ATTITUDINAL LEARNING OUTCOMES AND THEIR RETENTION BY
JUNIOR-HIGH SCIENCE STUDENTS USING AN ENVIRON-
MENTAL EDUCATION SIMULATION GAME

by

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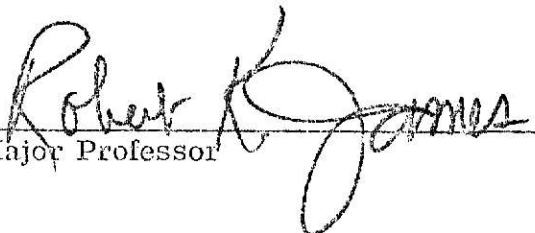submitted in partial fulfillment of the

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INTRODUCTION

Context of the Problem

The United States has the sole distinction in history of being the only

society so materially rich and so environmentally degraded (Swan, 1969). The

technology for solving a major portion of today's environmental problems has

been known for some time, but it has not been implemented. It can be concluded,

therefore, that many of the environmental problems are actually problems of

human behavior rather than problems of technology.

Increased awareness of environmental problems led to the passage of the

Environmental Education Act in 1969. Environmental education is defined by the

legislators who developed the act as "the educational process dealing with man's

relationship with his natural and man-made surroundings . . ." (Steidle, 1971, p. 21).

The principal feature of the philosophy of environmental education is that man is an

integral part of a system from which he cannot be separated.

When confronted with what is identified as a near crisis situation, Ameri-

cans characteristically turn toward education to solve the dilemma. The classic

example is the shock wave set off with the launching into orbit of the first Sputnik

satellite. The fear that Soviet space technology could spell doom for the United

States created an immediate government push in education--particularly in the math and science areas. A little over a decade later, with the nation-wide concern for the environment coming into focus on Earth Day, education was once again expected to solve the crisis. Science classes are now the training grounds for budding young environmentalists with environmental education programs designed to cause the effect.

The environmental education movement, in its infancy, is beginning to focus on case studies. It is predicted that as the movement further develops, the classroom case study approach will be supplemented with classroom environmental gaming simulations, along with other methods (Swinerton, 1972).

Simulation games are a relatively new concept in teaching environmental education. This method of instruction allows a student to undergo a vicarious experience in an interactive situation over a condensed period of time. Simulation games are characterized as high interest motivators. Livingston (1972) found that junior-high students prefer them by a wide margin over conventional instruction.

Students are more receptive to learning at higher interest levels, and environmental simulation games can provide an ideal introductory method to environmental education (Cherryholmes, 1966). Aside from being an interest motivator, how effective is an environmental simulation game as an instructional device? More specifically, what would be the affective learning outcomes of a brief exposure of junior-high students to the Make Your Own World simulation game? Also, what degree of retention is affected by this game when measured over a relatively brief time span of two weeks?

Make Your Own World is a simulation exercise in the Coca-Cola USA Ecology Kit XO13. It is designed to teach students the principle of ecology that all elements of the environment are interrelated and interdependent. It is played on an illustrated board which simulates a geographical area containing forests, farms, rivers, and urban areas. Students are involved in role playing--some with human roles, others with animal roles or basic resource roles. The students are presented with a series of proposals about adding various man-made features to the board. They then discuss the possible consequences of each proposal from the viewpoint of the role they have assumed. Throughout the exercise and after its conclusion, discussions are initiated about the interrelationships of man with his environment.

Statement of the Problem

The problems of this study are: (1) Does the simulation game, Make Your Own World, effect a positive attitude change in junior-high science students? (2) Are the attitudinal outcomes retained?

Statement of the Hypotheses

H_1: Junior-high science students, having completed the environmental simulation game Make Your Own World, will score significantly higher attitudinal learning outcomes than control groups.

H_2: Junior-high science students will exhibit significant retention of attitudinal learning outcomes over a two week post experiment period.

Significance of the Study

The relevance of this study to educational settings lies in the fact that educators, while somewhat aware of the effectiveness of environmental simulation games in motivating interest, are, however, somewhat reserved in resorting to a "gimmick" approach as they may conceive this relatively new method of instruction to be. Demonstrating attitudinal outcomes and their retention obtained from a brief exposure would tend to substantiate both the effectiveness of the simulation and the minimum amount of time required to administer it. It is not the intent of the study to imply that simulation games should be taught in one class period.

DEFINITIONS OF TERMS

Environmental education. This is an educational process designed to create an awareness in man of his interdependent relationship with his natural and man-made surroundings (Steidel, 1971).

Environmental simulation game. This is an educational method of transforming given environmental concepts into a dynamic process utilizing gaming and/or role playing techniques.

Cognitive learning outcomes. These are behavioral changes at the intellectual level such as knowledge, understanding, and thinking skills (Chartier, 1974).

Affective learning outcomes. These are behavior changes at the feeling or emotion level, such as interests, attitudes, appreciation and methods of adjustment (Chartier, 1974).

<u>Attitudinal learning outcomes</u>. These are modes of affective learning outcomes; learning that is an expression of feeling toward something or someone.

<u>Attitude</u>. This is an expression of feeling toward something or someone (Knapp, 1972).

<u>Retention</u>. This is the ability to retain attitudes over a brief (for the purposes of this study, two weeks) post treatment period.

<u>Simulation gaming</u>. This is an educational technique in which the student, involved in role playing, is presented with simulated real-life situations involving choices which result in different outcomes.

<u>Case study</u>. This is an analysis of specific environmental problems, usually local, with the goal to determine the origin and the solution.

