated that the outdoor environment group scored significantly higher than the indoor group. The concepts tests revealed significant gains for outdoor groups on concepts dealing with rocks, minerals, latitude, maps and contour models, and magnetic field.

Johnson's (26) findings suggested that insistence in mode of instruction was probably more important than whether it was taught in an indoor or outdoor environment. An eighth grade group comprised of 112 students was randomly assigned to one of four modes of instruction for the two selected areas of botany and zoology. The four models were: 1) indoors only, 2) outdoors only, 3) botany indoors, zoology outdoors, and 4) botany outdoors, zoology indoors. The same information was presented to all groups and identical unit tests were administered at the end of the ten-week session. Johnson found that the learning achieved by the outdoor and the indoor groups was similar, and both of these groups achieved better results than did the other two groups which received the mixed modes of instruction.

Slater (43) investigated the effects of an exploratory field trip experience on sixth grade students' cognitive understanding of specific ecological concepts. Subjects for the study were students in a sixth grade class studying the ecological concepts of adaptation, change, and interdependency in ecological communities. The class was comprised of eleven boys and nine girls from lower socioeconomic backgrounds.

Prior to participating in a one-day field trip involving exploration of three ecological communities, students took part in three pre-trip sessions which focused upon ecological communities. To determine changes in the students' cognitive understanding of concepts, Slater analyzed the cognitive level of their classroom dialogue by taping the first half-hour of three class periods before, and three class periods after, the field trip.

The "Florida Taxonomy Cognitive Behavior" instrument was used to analyze content of the tapes. The "Taxonomy" is an observational instrument which records different types of verbal behavior as they occur during the course of discussions. This instrument identifies seven categories of cognitive behavior: 1) knowledge of specifics; 2) knowledge of ways and means of dealing with specifics; 3) interpretations; 4) application; 5) analysis; 6) synthesis; and 7) evaluation. Classroom dialogues from the six classroom discussions were classified into the seven categories by having an observer listen to the tapes and record each time a specific type of cognitive behavior occurred. These seven categories were collapsed into two categories for analysis in the study, separating rote recall skills (the first three categories of the taxonomy) from the problem solving skills (the last four categories). All pre-field trip scores were grouped together and all post-field trip frequency marks were combined. These tabulations were then analyzed to determine pre- and post-field trip cognitive mean scores.

Results of the analysis revealed that cognitive behavior mean scores improved significantly as a result of the field trip. These scores reflected an increase in problem solving skills in the discussion following the field trip.

Buerstatte (5) compared the relative effectiveness of a field discovery approach and a field lecture approach in fostering students' ability to observe and explain ecological relationships. The field discovery approach emphasized independent work by students in contrast to the more conventional field lecture approach in which students were led into discovery. While no significant differences were found between the discovery group and the control group in observing ecological relationships, the discovery group did significantly better than the field lecture group in explaining those relationships.

Huntoon (25) investigated the effects of a two week environmental education day camp on forty 8-12 year old campers' understanding of ecological concepts. He used a pre- and posttest experimental design but did not use a control group. Campers were grouped according to age ranges: 8-10 years and 10-12 years. Each of the age groups in each of two, two week, camp sessions contained ten campers.

The instrument used for evaluation was developed by the investigator and termed the "Town Lake Day Camp Attitude Inventory." Twenty of the fifty-four statements on the instrument were statements of basic ecological concepts, the other thirty-four were statements of attitude toward the environment. While the same ecology concept statements were used in both pre- and posttests, two forms of the attitude statements were used, one as a pretest, the other as a posttest measure. Results of both age groups were considered separately. Scores for campers in the same age range from both sessions were combined to produce one combined score for each age group. To determine the effect of the treatment in each age group with respect to ecology concepts, campers' pre- and posttest responses were compared for each of the twenty ecology statements. Pretest average scores, average change, and direction of change were calculated for each ecology statement. Also computed
was an average change for the ecology statements as a group.

The results suggested that a number of changes occurred in campers' understanding of basic ecological concepts. Substantial changes in knowledge occurred almost entirely in the 10–12 year old age group. The younger 8–10 age group showed a sizeable increase in their understanding of only one concept.

Outdoor educators have advocated that the outdoors is the optimum setting for students to learn science (2). Intuitively this claim seems reasonable and the empirical research offers some qualified support. Three of the nine studies reviewed in this section, DeBlanc (11), Slater (43), and Huntoon (25) reported significant improvement in science knowledge during an outdoor experience, but in each of these studies pre- and posttests were conducted only on the experimental group. No control groups, which might have been exposed to the same material in an indoor environment, were included in these research studies. Thus, gains in science knowledge which occurred may be attributed to subjects being exposed to the material, rather than to the context in which the learning took place. The same limitation applies to Roller's (37) study since although she used a control group this group was not subjected to the same level of intensive exposure. If the subjects had been exposed to the same material for the same period of time in an indoor classroom context, it must be recognized that in each of these four studies similar gains in science knowledge could have resulted.

