THE TEACHING EFFECTIVENESS OF SIX PRESENTATION VARIATIONS OF AN INTERPRETIVE EXHIBIT

by

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ABSTRACT

An interpretive exhibit, designed to teach kindergarten through third grade children about the foods of six woodland animals, was developed at the Jordan Park Nature Center in Portage County, Wisconsin. Learning outcomes in 794 children who viewed this exhibit were measured by a paper and pencil test. The relative teaching effectiveness of six exhibit presentation variations was evaluated by comparing pre-exhibit and post-exhibit test scores.

The presentation variations of the exhibit were installed consecutively over a period of testing which lasted from January through mid-February, and from mid-April through June, 1979. Black and white flatwork, colored flatwork, and mounted animals with real foods were presented in these variations. Half of the children who viewed each presentation variation encountered a participatory element of the exhibit.

The colored flatwork with participation variation resulted in the most learning, followed by colored flatwork with no participation, black and white flatwork with participation, mounted animals/real foods with participation, black and white flatwork with no participation, and mounted animals/real foods with no participation. Limitations of the study, and implications of the results were discussed.

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INTRODUCTION

Environmental interpretation is a form of education that is widely used in nature centers, museums, and visitor centers throughout the country. It promotes concern about environmental problems, teaches ecologic principles, and enriches the outdoor experiences of millions of people.

The goal of environmental interpretation is the translation of information about the environment into understandable terms (Wagar, 1974). The interpreter's tools are natural areas, as well as plants, animals, and innate objects from natural areas. The interpreter's methods vary. He may choose a personal approach, using himself as a vehicle for the interpretive process, or he may use a non-personal type of interpretation, such as an exhibit.

The exhibit can provide entertainment for its viewers, but its major goal is essentially didactic (Shettel, 1973). Like other educational media, an exhibit has a learning objective which states what a viewer is expected to do as a result of his or her exposure to an exhibit (Screven, 1974a). By measuring the amount of learning in an exhibit viewer, the exhibit designer is able to determine if the exhibit objectives have been met, and to quantitatively evaluate the exhibit's effectiveness.

Most exhibits are one-way communication systems which end when the viewer receives the exhibit's message (Cameron, 1967). Research utilizing "feedback loops" is essential in determining whether or not interpretation has been successful. The key to obtaining feedback on exhibit effectiveness

is the formulation of specific, measurable learning objectives. According to Gagne (1965), an objective is valid if the performance required of a learner following a learning experience is the same as that stated in the objective. An exhibit designer can develop a "validated" exhibit by evaluating viewer performance (Nicol, 1969).

Exhibit evaluation is most effective during the process of exhibit development. Temporary exhibit variations, which differ in design or communication techniques, can be evaluated to determine the variation that is most successful in achieving the exhibit's objectives. By installing this variation permanently, the most effective and efficient exhibit is developed and utilized (Screven, 1976; Shettel et al, 1968; Nicol, 1969).

The information in an interpretive exhibit can be presented in a number of different ways. Exhibit presentation variables can include the use of colored vs. black and white illustrations, the use of flatwork vs. three-dimensional mounted specimens and real objects, and the use of viewer participation vs. no viewer participation.

Colored vs. Black and White Illustrations: If color is used properly in an exhibit it will not compete with objects or text. In an anthropology exhibit at the Milwaukee Public Museum, Parsons (1970) found that a monochrome color scheme was favored over a variety of colors. At the Franklin Institute Science Museum, Borun (1977) reported that although numerous background colors in an exhibit did not affect

attending behavior of the exhibit viewers, there was a negative correlation between the popularity of an exhibit and the number of background colors. In visitor centers in the Pacific Northwest, Washburne and Wagar (1972) found no difference in viewer interest levels when comparing exhibits using black and white photos to those using color photos.

Flatwork vs. Three-Dimensional Specimens and Objects: The basic precept of museum teaching, according to the American Association of Museums, is that there is no substitute for the "real thing." "Examining three-dimensional objects in exhibits and demonstrations rather than just reading about them makes the learning process much easier" (Oliver, 1971). Objects, specimens, and even pictures of real things enhance a learning experience and make it richer than if learning is purely from written words. Parr (1962) stresses the importance of "gooky exhibits" which feature real specimens instead of symbols. Dale's (1946) "cone of experience" model of learning emphasizes the importance of using instructional media that is as close to the "real thing" as possible.

Gropper (1966) states that in learning situations the "response strength" of the learner is high for physical objects because of his everyday experience with shapes, colors, and sizes, while the response strength for verbal and written symbols, or for abstract concepts is not likely to be as high. Real objects are intuitively understood whereas symbols for those objects may not be. This may be due to the fact that more than one sense is utilized in learning from real objects and the learner is able to use the sights, sounds, textures,

and odors of real objects.

Real objects, especially mounted animals, are more popular than words or pictures in an exhibit. In a visitor survey at the Milwaukee Public Museum, Niehoff (1970) found that life-size dioramas were the most preferred exhibits. At the Jordan Park Nature Center, Blahna (1978) reported that mounted birds and mammals, and real life objects were some of the exhibit characteristics that visitors found most interesting. Results of a study in a nature center in the Prince Albert National Park (Asmuss and Dutcher, 1969) revealed that exhibits of animals, especially mammals, attracted greater attention than did flat exhibit panels. Servos (1976) reached similar conclusions about the attractiveness of mounted animals, but both studies also reported that viewers' attention time span for animal exhibits was quite short.

Viewer Participation vs. No Viewer Participation: A participatory device in an exhibit is anything which the exhibit viewer can alter or manipulate through direct handling, or a large structure which the viewer can walk through or climb on (Borun, 1977). Participatory exhibits not only attract and hold attention, which is an important prerequisite for learning, but they also provide an opportunity for the exhibit viewers to experiment with objects in their environment and to observe results. Active participation in a learning experience evokes a deeper understanding than merely looking or listening. An ancient Chinese proverb states, 'I hear, and I forget, I see and I remember, I do and I understand' (Francisco, unknown).

Exhibit designers should utilize people's need for effectance (or causing physical change in their environment) (White, 1959). Being close to an object does not automatically cause learning about that object; "Personal involvement is the key" (Naumer, 1971). Children, especially, need to interact with concrete objects in order to stay interested and participation with exhibits stimulates interest. Linn (1976) reported that the amount of time spent at an exhibit is directly related to its participatory potential.

In addition to increasing viewer interest, participation allows an exhibit viewer to retain more factual information (Carmel, 1963; Shettel, 1973). Learning takes place more readily with participatory exhibits than with static exhibits or classroom experience because the exhibit viewer is challenged with questions which he can answer through self-discovery (Eason and Linn, 1976; Borun, 1977). Screven (1974b) found that interactive response devices such as punch boards, self-scoring latent image response cards, trainer-tester cards, self-paced cassettes, and computer terminals improve learning from exhibits. According to Robinson (1960), presentation techniques that actively involve the exhibit viewer are superior to passive involvement and graphic techniques for conveying factual information.

The participatory exhibit usually encourages viewer participation by asking questions. Questions not only challenge the viewer, but also direct him to the feature of the exhibit which the designer wants him to see, and thus, the exhibit objectives can be met (Screven, 1969). The selection of

proper questions is the key to stimulating interest in the viewer; "low-arousal" questions which are too difficult, lengthy, or condescending, will not be effective in encouraging participation (Bull, 1973). Parsons (1970) found that exhibit viewers favored a declarative statement approach in presenting exhibit information to a "do-it-yourself" question approach. He suggested that one reason for this may be that the questions took too much effort to answer. There is also the possibility that questions motivate viewers, and attract their attention, but do not always enhance learning (Royal Ontario Museum, 1976).