Chapter 2

REVIEW OF THE LITERATURE

Literature pertaining to the problem presented in this study is grouped

into five categories: (1) Need for environmental education; (2) Simulation games

in environmental education; (3) Learning outcomes of simulation games in environ-

mental education; (4) Retention of learning outcomes of simulation games; and

(5) Attitudinal measurement in environmental education.

Need for Environmental Education

The United States, in the past 50 years, has become a predominately urban

nation, both in thought and in physical character. Over 70 percent of this country's

population resides on 1.5 percent of the nation's land surface. The independent,

rural-oriented living that once characterized this country's social and political

heritage is no longer a dominating influence in the lives of most Americans. As

man became more urbanized, his intimate association and interaction with natural

resources diminished as did his awareness of his dependency on them. It remains

imperative that man, wherever he lives, comprehend that his welfare is dependent

upon the proper management and use of these resources.

Man should also have an awareness and understanding of his community

and its associated problems. While the problems are legitimate concerns of

governmental officials and planners, the responsibility for their solution is heavily

dependent upon the citizen. To an increasing extent, citizens are being asked to

make decisions that affect, either directly or indirectly, their environment.

Voting on community issues and election of officials are examples. It is important

to assist each individual, whether urban or rural, to obtain a fuller understanding

of the environment, problems that confront him, the interrelationship between the

community and surrounding land, and opportunities for the individual to be effective

in working toward the solution of environmental problems.

Education has this responsibility of preparing young citizens to deal with

man's relationship with his natural and man-made surroundings. The new approach

developed is called "environmental education" (Stapp and others, 1970).

Environmental education was officially founded with the passage of the

Environmental Education Act of 1969. The legislators who developed the act defined

it as

> The educational process dealing with man's relationship with his
> natural and man-made surroundings, and includes the relation of popu-
> lation, pollution, resource allocation and depletion, conservation, trans-
> portation technology, and urban and rural planning to the total human
> environment (Steidle, 1971, p. 21).

Though a completely acceptable definition of environmental education has yet to be

found due to the relative newness of the activity, it is basically a way of developing

and voicing concern for both man-made and the natural environment (Swan, 1969).

It is still undergoing important developments in its practical identification and

theoretical foundation (Bogan, 1973).

Simulation Games in Environmental Education

Swinerton (1972) wrote that the early stage of the environmental education

movement is beginning to focus on case studies (a) to bring field material into the

classroom, (b) to broaden the horizon of discipline specialists, and (c) to intro-

duce problem-solving techniques. He expects that, after a three- to five-year

period, the classroom case study approach will be supplemented with classroom

environmental gaming simulations, ecoaction centers, environmental encounters,

and finally, model construction of alternate futures of ecological systems.

Learning theory in environmental education has found learning to be de-

pendent upon active participation, reinforcement, feedback, variety, comprehen-

sion, and relevance (Abt, 1967). One of the top priorities, as seen by Swinerton

(1972) is to develop classroom environmental simulations. He refers to classroom

simulation as gaming. Simulation provides specific steps for placing each student

in a role playing environment, where the student assumes a decision-making role

and responds to game conditions. Swinerton observed that it is through this process

that a student can grasp a better understanding of the theoretical base for his actions,

test his ideas, confirm their reality, and see the practical consequences of various

alternate strategies of action.

Kidder (1971) discussed several recently published books on simulation

and games. He examined selected research studies and demonstration projects to

show the potential for simulation and gaming for teaching and training. A number

of the authors reviewed emphasize that today's students need to be involved when

learning, and that simulation games which have involvement built in provide a useful

meaning for learning. In agreement, Demak (1969) wrote that,

> There is increasing evidence that one of the most promising practices
> capable of 'turning on' youth is the concept of games and simulations.
> They can help educators engage the interests of youth and help with the
> continuing problem of motivation (p. 6).

The distinction between games and simulations is a matter of dispute

among social scientists and educators. Some draw a definite line between the two

terms while others use them interchangeably.

Not all simulations involve a game. This is particularly true with those

used for research purposes. All games definitely do not involve a simulation.

However, the technique used in school classrooms combines elements of both

simulation and games where "students assume the roles of decision-makers in a

simulated environment and compete for certain objectives according to specified

procedures or rules. Hence the term simulation games might best convey the

essential nature of this technique" (Nesbitt, 1971, p. 11). Chartier (1974) de-

fined simulation game as "an educational technology used to operationalize a given

social process into a dynamic process with gaming and/or role playing components"

(p. 2).

To this point the preceding review of literature has stressed the values and

advantages of simulation games. Beals (1971), while convinced that simulation

games have definite contributions to make to education, pointed out that the techniques

are not foolproof. The potential user should be aware that the techniques--as ex-

citing and stimulating as they may be to learners--have definite limitations. He

suggested that teachers ask the following questions of themselves before considering

the use of simulation games in the classroom:

1. Am I willing to devote the necessary time to the activity?
2. Does the game or simulation chosen really meet the needs of my students, and do my students have the necessary background for it?
3. Does my philosophy and the philosophy of my school permit the use of games and simulations?
4. Does the simulation over-simplify the real situation?
5. Are all the required supplies and materials readily available?
6. Is the game a justified part of the curriculum or just a pleasant pastime?
7. How can I evaluate the outcomes of a game or simulation?
8. Does the nature of the simulation place too much emphasis on winning?
9. Does the game or simulation prepare children for participation in a free and open society?
10. Is the activity sophisticated enough to provide a realistic view of the society being simulated?
11. Does the activity 'dehumanize' children without subjecting them to the constraints similar to those of the real world?
12. Do I have the time, energy and facilities to experience the game or simulation myself prior to using it in the classroom? (Beals, 1971, pp. 94ff).