Kaplan (27) and Johnson (26) reported that the outdoor group did no better than the control group, although both groups made significant gains after they had been exposed to the material. Johnson's (26) findings suggest that consistency in using either an indoor or outdoor environment was important, and that mixing them may lead to less effective results. Wise (49) found those in the direct outdoor group were able to make significantly more observations and were better able to retain material than the outdoor or indoor classroom instruction groups, but he did not find the direct outdoors experience to be more effective on tests which measured knowledge and comprehension of science concepts.

Wise's (49) findings do not appear to be entirely consistent with those reported by Buerstatte (5) and McNamara (33). Buerstatte (5) concluded that students taught by a field discovery approach were better able to explain ecological concepts than those taught by the more traditional field lecture approach, but this method did not seem to lead to any better student observation of ecological relationships. McNamara's (33) findings suggest that the real value of teaching general science in the outdoors may be its ability to stimulate critical thinking. While he was unable to report any significant difference in total achievement between using indoor and outdoor laboratories, the outdoor group scored significantly higher than the indoor group in critical thinking.

Although the studies reviewed in this section used different contexts, time frames, research designs, and evaluation measures, all of them reported some favorable results. However, the weakness of some of their research designs, and the partial and tenuous nature of several of their conclusions, suggest that more research efforts are needed before definitive claims can be made in support of extensively using the outdoors for teaching general science.

**Language Development**

This section of the paper reviews outdoor education research that has focused on language skills. Ward (47) suggests that the outdoors can facilitate language acquisition and development; similarly, Smith et al. (45) hypothesize that the informality often associated with outdoor field trips or camp settings is conducive to the development of natural expression.

In a particularly well-designed study, Clark (9) compared the effectiveness of teaching skill subjects (reading, spelling, and arithmetic) in the outdoors with teaching the same subjects in the classroom, over a six-week time period.

Subjects for this study were two fifth grade classes drawn from the same school district and matched on age, intelligence level, and achievement. A standardized instrument, the “Stanford Achievement Test,” was used for evaluation. The outdoor experience was conducted on the school grounds. When the test results of the experimental and control groups were compared, no significant gains were shown by the experimental group. In fact, in two of the skill areas, the control group showed significant gains (.01 level). The study suggested that the classroom method was more effective than the outdoor method in learning materials in the “skill” subjects.

In contrast to Clark's findings, Wilcox (48) reported that his experimental group acquired, "to a measurable degree," a greater amount of cognitive knowledge in language arts, mathematics, and science. However, no difference was found between his experimental and control groups in social studies. Wilcox used ninth graders. The experimental group consisted of 35 students while the control group comprised 30 students. Both groups were administered the "Iowa Test of Educational Development" (ITED) as a pretest. During the following semester, the experimental group received treatment which contained the outdoor education techniques, while the control group were exposed to the same material using traditional approaches. The results were deduced after the ITED posttest was administered.

Kraus (31) investigated the effect which study trips, followed by discussion groups, had on the vocabulary of kindergarten students from three social groups. The seventy-nine subjects were selected from three classrooms each from a different rural school district, and
were classified as middle class Anglo-American, lower class Anglo-American and lower class Mexican-American. One of the three groups served as the control group.

Once a week for a twelve-week period, students participated in a field trip followed by a discussion which encouraged them to use new words, and develop and expand the meanings of words. The evaluation instrument "Watts Vocabulary Test for Young Children" was administered to all subjects as high, average, and low verbal responders were observed in the classroom to determine the effect of the instruction on their verbal behavior. Kraus concluded that the vocabulary of the pupils in each of the social groups in the experimental classes was effectively stimulated by the instruction, but the instruction was least effective for lower class Mexican-American subjects and most effective for middle class pupils.

Kruger (32) investigated the effects of a four-week day camp program with planned reading experiences, on reading achievement. Ninety-six students selected from different elementary schools served as subjects. The experimental group was comprised of forty-eight students who attended the camp, while the control group was made up of forty-eight students who did not attend the camp, but were on the camp waiting list. Both the control group and the experimental group consisted of twenty-four fifth, and twenty-four sixth, graders.