Most recent exhibit evaluation studies have utilized adult audiences. Yet, it is the grade school children who come to the nature centers and museums by the busload to see and to learn from exhibits. Interpretive exhibits for children should use a different approach than exhibits for adults. "Children are fundamentally different from adults in their perceptions of the world and their capabilitites" (Machlis and McDonough, 1978), and interpretation for children should not be merely a "dilution" of interpretation for adults (Tilden, 1967).

Imagination and fantasy play an important role in a child's interpretation of what he sees around him, and interpretation for children should reflect this (Machlis and McDonough, 1978). If learning is to occur as a result of exposure to an exhibit, that exhibit must capture the viewer's attention and hold his interest long enough for him to learn (Shettel, 1973). An exhibit which gains a child's attention

by capturing his imagination may motivate him to learn more than one which does not. Because children are eager to see and learn, and visit nature centers extensively, and because they are at an age when the forming of environmental ethics is important, children were chosen as interpretive exhibit-viewing subjects for this study.

The objectives of this study were to 1) design an interpretive exhibit with a measurable cognitive learning objective for kindergarten through third grade children, 2) develop a valid, reliable learning test for children who view the exhibit, and 3) evaluate the relative effectiveness of six exhibit presentation variations which are tested in the exhibit, and choose the most effective one for the final exhibit. The six variations are 1) black and white flatwork with no viewer participation, 2) black and white flatwork with viewer participation, 3) colored flatwork with no viewer participation, 4) colored flatwork with viewer participation, 5) mounted animals and real foods with no viewer participation, and 6) mounted animals and real foods with viewer participation.

MATERIALS AND METHODS

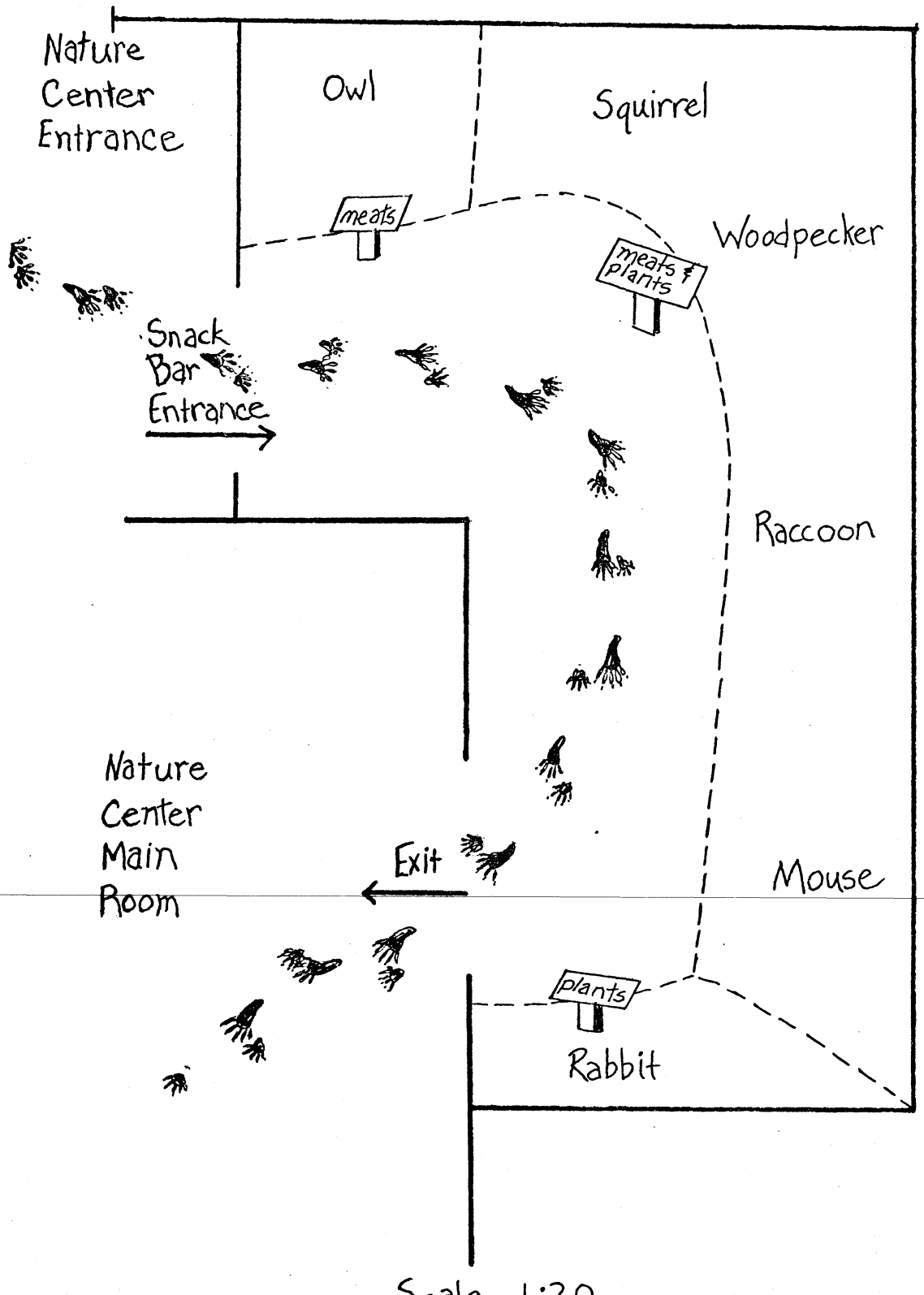
The Study Site and Subjects

An exhibit effectiveness study was conducted at the Jordan Park Nature Center in Portage County, Wisconsin. The Center, which is approximately five miles northeast of Stevens Point, is operated by the Portage County Park Commission. Throughout the year the Center provides an opportunity for people of all ages to learn about the environment from talks and exhibits in the Nature Center building, and from the Center's nature trails. The Center has approximately 4,000 visitors per year.

This study was part of the Center's Winter and Spring Children's Nature Programs which ran from mid-January through February, and from mid-April through May, 1979. Subjects for the study were 794 children in 24 kindergarten through third grade classes from the Stevens Point area schools. These classes, which visited the Center on week days, were accompanied by teachers and a few parents.

The Center building is a remodeled one-room schoolhouse. The study exhibit (Figure 1), entitled the Snack Bar, was built in an alcove situated between the front entrance and the main room. When a class arrived at the Center, half the children visited the Snack Bar, then took a cognitive learning test. The other half visited the Snack Bar after taking the test. All the children then joined in a half-hour lecture/discussion with the Center's Director of Children's Nature Programs about signs of animal life (during the winter session), and food webs (during the spring session). The

Figure 1. Layout of the Snack Bar Exhibit in the Jordan Park Nature Center.



Director used slides, aquaria, posters, and other visual aids to present ideas. The children then divided into small groups of 5-10, and accompanied the Center's naturalists on the nature trails for approximately 45 minutes to find signs of animal life, animal foods, and animal homes in the Jordan Park Woods. After their nature hike the children returned to school.