Learning Outcomes of Simulation Games in Environmental Education

Gagne (1971) listed five basic domains of learning: motor skills, verbal information, intellectual skills, cognitive strategies and attitudes. This literature review will concern itself with the cognitive and affective learning outcomes as they apply to simulation games.

Cognitive. The Johns Hopkins University's Center for Social Organization of Schools recently concluded a seven-year study entitled "The Hopkins Games Program" where educational games and simulations were analyzed. In a conclusive report of the program, Coleman and others (1973) observed that simulation games can teach factual information, though not more effectively than other methods of instruction. They also tend to improve students' performances on tasks similar

to those the students practice in the game.

Part of the Hopkins team, Fennessey (1972), earlier reported on a study involving the Coca-Cola environmental exercise: Make Your Own World. The study compared the use of the exercise per se, a game revision of the exercise, and a control. The results indicated the three treatments to be equally effective. Since by the strict definition, Make Your Own World is an exercise and not a game, due to the lack of competitiveness, Fennessey converted it into a game based on Prisoners' Dilemma (Rapoport and Chammah, 1965). (Prisoners' Dilemma is a game where each person's interests are opposed to the collective interest.)

In a closer look at the "control" treatment employed in the Fennessey study where the teachers were given the same factual booklet used with the Make Your Own World exercise and converted game, but with deletions of references to the exercise, the control groups were actually being taught from films and science experiments selected as being appropriate by the teachers. Therefore, it was concluded that the students can learn about as much from simulations of Make Your Own World as from film and science experiments selected by the teacher to fit the same materials covered by the simulations (Fennessey, 1972).

Another Hopkins team member, Livingston (1972), also reported "Simulation games appear to be equally good as conventional instruction--possibly better-- at influencing students' behavior in a performance test, either real or simulated" (p. 3). He later (1973) did a study regarding post-game discussion of simulation games and found discussion to have no effect on the students' understanding of the game and no consistent effects on their attitudes toward real-life persons represented

in the game.

Lucas (1974), in a study involving United States history class subjects—simulation gaming techniques vs. conventional lecture-discussion techniques—reported posttest results indicating that both groups performed equally well with respect to cognitive achievement. In a similar study involving graduate students in human ecology using the Community Land Use Game (CLUG) vs. conventional instruction, it was concluded that games were useful educational tools. This was especially so in that they contributed to the students' understanding of decision-making in dynamic systems. It was recognized, however, that games were only effective when well grounded in factual information and when carefully critiqued, and it was recommended that they be employed in conjunction with other teaching methods (Monroe, 1968). Heinkel (1970), working with junior college subjects in political science, also found no significant difference between simulation and conventional methods.

After reviewing research on the effectiveness of educational simulations, Cherryholmes (1966) concluded that no evidence could be found to support that participants in simulation exercises learned more facts or principles than they would in a more conventional manner.

Affective. Rokeach (1971), in a critique of a socio-economic simulation game—Ghetto, pointed out that the game offers two approaches which are the classical ways of inducing attitude change: (1) when the player's attitudes and values are not compatible with his experience in the simulation and (2) when the player believes that the information he receives during the simulation was developed

by known authorities in the field.

Knapp (1972), in an article entitled "Attitudes and Values in Environmental Education," pointed out that attitude change can be achieved in some people by counter-attitudinal role playing. Knapp further comments that behavior change precedes attitude change suggesting that direct involvement in action (simulation) games may result in attitudinal change.

Fennessey (1972) and Livingston (1972) in two separate articles, under the Hopkins Game Program aforementioned, reported simulation games to be equally effective as conventional instruction methods. Livingston further commented that they can sometimes produce marked changes in the expressed attitudes of the players toward persons and activities represented in the game although the changes may be short-lived.

In a study with junior college level subjects in political science, Heinkel (1970) concluded that simulations produced desirable attitudes and resulted in polarized feelings toward government. Cherryholmes (1966), in reviewing research of the effectiveness of educational simulations, reported that students do acquire realistic attitudes in simulation, but so do some students under more conventional methods.

Retention of Learning Outcomes of Simulation Games

Though one of the recognized assets of simulation games is that cognitive and affective learning are not separated (Demak, 1969), for the purposes of organization, the literature review on retention of learning outcomes will be discussed under the two headings: cognitive and affective.

Cognitive. In a study entitled "A Comparative Study of Cognitive Retention Using Simulation-Gaming as Opposed to Lecture-Discussion Techniques," Lucas (1974) found that cognitive retention was significantly higher as measured by the delayed-interval (10-week) posttest. However, Lucas raised a question on the findings because, on the delayed-interval posttest, the students actually scored higher than on the posttest given immediately at the conclusion of the treatment. The explanation was offered that the students were motivated by the game to the point that they continued to learn after the exercise, both individually and collectively, throughout the ten week period.

Garvey and Seiler (1966) reported that the subjects in the control group scored slightly higher than the experimental group in both the immediate posttest and the delayed-interval (two months) posttest, but the difference was not significant. They pointed out that there was less difference between the scores on the delayed-interval posttest indicating that the experimental group had better retention than the control. The authors concluded that this was especially noteworthy in the context that the experimental group had to learn the same factual information as the control and, in addition, learn the rules of the simulation game.

Affective. In an article, "Simulation Games and Attitudes Towards the Poor: Three Questionnaire Studies," Livingston (1971) found attitude change in the immediate posttest, but delayed-interval posttests of one week and four months respectively, did not reflect any change. Livingston concluded that simulation games would be valuable at the beginning of a unit of instruction so that the temporary

attitude change induced by the games would make the student more receptive to the related instruction which followed.