Two forms of the "Metropolitan Achievers Test," which tests readers' word knowledge and comprehension, were used for evaluation. The results indicated that students in the camp group in general demonstrated significantly greater achievement in word knowledge and comprehension than the waiting group during the school term following the camp experience.

Resident camps, as well as day camps, have been investigated for effectiveness in helping students develop reading skills. Konle (29) examined the effects of a reading study program involving some camp-style living, on the reading achievement of high school freshmen who were experiencing reading problems. The experimental reading program was seven weeks in length and included one week at a rural reading camp, followed by a similar weekend experience.

Of the forty-six students who accepted the invitation to participate in the program, forty were randomly selected to make up the sample for the experiment. Twenty students were assigned to the experimental group and twenty to the control group. Students in the control group received only their regular classroom reading instruction. The "Iowa Silent Reading Test, Level 2, Form E" was used as a posttest measure to evaluate the effect of the experimental programs. Results indicated there was no significant difference between the experimental and the control groups in reaching attainment.

There is little evidence to support claims that the outdoor environment is superior in aiding language development. Wilcox (48) provided some support for this claim, but the studies by Clark (9) and Konle (30) were unable to substantiate this contention. Although Kruger (32) found the use of an enriched reading program did help students develop word knowledge and comprehension, the absence of a control group means it is possible that a similar program offered in a classroom could have achieved the same results.

The investigation by Kraus (31) suggested that a combined approach of field trips, followed by post-trip discussions was effective in stimulating kindergarten students' language development. However, this program's effectiveness must be evaluated against other techniques or teaching methods designed to stimulate language development before claims for the unique effectiveness of the outdoors can be accepted.

Conclusions

Ausbel (1) points out that past experiences influence new learning and retention by having some impact on the cognitive structure of the child. Based upon the findings of Howie (23), Hosley (21), and Goldsbury (15) it is likely that environmental concepts may be learned more effectively if students are oriented in the classroom with relevant concepts, so they have some sense of structure before going to the outdoor experience.

The review suggests that the outdoors may be effective in stimulating critical thinking and increasing problem-solving skills (33, 43), and when concern is with developing concepts and understanding rather than with rote memory (33). Independent field research is likely to be most useful with students who are more academic (those who do a lot of reading) while the more guided traditional learning approach in the outdoors is likely to be most useful for slow learners (5).

Little evidence was found to support claims for the teaching of language development in the outdoors. The strongest support was for environmental education which presumably meets Sharp's (40) criterion of "that which can best be learned in the out-of-doors should there be taught."

The evaluative research reviewed for this paper offers qualified support to those who advocate the value of outdoor education in facilitating cognitive development in the areas of environmental education and general science. However, the evidence must be regarded as tenuous and uncertain. Given the long history of advocacy, there is a relative paucity of empirical research evaluating the utility of outdoor education for facilitating cognitive development. Unfortunately, much of the research which has been reported falls short of the scientific standards necessary for it to make a meaningful contribution to the body of knowledge in this area (46).
Many studies were discarded by the authors because they did not approach minimum scientific standards. Even the usefulness of some of those retained in the review was limited by inadequate research procedures. The main sources of these limitations were identified in an earlier review paper which addressed the effectiveness of outdoor education in the affective domain (10). One additional limitation which emerged in this study was that investigators often failed to define which dimension of the cognitive domain they were seeking to measure. Perhaps Bloom's (3) six-level hierarchy of the cognitive domain could form a basic taxonomy to which studies could refer: 1) knowledge; 2) comprehension; 3) application; 4) analysis; 5) synthesis; and 6) evaluation.

It is beyond the scope of this paper to discuss in detail the relative merits of alternative research designs. For this, readers are referred to the classic discussion offered by Campbell and Stanley (6). However, it does appear that some researchers have not given enough thought to the implications of their research designs.

Strong experimental research designs are obviously preferable, but the context within which the researcher is required to work sometimes dictates that weaker designs have to be implemented. These weaker designs should not be discouraged when there are no superior alternatives, since they can contribute insights to knowledge. However, it is imperative that a researcher be thoroughly aware of which specific variables the design fails to control in order that he or she can clarify for the reader the points on which the results are equivocal. Many of the studies reviewed in the paper failed to do this. Hence, readers without a sound knowledge of research methods remained unaware of the extent to which conclusions concerning purported causal linkage between variables might be spurious and misleading rather than informative.

The most critical ingredient in developing a strong research design is randomization. Strong designs require that the research be able to randomly assign treatments to randomly selected test units. In effect, the researcher can control the when and to whom of exposure to the treatment. Particularly good examples of strong designs reviewed in this paper are those used by Wise (49) and McNamara (33).

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