The Snack Bar Exhibit

The Exhibit's subject matter is the foods of six woodland animals (Table 1). The animals and their corresponding foods are divided into three food sections according to the animals' trophic levels. These sections are identified by signs mounted on low stands. Painted on each sign is the name of the food section ("meats", "meats and plants", or "plants"), and a representative picture.

To create an environment which would appeal to a child's imagination, both the entrance and exit of the Exhibit are "child-sized" arched doorways resembling the entrance and exit of a cave or tunnel. Animal tracks are painted on the floor leading into and out of the Exhibit. Parts of tree trunks, rocks, and pine and oak branches create an outdoor atmosphere. Because there are no windows in the exhibit area, lighting is controlled; yellow and white spotlights, mounted above a layer of leafy branches give the Exhibit a mottled, woodsy effect. All exhibit panels are mounted at a child's viewing height.

The Exhibit Learning Objective

The learning objective of the Exhibit is: after viewing

Table 1. The animals and animal foods* featured in the Snack Bar Exhibit at the Jordan Park Nature Center.

ANIMAL	FOODS	TROPHIC LEVEL	
Barred Owl	mice, rabbits	carnivore	(in "meats food section")
Fox Squirrel	eggs, beetles, acorns	omnivore	(in "meats and plants food section")
Redheaded Woodpecker	beetles, acorns, corn	omnivore	(in "meats and plants food section")
Raccoon	grasshoppers, corn, crayfish	omnivore	(in "meats and plants food section")
Deer Mouse	grass seed, grasshoppers, corn, beetles	omnivore	(in "meats and plants food section")
Cottontail Rabbit	herbs, bark	herbivore	(in "plants food section")

*(Bent, 1964; Karalus and Eckert, 1974; Martin et al, 1951; Palmer and Fowler, 1975)

the Exhibit, the learner will be able to correctly match the pictures of six animals found in the Exhibit to pictures of the animals' appropriate foods. Learning from the Exhibit was evaluated by a paper and pencil test where the learner matched pictures of animals and their foods (Appendix A).

The Learning Test

The learning test was developed in a preliminary study with the cooperation of kindergarten through third grade school teachers and their classes in Stevens Point and Janesville, Wisconsin. Tests administered in this study varied in length, format, and difficulty level in order to establish which test was best suited to the ages of the children who would visit the Center, and to the time restrictions put on the testing procedure.

An analysis of results of the preliminary study determined that the best test format involved a pictoral test where the children matched pictures by drawing lines.

During the preliminary study some of the tests were given after children were exposed to mock-up representations of the exhibit components. This was done to predict the increase in score due to learning in the Snack Bar Exhibit. Knowing the probable increase in score made it possible to adjust the difficulty of the test so that it would be sensitive to increases in learning measured at the high score range.

Each test developed during the preliminary study was analyzed to determine the distribution of scores, the mean score, the standard deviation of the scores, the standard

error of measurement, the Kuder-Richardson 20 reliability coefficient of the tests (Ebel, 1965), and the discrimination and difficulty indexes of each test item.

Reliability coefficients improved with each of the five preliminary learning tests, rising from zero to 0.68. Reliability was improved by eliminating items that did not discriminate well (discrimination index below 0.41). Items which were too easy, or too difficult (those which did not have an index of difficulty between 0.25 and 0.75) were also eliminated (Ebel, 1972).

During the preliminary study period individual classes took each test (15 to 30 students). Because reliability increases with an increase in sample variance (Ebel, 1972), a higher reliability coefficient was anticipated for the final test analysis because children in four grade levels from several schools would be tested.

The time required for a class to take each of the preliminary tests was recorded. Although a higher value was obtained for a 16 item test, a 12 item test was most suitable for the time allotted for testing at the Jordan Nature Center.

When the preliminary study was completed, and 12 test items selected for the final test, detailed rapidograph drawings were made of the Snack Bar Exhibit animals and their foods. The drawings were reduced, and offset copies of the three page test were made (Appendix A). Because yellow is a child's favorite color (Birren, 1976), yellow paper was used to make the test more appealing to children.

Testing Procedure

When a class of children came to the Center they were greeted at the front entrance by the Center's Director of Children's Nature Programs. Because of time limitations a completely randomized assignment of the children into pre-exhibit and post-exhibit viewing groups was not feasible. Instead, teachers were requested by the Director to divide their classes into small groups of 5 to 10 children so that the naturalists would have well-defined groups to accompany them on the Center's nature trails after the testing and discussions in the Center building. As a result, an even-odd assignment of these groups into pre-exhibit and post-exhibit viewing groups was made.

One half of the children (the pre-exhibit test group) were led into the main room via an alcove located on the opposite side of the building from that in which the Exhibit was located. These children were instructed to take a seat in the main room where a "game" (the learning test) and a pencil had been placed. They were told:

> "Please pick up the game next to you and fill in your age on the line at the top of the first page. On each page of this game are four large circles. In the center of each large circle is an animal in a smaller circle drawn with a thick black line. Look at the animal in the center of this smaller circle, and then look at the four foods that are around the animal. Decide which one of the four foods that animal eats, and then draw a line from the animal to that food. Even if you are not quite sure of an answer, make a guess. When you have finished all three of the pages in the game turn your paper over and put your pencil down so that I know that you have finished. Then I will collect the games. Please do not talk during the game so that others can think. Please do your own work."

Meanwhile the other half of the class remained inside the entrance to the Center in front of the Snack Bar where they received a short orientation talk:

> "Do you ever wonder what the animals in the woods find to eat? The first thing we'll do today at the Nature Center is visit the Snack Bar. What do you think you'll find?....There are different food sections in the Snack Bar like the food sections in your grocery store. You'll find foods in the "meats section", in the "plants section", and in the "meats and plants section". Follow the animals' tracks into the Snack Bar and see what foods they eat. Try to stay in a single line or in pairs so that everyone can see. You may take your time."

When participatory elements of the Exhibit were present (page 17) the children were told that they could handle items in the Exhibit, and that they would have to lift the question mark in order to see what the animals ate. Upon leaving the Snack Bar each child was given a "game" and a pencil, and was instructed how to "play the game." By this time the pre-exhibit test group of children had finished with their "games", and were entering the Snack Bar. As they came out of the Exhibit, the post-exhibit test group had finished their tests.

All of the teachers who brought classes to the Center were informed of this study, so that they were not surprised when their children were asked to "play the animal foods game."

The children had no prior knowledge that they would take a test or play a game, so they had no unusual motivation to learn, and little anxiety about performing well. Very few asked about their scores. Many realized where the answers to the game were found and went back to the Snack Bar to

look at the correct answers after they had finished their tests.

An exact time limit for taking the test was not set because the amount of time spent quieting the children and getting them to concentrate on the "game" varied with class size, the age of the children, and the amount of control the teachers exercised over their students. Generally, 10 to 20 minutes elapsed from the time the test instructions were started to the time the tests were collected. All of the children were allowed to finish their tests, but stragglers were encouraged to finish quickly.

Children who were tested after viewing the Exhibit tended to select more than one food item for each animal on the test more often than children who took the pre-exhibit test. This was not discouraged because more than one food was presented for each animal in the Exhibit. When the tests were scored, one point was given for each correct item, even if the child chose more than one answer for the item. An item was considered "incorrect" if the correct answer was not chosen, or if there was no answer at all.

Exhibit Presentation Variations

Throughout the study the basic layout of the Exhibit (ie. the positions of the animals and their foods) remained constant (Figure 1). Only the techniques used to represent the subject matter in each variation were changed, so that six exhibit presentation techniques could be evaluated.