Attitudinal Measurement in Environmental Education

Attitude is defined by Knapp (1972) as a person's favorable or unfavorable expression toward a class of objects or events. Attitudes are primarily characterized by evaluative human responses.

George (1966) stated that, in terms of educational history, the study of attitudes is a relatively young subject. The early studies were carried on in the 1920's by Thurstone and his associates. Likert further investigated the subject and, building on the work of Thurstone, developed the "Likert Scale." This attitude scale involves the method of "summated ratings" and deals with the use of statements of attitude toward some psychological object.

In construction, the scale involves five degrees of responses: SA meaning strongly agree; A meaning agree; U meaning undecided; D meaning disagree; and SD meaning strongly disagree. The subject taking the test encircles the response which best fits his own attitude.

The interval between each of the five points is assumed to be equal. Each statement is scored on the basis of 4 or 5 points for full agreement with a favorable attitude, and one point less for each step (interval) further removed from full agreement. The scoring procedure is reversed for statements expressing unfavorable attitudes. Therefore, the attitude score for a number of statements is the sum of the weights of responses (George, 1966).

Masters (1974), in a study of "The Relationship Between Number of Response Categories and Reliability of Likert-Type Questionnaires," found that, in situations where low total score variability is achieved with a small number of categories, the reliability can be increased through increasing the number of categories used. However, in situations where opinion is widely divided toward the context being measured, reliability appeared to be independent of the number of response categories.

Of the literature reviewed, the Likert scale was, with one exception (Fennessey, 1972), the instrument design used to measure attitudinal (affective) learning outcomes.

Chapter 3

RESEARCH PROCEDURES

Subjects

The population consisted of rural junior–high life science students located

in four intact classes at the seventh grade level. Assignment to the classes was

affected during semester enrollment based on scheduling priority only and not on

achievement or any other consideration. The four intact classes consisted of 24–

27 subjects for a total population of 103. An examination of the curriculum, in

visiting with local instructors, indicated that the subjects had not received any

formal instruction in environmental education or related subject areas in either

prior school history or during the experimental period except that controlled during

the experiment.

Instrumentation

A pilot instrument was designed (Appendix) consisting of a twenty response

Likert scale measure. Each item was a statement regarding one of the ten proposals

of optional add-on man-made features of the game. One-half of the statements were

true and one-half false. The statements concerned facts that the subjects could

answer from prior experience, not related to the treatment. For example, several

statements were based on the fact that impervious surfaces, such as parking lots,

roofs, etc., result in storm water run-off, sometimes causing flash flooding. Any subject, with normal powers of observation and the knowledge of association, could rationalize the answer without having the facts brought to attention during some exercise such as <u>Make Your Own World</u>.

A field test of this instrument was run on sixth grade students at a nearby school. Based on an item analysis procedure, testing for difficulty (Nunnally, 1972) and discriminability (Tuckman, 1972), seven items were revised. (See Appendix, p. 35.) The revision (see Appendix, p. 36) constituted the instrument used in this study. The seven revised items were analyzed during the first observation (see Appendix, p. 38) and were left intact.

Procedures

The assignment of classes to treatment or control was accomplished randomly using a coin toss, "odd-man out," procedure. Two classes were designated experimental (C_1 and C_2) and the remaining two classes were controls (C_3 and C_4).

The experimental classes received the treatment (Coca Cola USA Ecology Kit XO13 simulation game <u>Make Your Own World</u>) in its entirety in one 55 minute class period. The treatment was implemented by the researcher in the presence of the resident teacher and actually lasted 50 minutes.

The immediate posttest (first observation) was administered to the experimental classes at the conclusion of the treatment and lasted five minutes. The number of subjects in the respective classes were: C_1, 22 and C_2, 27.

Control classes (first observation) were given the identical instrument, in the presence of their resident teacher, immediately upon entering the classroom and, as with the experimental classes, was of five minutes duration. The control classes did not receive any treatment even remotely related to ecological facts and concepts prior to or during the delayed-interval experimental period. The number of subjects in the respective control classes were: C_3, 25 and C_4, 27.

After a period of two weeks, a delayed-interval posttest was administered to both experimental and control classes immediately upon their entrance to the classroom. Again the identical instrument was used and the allowed testing time was five minutes. The experimental classes, receiving only the instrument this time, consisted of the respective subject numbers: C_1, 24 and C_2, 26.

The number of subjects in the control classes respectively were as follows: C_3, 26 and C_4, 26.

The instrument was scored as follows: for true statements, SA (Strongly Agree) = 5; A (Agree) = 4; U (Undecided) = 3; D (Disagree) = 2; and SD (Strongly Disagree) = 1. The scoring was reversed for the false statements. Therefore, the maximum possible score was 100 (20 items times 5 points maximum per item).

Data Analysis

The raw data (test scores) were compiled and keypunched on computer cards for each subject by class and observation. Experimental and control treatments were distinguished by class coding (See Appendix, p. 39).

The computer program used was the Least Squares Unequal Subclass

Analysis of Variance (Kemp, 1972). The model used involved: (1) observation

effect, (2) treatment effect and (3) classes nested within treatment effect.

Chapter 4

RESULTS

Null Hypothesis 1

There will be no significant differences in attitudinal learning outcomes scores of junior-high science students, having completed the environmental simulation game Make Your Own World, and those students not receiving the game. Mean scores and standard errors for the first observation are in Table 1.