Three major variations of the Exhibit were installed. They were 1) black and white flatwork, 2) colored flatwork,

and, 3) mounted animals and real foods. Each of these three variations had two phases. Half of the test subjects who viewed each variation encountered a participatory exhibit element; the other half did not.

In the first variation of the Exhibit animals and their foods were represented by two-dimensional black line paintings on white canvases.

In the second variation of the Exhibit the paintings were colored. Simple colors were used, but the natural color of the animals and their foods was simulated as much as possible. A yellow background was used on the canvases because yellow is a child's favorite color (Birren, 1976), and it is the most visible background color for the black outlines of the paintings (Royal Ontario Museum, 1976).

In the third variation mounted and freeze-dried animals were used. To further enhance this three-dimensional effect, real food items were used when possible. Insects and other small items were cast in clear plastic resin to prevent them from falling apart when handled. The animals and their foods were placed on small shelves attached to plywood panels. They were anchored in place, but were not covered with glass or plexiglass.

In all three variations the participatory element of the Exhibit remained the same. In order to discover what an animal eats, a child had to lift a canvas flap which covered the foods. This flap was equipped with a large black question mark and a brass handle. The same canvas flaps were used for the participatory phase of the three major exhibit varia-

tions, and were placed out of sight when not in use.

The Research Design

Test scores were installed in a factorial analysis of variance design where there was matching between pre-exhibit test and post-exhibit test groups within each class. The factorial design was used to determine if the six exhibit presentation variations affected score because it facilitated the introduction of a number of exhibit variables. In this factorial design the differences in mean score between the pre-exhibit and post-exhibit groups in each class were compared rather than the difference between the mean scores of the pre-exhibit and post-exhibit groups as wholes so that interference with the treatment effects by variance among classes which came to the Center would be reduced as much as possible.

It was suspected that age, school, and class size were among the sources of this variance, and analyses of variance were generated to determine if these factors did indeed affect score.

For each class a randomized control-group posttest only design (Campbell and Stanley, 1963) was used to set up the experimental and control groups. However, a limitation in this study was that complete randomization in assignment of experimental and control groups was not feasible.

Factors not subject to control were: 1) testing of the exhibit variations took place over a period of five months (which covered two seasons); 2) the exhibit variations were tested consecutively rather than simultaneously so that each

variation was viewed by a different group of subjects; and 3) each of the six exhibit presentation variations was viewed by only four classes, and the age of the viewers and the school they were from was not held constant for all variations.

The sources of control in this study were: 1) all of the exhibit variations were in the same place; 2) all of the exhibit variations were designed by the same person; 3) the exhibit layout remained the same throughout the study; 4) the same test for learning was used throughout the study; and 5) children viewed the exhibit without knowing they would be tested.

RESULTS AND DISCUSSION

The Snack Bar Exhibit

The topic of animal foods was chosen as subject matter for the Exhibit for a number of reasons. First, children have a high intrinsic interest in animals (Nicol, 1969). Second, the topic of animal foods is appropriate for the level of cognitive development of six to eight year old children. At this age children are not yet able to understand such abstract concepts as the conservation of natural resources (Wagar, 1976), but they do recognize likenesses and differences, and have begun to develop classification skills (Machlis and McDonough, 1978). The classification of animals as plant or meat eaters, and the comparison of their foods is appropriate for children who view the Exhibit. Third, children can relate to an animal's need for food because of their own food requirements.

The Exhibit's subject matter complimented topics which were presented to the children after they had viewed the Exhibit. Much of the learning which took place in the Exhibit was reinforced by the ensuing discussions in the Center and by the children's experiences on the Center's nature trails.

The Learning Test

The mean score of all 794 tests was 5.70, which is close to a score of 6.0 or 50%. The pre-exhibit mean score was 4.49. This is higher than a score expected from chance alone (3.0 or 25%), which indicates that the children who took the test before seeing the exhibit had some prior knowledge of animal foods. The post-exhibit test mean was 6.89 or 2.40

points (20%) higher than the pre-exhibit test mean score.

Test scores were distributed normally (Figure 2). The standard deviation of the distribution of all scores was 2.86. This is well above one sixth the range between the highest possible score and the chance score (1.5) which indicates satisfactory variability (Ebel, 1972).

A test analysis was run on the learning test. The Kuder-Richardson 20 reliability formula (Table 2) was used to generate a measure of reliability: r=0.71.

The number of items in the learning test (12) is low. According to Ebel (1972) the reliability of a test will increase with the addition of more items, and the Spearman Brown formula may be used to predict the increase in reliability from lengthening the test. By using this formula it can be shown that by increasing the number of items in the final test from 12 to 24, the reliability could be increased to 0.83.

Test validity refers to the accuracy with which a group of test scores measure learning. Usually there is no good way to measure test validity, however, good reliability, or the consistency with which a group of test scores measure learning, is a condition for validity. Even though the reliability of a test does not automatically make that test valid, it is a good indicator of validity (Ebel, 1972). It is assumed that because r=0.71, and that the tasks called for in the learning test correspond to the learning objectives for the Snack Bar Exhibit, the animal foods test is valid as well as reliable.

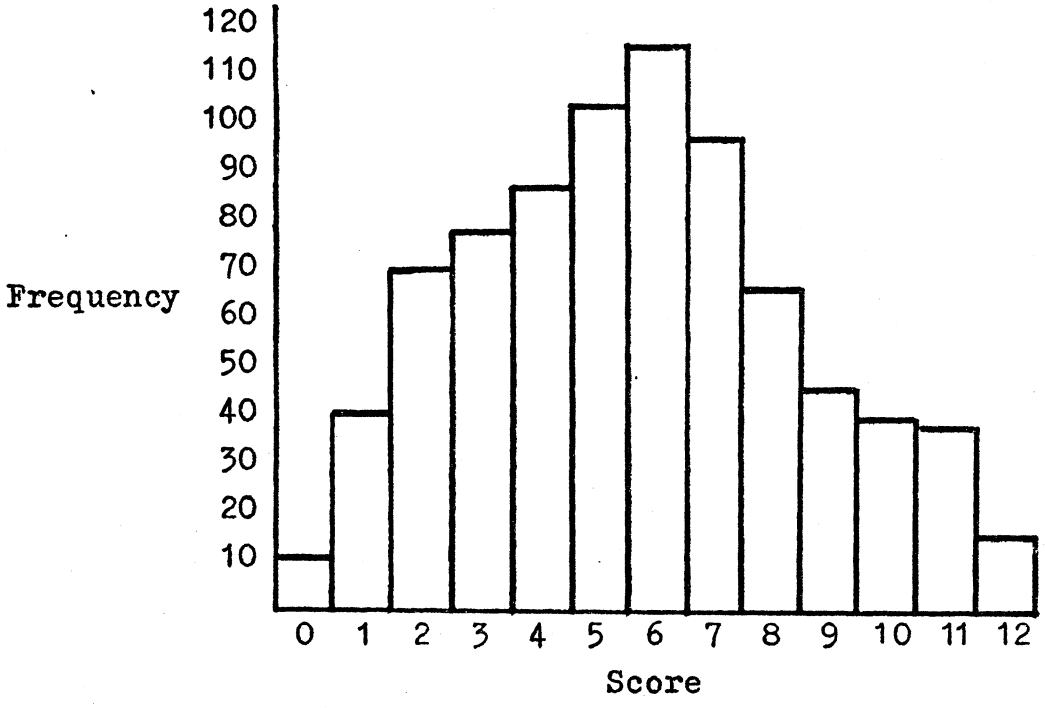


Figure 2. Frequency plotted against score on the learning test for the Snack Bar Exhibit at the Jordan Park Nature Center (pre-exhibit test and post-exhibit test groups are combined, n=794).

Table 2. Analysis of the learning test used to evaluate the teaching effectiveness of six presentation variations of the Snack Bar Exhibit at the Jordan Park Nature Center.

Mean Score	5.70
Standard Deviation	2.86
K-R 20 Reliability Coefficient*	0.71
Standard Error of Measurement	1.53

Item Analysis

Test Item	D**	d***
1 raccoon eats crayfish	0.66	0.45
2 squirrel eats eggs	0.56	0.33
3 owl eats rabbit	0.64	0.61
4 rabbit eats bark	0.40	0.36
5 woodpecker eats beetle	0.71	0.60
6 mouse eats grasshopper	0.60	0.59
7 raccoon eats grasshopper	0.60	0.41
8 squirrel eats beetle	0.60	0.38
9 owl eats mouse	0.61	0.60
10 squirrel eats beetle	0.56	0.27
11 woodpecker eats beetle	0.66	0.63
12 mouse eats grass seed	0.52	0.46

*K-R20:
reliability $r = \frac{k}{k-1}\left(1 - \frac{\sum pq}{s^2}\right)$

k=no. of test items
p=proportion of responses to each item that are correct
q=proportion of responses to each item that are incorrect
s^2=variance of total scores

**Index of Discrimination, 214 scores in upper group, 366 scores in middle group, 214 scores in lower group.
***Index of Difficulty (Percentage of incorrect responses).

Analyses of variance in test score were run to determine if a child's age, the school he was from, or his class size affected his score. In an ANOVA in pre-exhibit test score age was a significant factor ($F=14.203$, $df=1,16$, $P<0.05$). In an ANOVA in post-exhibit test score age was also significant ($F=7.509$, $df=1.16$, $P<0.05$). The effect of school was significant in the pre-exhibit test score ANOVA ($F=1.906$, $df=10,16$, $P<0.05$), and in the post-exhibit test score ANOVA ($F=2.617$, $df=10,16$, $P<0.05$). The effect of class size was not significant in the pre-exhibit test score ANOVA ($F=0.095$, $df=1,16$, $P>0.05$), nor in the post-exhibit test score ANOVA ($F=1.272$, $df=1,16$, $P>0.05$).

These results indicate that a child's age affected his score on the learning test. This may be due to the effect of age on his pre-exhibit knowledge, his ability to take a test, or his attention span.

The school a child is from also affected his score. According to Gross (1977), consistent relationships have been reported between a person's environmental knowledge and attitudes and the community he is from. This may explain the effect of school on test score. In addition, schools may vary in the degree of emphasis which is put on environmental education because of differences in policy or the expertise of the staff.

Although the class size seemed to affect the amount of crowding in the Snack Bar Exhibit, it did not seem to significantly affect learning.

Exhibit Presentation Variations

Results from an analysis of variance indicate that the three exhibit presentation variations had a significant effect on learning test scores. Viewer participation with the Exhibit also significantly affected test score (Table 3).

Interaction between the pre-exhibit / post-exhibit test treatment effects and exhibit presentation variation treatment effects (Table 3) may be explained by the fact that some children in one class in the pre-exhibit test/mounted animals-real foods/ no participation with the exhibit group had participated in the preliminary study when the learning test was being developed and had retained enough knowledge of animal foods to score abnormally high on the pre-exhibit test.

In this study comparison of differences in the pre-exhibit test grand means and the post-exhibit test grand means (Figure 3), shows that the greatest increase in learning occurred when the children participated in a colored flatwork variation of the Exhibit (Table 4). Less learning occurred when there was no participation with the Exhibit. Black and white flatwork, with participation, ranked third in teaching effectiveness. Mounted animals and real foods, with participation, ranked fourth. Slightly less learning occurred when there was no participation with the black and white variation of the Exhibit. Very little learning occurred when the children viewed the mounted animals and real foods variation with no participation.

The results of this study indicate that the colored

Table 3. Summary table for analysis of variance in score on the learning test for the Snack Bar Exhibit at the Jordan Park Nature Center.

Source	df	S.S.	M.S.	F Ratios
Subjects	23	38.7548	1.6850	
Exhibit Presentation Variation (B)	2	13.1691	6.5846	6.4222**
Viewer Participation with Exhibit (C)	1	6.1705	6.1705	6.0183*
BC	2	0.9601	0.4800	0.4682
Error	18	18.4551	1.0253	
Within	24	98.1131	4.0880	
Pre-exhibit test/post-exhibit test (A)	1	66.9060	66.9060	63.7017**
AB	2	8.4279	4.2139	4.0127*[1]
AC	1	2.9950	2.9950	2.8520
ABC	2	0.8814	0.4407	0.4197
Actual	18	18.9028	1.0502	
Total	47	136.8678	2.9121	

*significant at .05
**significant at .01
[1]When separate analyses of variance were done for each level of treatment C, the AB interaction was not significant for one level of C, and the F Ratio for treatment A in this case was still highly significant. Therefore, it is assumed that the AB interaction was slight and did not mask the effect of treatment A.