Table 1

Means and Standard Errors of Attitudinal Learning
Outcome Scores, First Observation

Treatment		Mean	Standard Error
Experiment		63.84	1.27
Control		58.51	1.23
Experiment--Class 1		64.09	1.89
	Class 2	63.59	1.70
Control--	Class 3	58.88	1.77
	Class 4	58.15	1.70

Results in Table 2 show that the mean score for the experimental classes was significantly higher at the beyond .01 level than the mean score of the control

classes in the first observation. Therefore, Null Hypothesis 1 is rejected.

Table 2

Analysis of Variance of Attitudinal Learning
Outcome Scores, First Observation

Comparison	Degrees of Freedom	Sums of Squares	Mean Squares	F–Ratio
Experiment/Control	1	711.70	711.70	9.08
Classes/Treatment	2	9.96	4.98	0.06

Probability $<$ .01

Null Hypothesis 2

There will be no significant difference in retention of attitudinal learning outcomes over a two week post experimental period for the junior–high science students. Mean scores and standard errors for the second observation are in Table 3.

Table 3

Means and Standard Errors of Attitudinal Learning
Outcome Scores, Second Observation

Treatment		Mean	Standard Error
Experiment		64.49	1.19
Control		59.81	1.18
Experiment--	Class 1	64.83	1.74
	Class 2	64.15	1.64
Control--	Class 3	60.15	1.70
	Class 4	59.46	1.70

Results in Table 4 show that the mean score of the experimental classes was significantly higher at the beyond .01 level than the control classes, second

observation. Since the difference between experiment and control is significant on both, first and second observations, though slightly less on the second observation, retention is evident. Therefore, Null Hypothesis 2 is rejected.

Table 4

Analysis of Variance of Attitudinal Learning Outcome
Scores, Second Observation

Comparison	Degrees of Freedom	Sums of Squares	Mean Squares	F-Ratio
Experiment/Control	1	563.68	563.68	7.78
Classes/Treatment	2	12.20	6.10	0.08

Probability $< .01$

Chapter 5

SUMMARY AND CONCLUSIONS

The findings in this study led to the following conclusions:

1. Junior-high science students, having completed the environmental simulation game Make Your Own World, scored significantly higher attitudinal learning outcomes than controls.

2. Junior-high science students exhibited significant retention of attitudinal learning outcomes over a two week post experiment period.

The study, in effect, validated the environmental simulation game, Make Your Own World, as an effective instructional method in influencing and retaining environmental attitudes in junior-high students. The results were in line with most of the literature reviewed on the subject.

Several limitations existed in the study that could be expanded in future investigations. These are: (1) comparison to no instruction rather than conventional instruction controls; (2) brief delayed-interval (2 weeks); (3) small sample; and (4) rural subjects.

Since most studies in the literature reviewed dealt with cognitive learning outcomes of simulation gaming instruction versus conventional instruction, this would suggest that affective learning outcomes also be studied on the basis of simulation gaming versus conventional instruction.

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The two week interval for measuring retention could be lengthened to six weeks for further analysis of retention.

However, the most interesting limitation of the study may be the exclusion of urban subjects. George (1966) found 4-H youth to measure significantly higher (.05 level) conservation attitude scores than Boy Scouts. Since 4-H youth are of predominately rural and scouts of urban backgrounds, it would appear to the author that the background rather than the conservation training experience within the organizations accounts for this difference. This would be an interesting area for further investigation. George attributed the difference to the training of the 4-H youth in a special, week-long, State 4-H Conservation Camp.

In summary, the evidence in this study supports the conclusion that the game, Make Your Own World, can be an effective educational method for positively affecting the attitudes of junior-high school students toward environmental concerns. In addition to its value in effecting attitudinal learning outcomes, it is the observation of the author that the high motivation associated with its use provides an excellent setting for introducing a unit of instruction of environmental education. Simulation games, such as the one used in this study, are not seen as an end in themselves but as a means to the end--environmental education.

The study results should be further tested, especially in the field with consideration toward expanding the sample, lengthening the retention period, and comparison with conventional instruction. Also, an intriguing study would be to explore the question raised regarding student background--rural/urban and organization training--4-H/Boy Scout.

REFERENCES CITED

Abt, Clark C. 1967. "Education is Child's Play," Hirsch, Werner A., *Inventing Education for the Future*. San Francisco: Chandler Publishing Company.

Beals, Paul E. 1971. "Games and Simulations," *Grade Teacher*, 88:94ff.

Bogan, Walter J., Jr. 1973. "Environmental Education Redefined," *The Journal of Environmental Education*, 4:1-3.

Chartier, Myron Raymond. 1974. "Toward a Theoretical Model of Learning as it Relates to Simulation Games with Discussion," ERIC Ed 088-417, American Baptist Seminary of the West, Covina, California.

Cherryholmes, C. H. 1966. "Some Current Research on Effectiveness of Educational Simulations: Implications for Alternative Strategies," *American Behavioral Scientist*, 10:4-7.

Coleman, James S. and others. 1973. "The Hopkins Games Program: Conclusions from Seven Years of Research," *Educational Researcher*, 2:3-7.

Demak, Leonard S. and Dworkin, Leo. 1969. "Games and Simulations: An Approach to Meaning Through Participation," ERIC Ed 031-949, Wayne County Intermediate School District, Detroit, Michigan.

Fennessey, Gail M. and others. 1972. "Simulation, Gaming, and Conventional Instruction: An Experimental Comparison," ERIC Ed 062-303, The Johns Hopkins University, Baltimore, Maryland.

Gagne, Robert M. 1971. *Domains of Learning*. Tallahassee: Florida State University.

Garvey, Dale M. and Seiler, William H. 1966. "A Study of Effectiveness of Different Methods of Teaching International Relations to High School Students," ERIC Ed 010-007, Kansas State Teachers College, Emporia, Kansas.