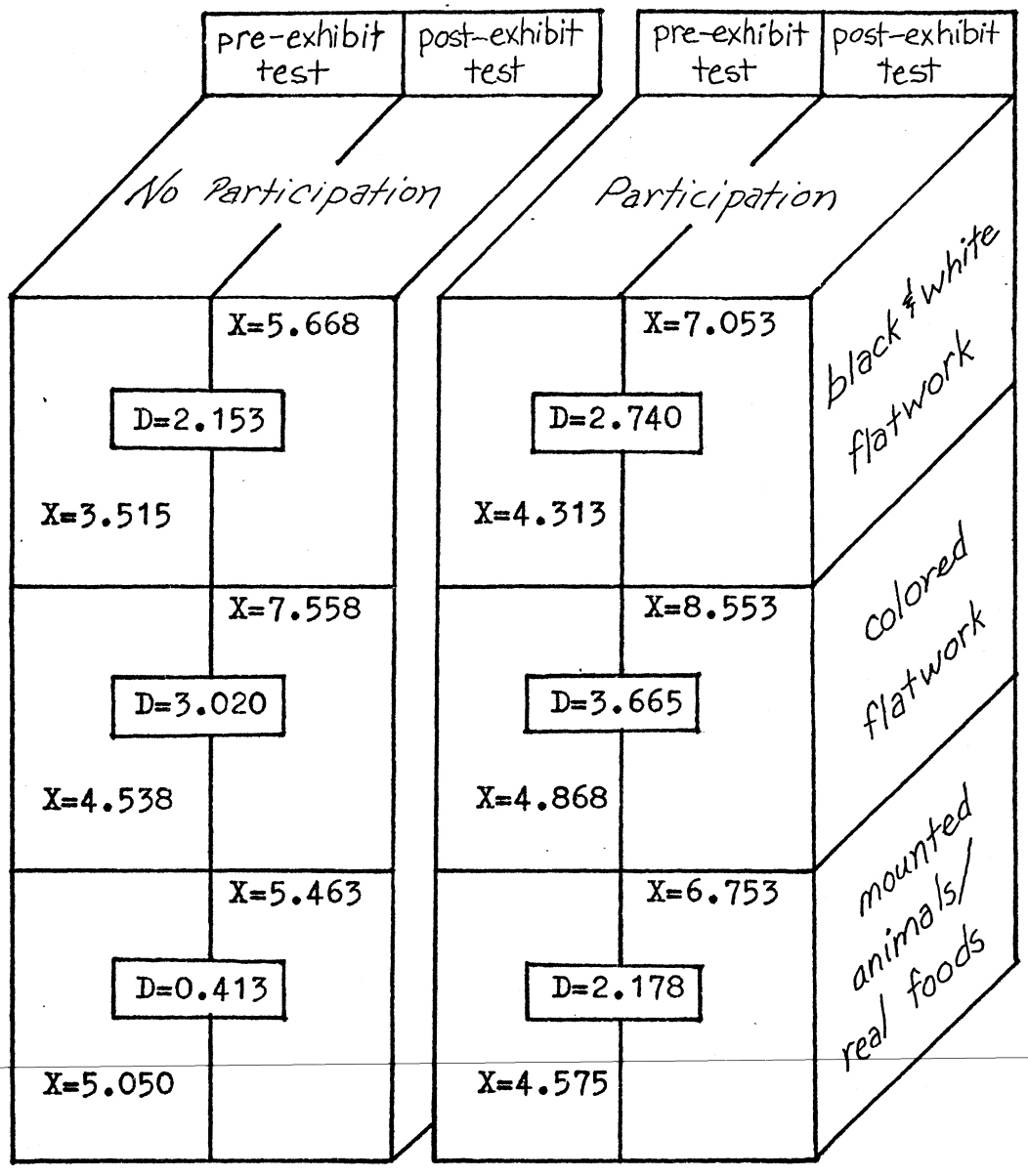


Figure 3. Schematic diagram of the factorial research design used to evaluate the relative teaching effectiveness of six presentation variations of the Snack Bar Exhibit at the Jordan Park Nature Center.

In each cell, X=the grand mean of mean scores for four classes. D=the difference in grand means for each pre-exhibit test/post-exhibit test match.

Table 4. Rank order of effectiveness of the six exhibit presentation variations of the Snack Bar Exhibit at the Jordan Park Nature Center according to the magnitude of difference in pre- and post-exhibit test mean scores of the subjects who viewed the Exhibit.

Exhibit Variation	D*	Rank
Colored Flatwork Participation	3.665	1
Colored Flatwork No Participation	3.020	2
Black and White Flatwork Participation	2.740	3
Mounted Animals/Real Foods Participation	2.178	4
Black and White Flatwork No Participation	2.153	5
Mounted Animals/Real Foods No Participation	0.413	6

*D=pre-exhibit test grand mean minus post-exhibit test grand mean.

flatwork variation of the Exhibit, even without participation by viewers, is superior to the black and white flatwork and the mounted animals/real foods variations in teaching effectiveness for children who visited the Nature Center.

Color is attractive to children, and can affect learning. The colors painted on the canvases emphasized the differences in animals and their foods which black and white paintings did not do. The colors on the canvases were also clearer and brighter than the subtler hues in the mounted animals.

Both the black and white, and the colored paintings promoted more learning in the Exhibit than the mounted animals and real foods. This may be partially due to the fact that paintings can be made "larger than life", which helps to emphasize small objects like insects and acorns.

The mounted animals were interesting, and attracted attention, but, as others have found, their attracting power did not always promote learning (Asmuss and Dutcher, 1969; Servos, 1976). The attraction which the mounted animals had for children may even interfere with the learning objectives of the Exhibit. Children who saw the mounted animals/real foods variation of the Exhibit may have learned much about the way an owl or a raccoon looks, but they did not pay much attention to what these animals eat. Perhaps the "real thing" in exhibits is more valuable than pictures for drawing attention, but it may not always be more valuable than well designed pictures or illustrations for teaching.

When children interacted with the Exhibit by lifting the handles on the canvas flaps, many times the canvases were not

lifted completely. As a result, the uppermost food item depicted on canvas or mounted on the plywood panels was not always seen. Despite this fact, when children were exposed to a participatory exhibit learning was greater for all three exhibit variations than when there was no participation.

Some researchers have aimed at increasing an exhibit's effectiveness by increasing viewer motivation. By using a game-like "recycle question machine" Fazzini (1972) increased visitor motivation to learn from an exhibit on the skulls of primitive man by offering a chance for a "free play" at the machine or an "expert medal" for knowing the correct answers to questions concerning the exhibit. Shettel et al (1968) provided motivation to learn by telling his viewers that they would take a "test" on an exhibit after viewing it for a specified period of time.

The casual viewer who does not play a game or expect to take a test learns less than the more motivated individual. Maintenance of "attending behavior" at an exhibit depends on the consequences that people expect from this behavior (Screven, 1974b). Rewards should be provided for the exhibit viewer because they offer a positive reinforcement that is a powerful molder of behavior (Shettel, 1973). Such rewards include knowledge of results of a test or a game, success in answering a question correctly, or progress toward a goal.

Tests and game machines are not always feasible for exhibits in a nature center or a museum, and should not be relied upon to promote attending power. Motivation to learn in the Snack Bar Exhibit was not provided by a specific prom-

ise of reward. Rather, it was a result of the environment created in the Exhibit and the intrinsic interest which children have for animals. Perhaps the study results would be different if the children viewing the Exhibit had anticipated a test.

Most people view interpretive exhibits singly, or in groups of family and friends. A detriment to learning from the Exhibit may have been the fact that children viewed it as a class and were not able to stay in the Exhibit as long as they wished because of the pressure of their classmates behind them who were eager to enter the Exhibit. However, they did view the Exhibit in pairs or larger groups of classmates, and it has been found that group interaction in an interpretive setting is often beneficial to learning (Young et al, unknown).

Based on the results of this study, some conclusions about the relative effectiveness of various presentation techniques in the Snack Bar Exhibit can be made. For kindergarten through third grade classes of children who visit the Jordan Park Nature Center, colored flatwork is superior in teaching effectiveness to black and white flatwork, or mounted animals and real objects. Furthermore, regardless of the exhibit presentation technique of the Snack Bar Exhibit, children's participation increases its teaching effectiveness.

The limitations of the design in this study, such as the incomplete randomization of assignment of subjects into pre- and post-exhibit test groups, the low number of test groups which viewed each exhibit variation, and the wide range of

subjects' ages and schools are appreciated. Further studies are needed to evaluate the effectiveness of exhibit presentation techniques which involve fewer independent variables and tighter control over test groups.

The Snack Bar Exhibit provided a learning experience for the environmental interpreter as well as the children who visited it. Results of this study emphasize a need for careful consideration of the effects of color, three-dimensional specimens and objects, and viewer participation on learning from interpretive exhibits for children. The evaluation of these, and other presentation variables is a necessary step in the development of effective interpretive exhibits. From this study I have become familiar with the process of exhibit development and validation, and can recommend that for the Children's Nature Programs at the Jordan Park Nature Center, colored flatwork, with participation be installed in the final Snack Bar Exhibit.

LITERATURE CITED

Asmuss, B.G.E., and R.L. Dutcher. 1969. Visitor response to the nature center in Prince Albert National Park. unknown. 43pp.

Bent, Arthur Cleveland. 1964. Life histories of North American woodpeckers. Dover Publications, Inc. New York. 334pp.

Birren, Faber. 1976. Color perception in art. Van Nostrand Reinhold Company. New York. 75pp.

Blahna, Dale J. 1978. The Jordan Park Nature Center visitor survey and implications for interpretive program planning. M.S. Thesis, Univ. of Wisconsin-Stevens Point. 101pp.

Borun, Minda. 1977. Measuring the immeasurable: a pilot study im museum effectiveness. Association of Science and Technology Centers. Washington, D.C. 114pp.

Bull, S.G. 1973. The role of questions in maintaining attention to textural material. Review of Educational Research. 43:83-87.

Cameron, Duncan F. 1967. How do we know what our visitors think? Museum News. 45(7):31-33.

Campbell, Donald T., and Julian C. Stanley. 1963. Experimental and quasi-experimental designs for research. Rand McNally. Chicago. 84pp.

Carmel, James H. 1963. Exhibition Techniques. Reinhold Publishing Corporation. New York. 216pp.

Dale, Edgar. 1946. Audio-visual methods in teaching. The Dryden Press. New York. 546pp.

Eason, Laurie P., and Marcia C. Linn. 1976. Evaluation of the effectiveness of participatory exhibits. Curator. 19(1):45-62.

Ebel, Robert L. 1965. Measuring educational achievement. Prentice Hall, Inc. Englewood Cliffs, New Jersey. 481pp.

_____. 1972. Essentials of educational measurement. Prentice Hall, Inc. Englewood Cliffs, New Jersey. 621pp.

Fazzini, Dan. 1972. The museum as a learning environment: a self-motivating, recycling, learning system for the museum visitor. Ph.D. Thesis. Univ. of Wisconsin-Milwaukee. 89pp.

Literature Cited (continued).

Francisco, Robert. unknown. A second look at participatory exhibits. Admore Incorporated, Exhibit Design by Objectives. Shrewsbury, Massachusetts. 9pp.

Gagne, R.M. 1965. The conditions of learning. Holt, Rinehart and Winston. New York. 308pp.

Gropper, George L. 1966. Learning from visuals: some behavioral considerations. AV Communications Review. 14(1):37-69.

Gross, Michael P. 1977. An analysis of attitudes, knowledge, and perceptions of elementary school students following participation in a special environmental education program. Doctoral dissertation, University of Iowa. 162pp.

Karalus, Karl E., and Allan W. Eckert. 1974. The owls of North America (north of Mexico). Doubleday, Inc. Garden City, New York. 275pp.

Linn, Marcia C. 1976. Exhibit evaluation-informal decision making. Curator. 19(4):291-302.

Machlis, Gary and Maureen McDonough. 1978. Children's interpretation: a discovery book for interpreters. National Park Service Cooperative Park Studies Unit. College of Forest Resources, Univ. of Washington-Seattle. 28pp.

Martin, Alexander C., Herbert S. Zim, and Arnold L. Nelson. 1951. American wildlife and plants. Dover Publications, Inc. New York. 500pp.

Naumer, Helmuth J. 1971. A marketable product. Museum News. October:14-16.

Nicol, Elizabeth H. 1969. The development of validated museum exhibits. U.S. Department of Health, Education, and Welfare. Washington, D.C. 114pp.

Niehoff, Arthur. 1970. Audience reaction in the Milwaukee Public Museum: the winter visitors. The Museum Visitor. 3:22-31.

Oliver, Ruth Norton. 1971. Museums and the environment: a handbook for education. American Association of Museums. Washington, D.C. 272pp.

Palmer, Laurence E., and Seymour Fowler. 1975. Fieldbook of natural history, 2nd ed. McGraw-Hill Book Company. New York. 779pp.

Literature Cited (continued).

Parr, A.E. 1962. A nice "gooky" exhibit. Curator. 5(2):118-119.

Parsons, Lee A. 1970. Systematic testing of display techniques for an anthropology exhibit. The Museum Visitor. Milwaukee Public Museum. Milwaukee, Wisconsin. 3:81-98.

Robinson, P.V. 1960. An experimental study of exhibit arrangement and viewing method to determine their effect upon the learning of factual material. Dissertation Abstracts. University Microfilms, Inc. Ann Arbor, Michigan. No. 6:1480-1481.

Royal Ontario Museum Communication Design Team. 1976. Communicating with the museum visitor: guidelines for planning. Royal Ontario Museum. Toronto, Canada. 528pp.

Screven, C.G. 1969. The museum as a responsive learning environment. Museum News. 47(10):7-10.

_____. 1974a. Learning and exhibits: instructional design. Museum News. 52(5):67-75.

_____. 1974b. The measurement and facilitation of learning in the museum environment: an experimental analysis. Smithsonian Institution Press. Washington, D.C. 91pp.

_____. 1976. Exhibit evaluation-a goal-referenced approach. Curator. 19(4):271-290.

Servos, Susan R. 1976. A study to determine visitor preference for exhibits in the Prince Albert National Park nature center. unpublished. 55pp.

Shettel, Harris H. 1973. Exhibits: art form or educational medium? Museum News. 52(1):32-41.

Shettel, Harris H., Margaret Butcher, Timothy S. Cotton, Judi Northrup, and Doris Clapp Slough. 1968. Strategies for determining exhibit effectiveness. U.S. Dept. of Health, Education, and Welfare, Office of Education Bureau of Research Final Report for Project no. V-D11. 246pp.

Tilden, Freeman. 1967. Interpreting our Heritage. Univ. of North Carolina Press. Chapel Hill. 120pp.

Wagar, J. Alan. 1974. Interpretation to increase benefits for recreationists. Outdoor recreation research: applying the results. U.S. For. Ser. Gen. Tech. Rep. NC-9: 101-106.

Literature Cited (continued).

Wagar, J. Alan. 1976. Achieving effectiveness in environmental interpretation. U.S. For. Ser. Gen. Tech. Rep. SE-9. 15pp.

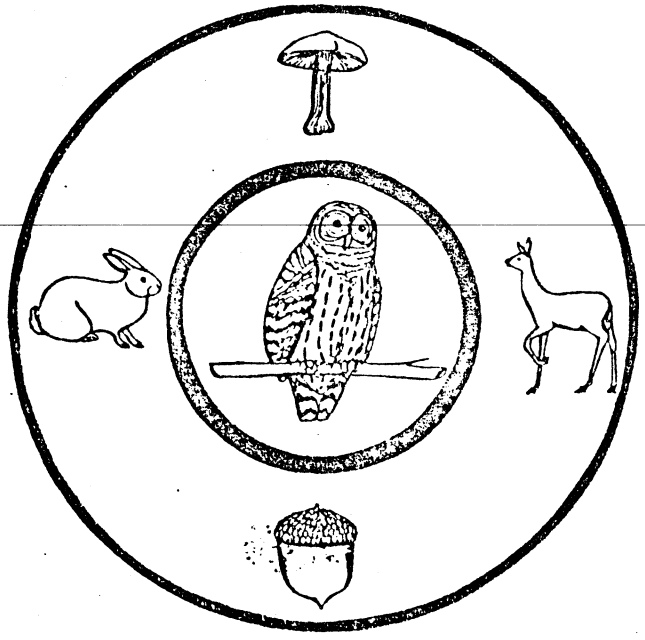
White, Robert W. 1959. Motivation reconsidered: the concept of competence. Psychological Review. 66:297-333.