George, Robert Worth. 1966. "A Comparative Analysis of Conservation Attitudes in Situations Where Conservation Education is a Part of the Educational Experience," unpublished doctoral dissertation, Michigan State University.

Heinkel, O. A.   1970.   "Evaluation of Simulation as a Teaching Device," Journal of Experimental Education, 38:32-36.

Kemp, Kenneth E.   1972.   "Least Squares Analysis of Variance, A Procedure, A Program, and Examples of Their Use.   Part II--The Least Squares Program," Research paper 7, Kansas State University, Manhattan, Kansas.

Kidder, Steven J.   1971.   "Simulation Games: Practical References, Potential Use, Selected Bibliography," ERIC Ed 054-486, The Johns Hopkins University, Baltimore, Maryland.

Knapp, Clifford E.   1972.   "Attitudes and Values in Environmental Education," Journal of Environmental Education, 3:26-29.

Livingston, Samuel A.   1971.   "Simulation Games and Attitudes Towards the Poor; Three Questionnaire Studies," ERIC Ed 057-612, The Johns Hopkins University, Baltimore, Maryland.

Livingston, Samuel A.   1972.   "The Academic Games Program: A Summary of Research Results (1967-1972)," ERIC Ed 072-393, The Johns Hopkins University, Baltimore, Maryland.

Livingston, Samuel A.   1973.   "Simulation Games in the Classroom: How Important is the Post-Game Discussion?" ERIC Ed 083-324, The Johns Hopkins University, Baltimore, Maryland.

Lucas, Lawrence A. and others.   1974.   "A Comparative Study of Cognitive Retention Using Simulation-Gaming as Opposed to Lecture-Discussion Techniques," ERIC Ed 089-690, Ball State University, Muncie, Indiana.

Masters, J. R.   1974.   "The Relationship Between Number of Response Categories and Reliability of Likert-Type Questionnaires," Journal of Educational Measurement, 11:49-53.

Monroe, Margaret Warne.   1968.   "Games as Teaching Tools. An Examination of the Community Land Use Game," ERIC Ed 084-886, Cornell University, Ithaca, New York.

Nesbitt, William A.   1971.   Simulation Games for the Social Studies Classroom, 2nd ed.   Washington, D.C.: Foreign Policy Association.

Rapoport, A. and Chammah, A. M.   1965.   Prisoners' Dilemma: A Study of Conflict and Cooperation. Ann Arbor: University of Michigan Press.

Rokeach, Milton.   1971.   "Long-Range Experimental Modification of Values, Attitudes, and Behavior," American Psychologist, 26:453-459.

Stapp, William B. and others. 1970. "The Concept of Environmental Education," The American Biology Teacher, 32:14-15.

Steidle, W. E. 1971. "Environmental Education Act," Science and Children, 8:21-22.

Swan, James. 1969. "The Challenge of Environmental Education," Phi Delta Kappan, 51:26-28.

Swinerton, E. Nelson. 1972. "Environmental Gaming Simulations," The Journal of Environmental Education, 3:49-52.

BIBLIOGRAPHY

Abt, Clark C. "Education is Child's Play," Hirsch, Werner A., Inventing Education for the Future. San Francisco: Chandler Publishing Company, 1967.

Beals, Paul E. "Games and Simulations," Grade Teacher, 88, 1971, 94ff.

Bogan, Walter J., Jr. "Environmental Education Redefined," The Journal of Environmental Education, 4, 1973, 1-3.

Boocock, Sarane S. and others. "Simulation Games and Control Beliefs," ERIC Ed 016-736, The Johns Hopkins University, Baltimore, Maryland, 1967.

Chartier, Myron Raymond. "Toward a Theoretical Model of Learning as it Relates to Simulation Games with Discussion," ERIC Ed 088-417, American Baptist Seminary of the West, Covina, California.

Cherryholmes, C. H. "Some Current Research on Effectiveness of Educational Simulations: Implications for Alternative Strategies," American Behavioral Scientist, 10, 1966, 4-7.

Coleman, James S. and others. "The Hopkins Games Program: Conclusions from Seven Years of Research," Educational Researcher, 2 1973, 3-7.

Demak, Leonard S. and Dworkin, Leo. "Games and Simulations: An Approach to Meaning Through Participation," ERIC Ed 031-949, Wayne County Intermediate School District, Detroit, Michigan, 1969.

Ditton, Robert B. and Johnson, Per K. "A Survey of Recreation Behavior and Attitude Patterns of High School Juniors and Seniors: Implications for Environmental Education and Resource Management," ERIC Ed 088-699, University of Wisconsin, Madison, Wisconsin, 1974.

Edwards, Keith J. "The Effect of Ability, Achievement and Number of Plays on Learning from a Simulation Game," ERIC Ed 055-309, The Johns Hopkins University, Baltimore, Maryland, 1971.

Fennessey, Gail M. and others. "Simulation, Gaming, and Conventional Instruction: An Experimental Comparison," ERIC Ed 062-303, The Johns Hopkins University, Baltimore, Maryland, 1972.

Gagne, Robert M. Domains of Learning. Tallahassee: Florida State University, 1971.

Garvey, Dale M. and Seiler, William H. "A Study of Effectiveness of Different Methods of Teaching International Relations to High School Students," ERIC Ed 010-007, Kansas State Teachers College, Emporia, Kansas, 1966.

George, Robert Worth. "A Comparative Analysis of Conservation Attitudes in Situations Where Conservation Education is a Part of the Educational Experience," unpublished doctoral dissertation, Michigan State University, 1966.

Hamilton, W. and Asche, W. E. "Can We Change Environmental Attitudes?" Agricultural Education Magazine, 46, 1974, 187-188.