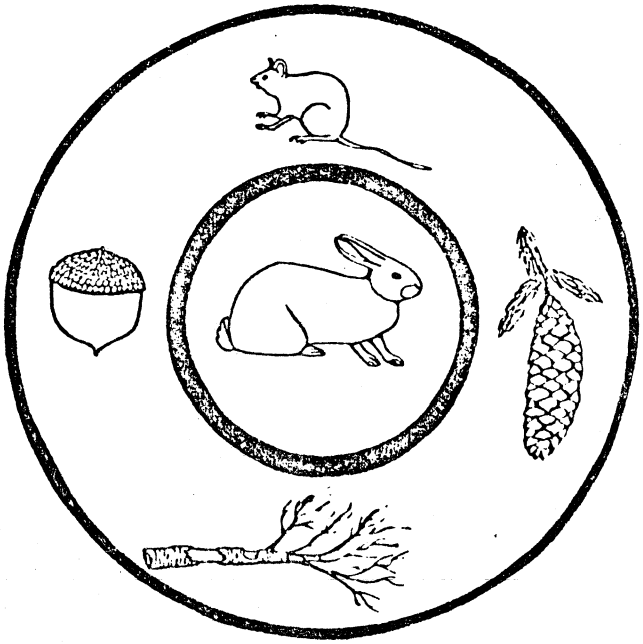
Washburne, Randel F., and J. Alan Wagar. 1972. Evaluating visitor response to exhibit content. Curator. 15(3): 248-254.

Young, Bart, Merlin Shelstad, and William Burch. unknown. The use of interpretive media in environmental education. unpublished working paper. Institution for Social and Policy Studies, Yale Univ. 111 Prospect St., New Haven, Conn. 50pp.

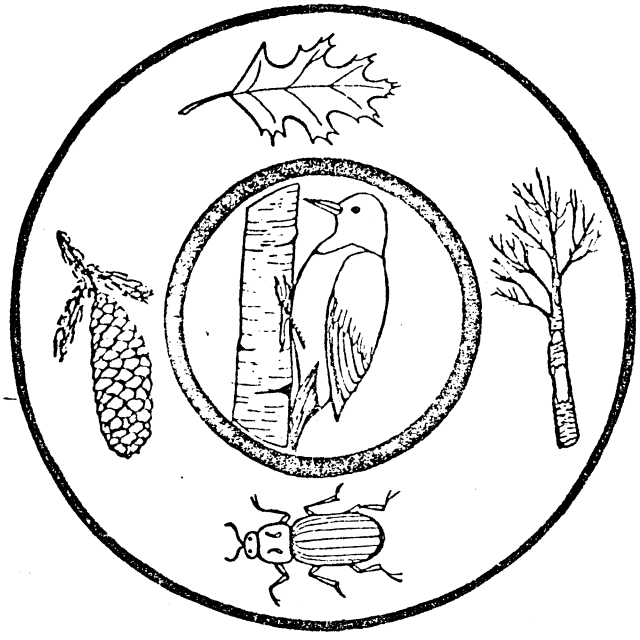
Appendix A. The learning test used to evaluate the teaching effectiveness of six presentation variations of the Snack Bar Exhibit at the Jordan Park Nature Center (reduced 23% in size).

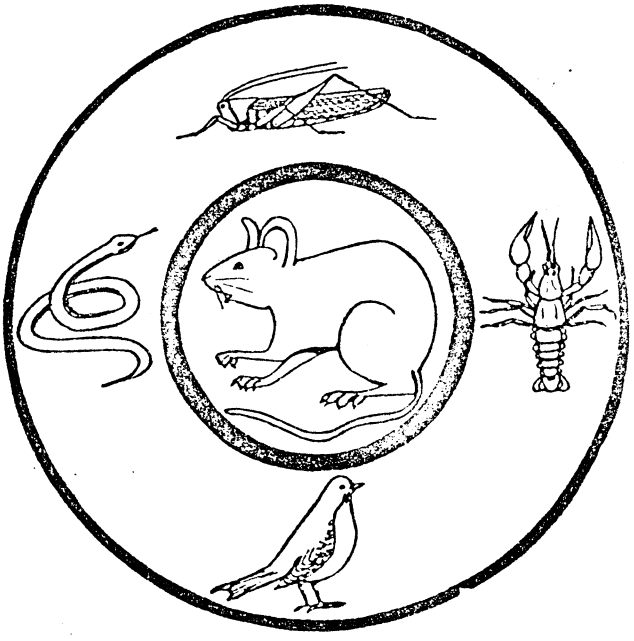
I am ___ years old.

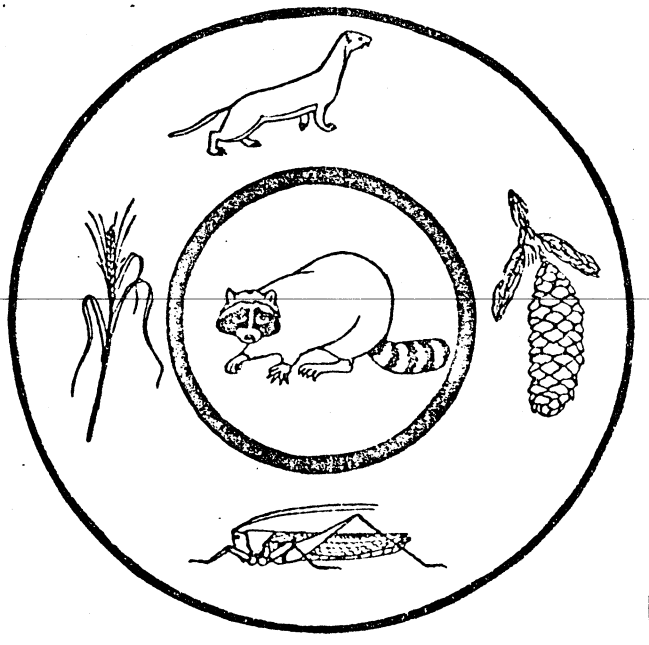


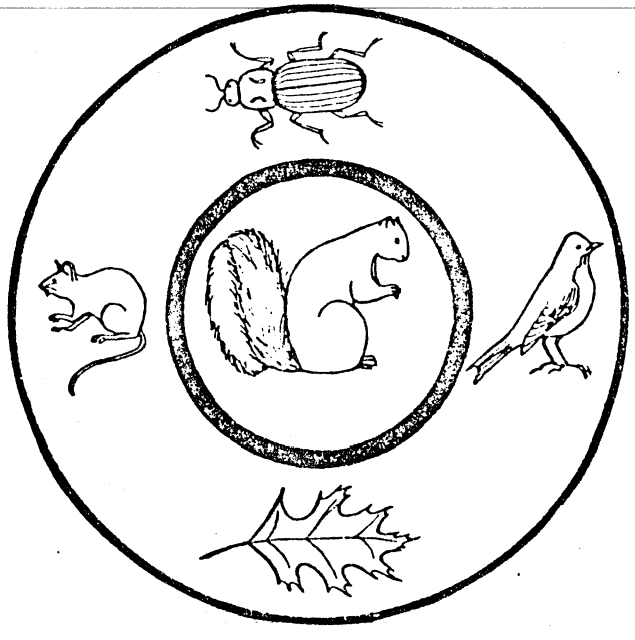


Appendix A (continued).









Appendix A (continued).