Harmon, Carol. "Environmental Games. An Analysis," ERIC Ed 067-232, Vermont Environmental Center, 1971.

Heinkel, O.A. "Evaluation of Simulation as a Teaching Device," Journal of Experimental Education, 38, 1970, 32-36.

Kemp, Kenneth E. "Least Squares Analysis of Variance, A Procedure, A Program, and Examples of Their Use. Part II--The Least Squares Program," Research paper 7, Kansas State University, Manhattan, Kansas, 1972.

Kidder, Steven J. "Emotional Arousal and Attitude Change During Simulation Games," ERIC Ed 054-513, The Johns Hopkins University, Baltimore, Maryland, 1971.

Kidder, Steven J. "Simulation Games: Practical References, Potential Use, Selected Bibliography," ERIC Ed 054-486, The Johns Hopkins University, Baltimore, Maryland, 1971.

Knapp, Clifford E. "Attitudes and Values in Environmental Education," Journal of Environmental Education, 3, 1972, 26-29.

Livingston, Samuel A. "Simulation Games and Attitudes Towards the Poor: Three Questionnaire Studies," ERIC Ed 057-612, The Johns Hopkins University, Baltimore, Maryland, 1971.

Livingston, Samuel A. "The Academic Games Program: A Summary of Research Results (1967-1972)," ERIC Ed 072-393, The Johns Hopkins University, Baltimore, Maryland, 1972.

Livingston, Samuel A. "Simulation Games in the Classroom: How Important is the Post-Game Discussion?" ERIC Ed 083-324, The Johns Hopkins University, Baltimore, Maryland, 1973.

Lucas, Lawrence A. and others. "A Comparative Study of Cognitive Retention Using Simulation-Gaming as Opposed to Lecture-Discussion Techniques," ERIC Ed 089-690, Ball State University, Muncie, Indiana, 1974.

Masters, J. R. "The Relationship Between Number of Response Categories and Reliability of Likert-Type Questionnaires," Journal of Educational Measurement, 11, 1974, 49-53.

Monroe, Margaret Warne. "Games as Teaching Tools. An Examination of the Community Land Use Game," ERIC Ed 084-886, Cornell University, Ithaca, New York, 1968.

Nesbitt, William A. Simulation Games for the Social Studies Classroom, 2nd ed. Washington, D.C.: Foreign Policy Association, 1971.

Nunnally, Jum C. Educational Measurement and Evaluation. 2nd ed. New York: McGraw Hill Book Company, 1972.

Rapoport, A. and Chammah, A.M. Prisoners' Dilemma: A Study of Conflict and Cooperation. Ann Arbor: University of Michigan Press, 1965.

Rokeach, Milton. "Long-Range Experimental Modification of Values, Attitudes, and Behavior," American Psychologist, 26, 1971, 453-459.

Stapp, William B. and others. "The Concept of Environmental Education," The American Biology Teacher, 32, 1970, 14-15.

Steidle, W. E. "Environmental Education Act," Science and Children, 8, 1971, 21-22.

Steiner, R. L. and Barnhart, R. B. "The Development of an Instrument to Assess Environmental Attitudes Utilizing Factor Analytic Techniques," Science Education, 56, 1972, 427-432.

Stronck, David R. "A Question on Environmental Issues," American Biology Teacher, 34, 1972, 212-214.

Swan, James. "The Challenge of Environmental Education," Phi Delta Kappan, 51, 1969, 26-28.

Swinerton, E. Nelson. "Environmental Gaming Simulations," The Journal of Environmental Education, 3, 1972, 49-52.

Tuckman, Bruce W. Conducting Educational Research. New York: Harcourt Brace Javonovich, Inc., 1972.

APPENDIX

Please indicate your agreement with the following statements by circling the appropriate response: SA – strongly agree; A – agree; U – undecided; D – disagree; SD – strongly disagree.

SA A U D SD 1. Wildlife preserves such as National Wilderness Areas should be set aside.

SA A U D SD 2. Because of the energy crisis, America should proceed at a fast pace to build hydroelectric dams and reservoirs.

SA A U D SD 3. With the reduced speed limit in the nation of 55 mph., more and larger air ports should be constructed to speed up travel.

SA A U D SD 4. Superhighways are seriously needed now in the United States.

SA A U D SD 5. Because of the convenience and lower prices, more shopping centers are needed in most cities.

SA A U D SD 6. More marinas are needed on our lakes and rivers as they provide more jobs and increase service to boat owners.

SA A U D SD 7. In today's jet age we do not need more amusement parks because people have too many things to do for entertainment as it is.

SA A U D SD 8. An auto speedway is desirable because of the tourists it attracts and jobs provided to local residents.

SA A U D SD 9. High-rise apartments are needed in most communities as they provide newer homes and offer swimming pools and game rooms as well as bring more money into the area.

SA A U D SD 10. Industrial parks are not needed because they attract more industry which in turn attracts more people.

SA A U D SD 11. The proposed Tall Grass Prairie National Park in Kansas is a luxury we can not afford with the increasing demand for food and fiber production.

SA A U D SD 12. Hydroelectric dams and reservoirs can be as harmful in many situations as they can be helpful.

SA A U D SD 13. Because of the fuel shortage, the use of air travel should be limited.

SA A U D SD 14. With the move to smaller cars and lower speed limits, super-highways are not very important.

SA A U D SD 15. Shopping centers are too large and crowded.

SA A U D SD 16. Marinas often are the source of pollution coming from leaking and spilled gas and oil.

SA A U D SD 17. Amusement parks are a great source of entertainment.

SA A U D SD 18. The noise and lurking danger of an auto speedway makes it a poor source of entertainment for a community.

SA A U D SD 19. One disadvantage of a city is the blockage of the view by large high-rise apartment buildings.

SA A U D SD 20. Industrial parks help create more jobs.

Paper and Pencil Performance Test

Item	Upper 25% Who Pass		Lower 25% Who Pass		Easiness Percent	Discrimina- tion Index
	Number	%	Number	%		
**1	4	67	3	50	58	17
** *2	1	17	1	17	17	0
3	5	83	1	17	50	66
4	4	67	1	17	42	50
5	4	67	2	33	50	34
6	3	50	0	0	24	50
** *7	1	17	0	0	8	17
8	5	83	2	33	58	50
*9	2	33	0	0	17	33
10	4	67	1	17	42	50
*11	2	33	0	0	17	33
12	4	67	1	17	42	50
13	5	83	3	50	67	33
14	4	67	1	17	42	50
15	4	67	0	0	33	67
16	5	83	2	33	58	50
** *17	0	0	0	0	0	0
18	5	83	0	0	42	83
19	5	83	3	50	67	33
**20	4	67	3	50	58	17

*These items were discarded because they were shown to be too difficult---below 20%.

**These items were discarded because their discrimination index was less than 20%.

Please indicate your agreement with the following statements by circling the appropriate response: SA – strongly agree, A – agree, U – undecided, D – disagree, SD – strongly disagree.

SA A U D SD 1. A wildlife preserve seldom has any adverse impacts on the environment of a nearby community.

SA A U D SD 2. With an energy crisis on hand and potential periodic flooding to come, we should proceed to build more hydroelectric dams and reservoirs with little concern for their impact on the environment.

SA A U D SD 3. With the reduced speed limit in the nation of 55 m.p.h., more and larger airports should be constructed to speed up travel.

SA A U D SD 4. Super highways are seriously needed now in the United States.

SA A U D SD 5. Because of their convenience and lower prices, more shopping centers are needed in most cities.

SA A U D SD 6. More marinas are needed on our lakes and rivers as they provide more jobs and increase service to boat owners.

SA A U D SD 7. Environmental hazards created by an amusement park give reason to question the park as an asset to a community.

SA A U D SD 8. An auto speedway is desirable because of the tourists attracted and jobs provided to local residents.

SA A U D SD 9. The advantages of high-rise apartments (newer housing, swimming pools, game rooms) outweigh their disadvantages (destroyed forest area, lack of yards).

SA A U D SD 10. Industrial parks are needed because they attract more industry which, in turn, attracts more people.

SA A U D SD 11. Wildlife preserves are heavily littered by users and require tax money for creation and maintenance.

SA A U D SD 12. Hydroelectric dams and reservoirs can be as harmful in many situations as they can be helpful.

SA A U D SD 13. Because of the fuel shortage, the use of air travel should be limited.

SA A U D SD 14. With the move to smaller cars and lower speed limits, super highways are not very important.

SA A U D SD 15. Shopping centers can cause flash flooding.

SA A U D SD 16. Marinas often are the source of pollution coming from leaking and spilled gas and oil.

SA A U D SD 17. Amusement parks can cause flash flooding.

SA A U D SD 18. The noise and polluting fumes of an auto speedway make it a poor source of entertainment for a community.

SA A U D SD 19. One disadvantage of a city is the blockage of the view by large high-rise apartment buildings.

SA A U D SD 20. Since industrial parks encourage more industry to locate within the community with more jobs being provided and larger community payrolls, the quality of life for the residents is improved.

Paper and Pencil Performance Test

Item	Upper 25% Who Pass		Lower 25% Who Pass		Easiness Percent	Discrimination Index
	Number	%	Number	%		
1	6	50	3	25	38	25
2	7	58	6	50	54	8
7	9	75	2	17	46	58
9	8	67	4	33	50	34
11	9	75	5	42	58	33
17	6	50	2	17	33	33
20	5	42	2	17	29	25

CLASS CODING PROCEDURE

First Observation

Classes

Treatment	C_1 (22 S^s)	C_2 (27 S^s)
Control	C_3 (25 S^s)	C_4 (27 S^s)

Second Observation

Classes

Treatment	C_1 (24 S^s)	C_2 (27 S^s)
Control	C_3 (26 S^s)	C_4 (26 S^s)

ATTITUDINAL LEARNING OUTCOMES AND THEIR RETENTION BY
JUNIOR-HIGH SCIENCE STUDENTS USING AN ENVIRON-
MENTAL EDUCATION SIMULATION GAME

by

JAMES CHARLES GEISLER

B.S., University of Missouri, 1964

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1975

Educators are once again expected to solve the current crisis in the United States by teaching environmental education to the youth. The purpose of this study was to evaluate an instructional method, simulation games, as a means to effectively teach environmental education. More specifically, the Coca Cola USA Ecology Kit XO13 simulation game, Make Your Own World, was studied for its effect on attitudinal learning outcomes and their retention by junior-high science students of a rural background.

Two experimental classes received the Make Your Own World game in its entirety and were tested, using a 20 item Likert scale, within a 55 minute class period. After a two week interval, a second testing, using the same instrument, was made.

The two control classes received the same instrument as the experimental groups, but, without the treatment. The test was given under the same time limitations as for the experimental groups. After a two week interval, a second testing was administered, using the same instrument as before.

Using the Least Squares Unequal Subclass Analysis of Variance computer program, it was concluded that both higher attitudinal learning outcomes and retention was significant beyond the .01 level for the junior-high science students. It was suggested that the simulation gaming technique be employed as an introductory method to teaching a unit of environmental education.