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THE DESIGN AND EVALUATION OF A LAND USE SIMULATION GAME

by

WILLIAM DONALD BARKLEY

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Department of Adult Education

The University of British Columbia
Vancouver 8, Canada

Date July 24, 1972.

ABSTRACT

This study was concerned with the design and evaluation of a land use simulation game for rural residents of the East Kootenay region of British Columbia.

The rationale behind the study was that gaming was a technique worthy of investigation for use in the environmental education of adults.

Two hypotheses were proposed to guide the research on the land use simulation game designed. The first proposed that the game would produce a significant increase in knowledge and change in attitude, and the second stated that significant relationships would be shown between player characteristics, game play data and test results.

A simulation game was designed using a modified version of a procedure set out by Glazier (41) for designing educational games. Two preliminary versions were tested and a final version set up. The game was a board game using an enlarged piece of a land capability map. Players bought and planned pieces of land through the four seasons of the year. The objective of the game was to maximize economic returns without severely damaging the environment. Instruments for evaluating the game were simultaneously designed and tested.

The simulation game was played with 40 East Kootenay residents in school district number 2, Cranbrook on properties

of 50 acres or more. Family groups played the game and completed both a pre and post-test.

The people playing the simulation game came mostly from productive farms (82.5%). Thirty-five percent of the sample were husbands and wives, 45 percent children, and 20 percent were others which included farm hands and neighbours. The mean educational level of the group was 10.7 years. The mean land holding size was 537.1 acres and the mean number of players per each of the nine gaming sessions was 4.7 persons.

Years of schooling correlated positively with the total score a person received on the game. Objective 6 on the ability to identify good and poor land uses correlated significantly with a number of other variables. This objective appears to be an important one to consider in future game modification. Knowledge and attitude correlated significantly and positively with years of schooling, money scores, total scores, playing time, number of players, attitude towards the game, and rank within a group; and negative significant correlations were found with property size and environmental unit scores.

T-test results showed that there had been a general increase in knowledge and in particular an increase in the knowledge about the competitive relationships that exist between wild and domestic populations. A change in attitude about the effects of land use on neighbouring lands was also found to be significant.

It was concluded that the simulation game had been a limited success with some learning statistically demonstrable. Correlation data and subjective data provided sufficient information for the further modification of this learning device to enhance its effectiveness.

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Chapter 1

INTRODUCTION

The deterioration of the natural environment and the apparent public concern stimulated by the mass media have created a need for providing environmental education programs to the public. In North America numerous education programs dealing with the natural environment have been created. Concomitant with this need for public programs is a need to examine, evaluate and create new methods, techniques and devices for use in environmental education.

One facet of environmental education which is especially challenging is environmental education for adults. Providing adults with an awareness of environmental processes is important because they are the decision makers and many environmental problems cannot wait to be solved by the next generation. A major difficulty in educating adults in the public at large is the lack of a structured educational system so that participation in environmental education programs is voluntary and informal. In view of this, methods and techniques must to some degree motivate and interest people enough to take part in what is offered. Thus, adult educators need to generate and evaluate methods and techniques which can be adapted to the voluntary and informal characteristics of adult environmental education.

One such technique which has potential and deserves further investigation is simulation gaming. This technique attempts to reproduce real world processes in a simplified form and present them to the potential learner for manipulation in a gaming context. The player, by playing out his role in the game, must make decisions consistent with the simulated process and hence compatible with reality. Complicating the processes reflected are other players operating with conflicting interests. Constrained by the rules and simulated processes, players must compete and co-operate with other players to achieve game objectives. The learning that takes place is a result of collecting data on which to make decisions, negotiating with other players, and bearing the consequences of decisions.

A feature of simulation gaming that has been well documented by research studies is the motivation and interest it creates in students. This alone would be sufficient to justify using the gaming technique with adults. In addition, simulation games illustrate processes in a dynamic, simplified form which is compatible with what needs to be taught about the environment. For the adult learner simulation games also accommodate a variety of backgrounds, allow for the use of past experience, skills and knowledge, create a sense of control or efficacy over environmental phenomena, control for passivity engendered in more verbal presentations, and provide for the transfer of learning to real life situations because of the reality inherent in the simulation.

PURPOSE

The purpose of this study was to design and evaluate a land use simulation game that would teach rural residents about the processes and outcomes of land use plans. The product resulting from the design process was played with rural residents in the East Kootenay area of British Columbia in order to investigate and evaluate the effectiveness of the game as an adult education technique.

HYPOTHESES

Two general hypotheses were formulated to guide the assessment of the effectiveness of the land use planning simulation game.

1. Individuals who play the simulation game will show a significant increase with respect to their knowledge and attitudes about land use planning as expressed in six instructional objectives described below:
    1 The learner will develop a favorable attitude towards the land use planning process.
    2 The learner will develop a more positive attitude towards considering the effects of his land use plans on neighbouring lands.
    3 The learner will conclude that a given piece of land has certain capabilities or potentials.

4 The learner will describe the interplay between economic and ecological factors in land use planning.

5 The learner will be able to describe the competitive relationships existing between forestry and field crops, waterfowl and field crops, cattle and field crops, cattle and waterfowl, cattle and big game, forestry and cattle, and big game and forestry.

6 The learner will be able to differentiate between good and poor land use strategies.

2. The personal characteristics of those who play the simulation game will be related to their success in playing the simulation game as well as to their knowledge and attitudes about land use planning.

PROCEDURE

The first stage of this study was the design of a simulation game. Data from the East Kootenay Area Land Capability Analysis was examined to determine how the ecological interactions taking place on East Kootenay lands could be simulated. Staff involved in the East Kootenay Area Land Capability Analysis were consulted for their opinions on what could be simulated and what rural residents of the East Kootenay needed to know about land use. A land use simulation game was designed using the East Kootenay Area Land Capability

Analysis Map (16), the socio-economic survey of the East Kootenay by Verner, Dickinson and Alleyne (85) and Glazier's (41) publication on the design of educational games.

The simulation game was then played with various groups of graduate and undergraduate students at the University of British Columbia to eliminate operational difficulties.

The simulation game was taken to a sample of East Kootenay rural families where it was played with family members in their homes. Each individual who played the game was given a test before and after playing the game.

The Sample

The population of potential players of the simulation game was defined as owners of rural land holding 50 or more acres in School District Number 2, Cranbrook. Those properties were identified in the tax assessment rolls located in the City of Cranbrook. The population was listed by the name of the property owner, with properties owned by companies and those showing no improvements on the land excluded for purposes of the study.

The total population of the study consisted of 83 families. It was intended originally to select a 20 percent random sample of the population, however, a high rate of refusal to participate necessitated the use of all names listed. Contact was established therefore with as many of the listed names as was possible. Of the 76 families who could be reached, ten consented to participate. One of those ten

families later refused to participate in the land use game so that the players finally numbered nine families comprising 40 persons.

Data Collection

A pre-test was constructed consisting of a 16 statement Likert scale which related to instructional objectives 1 and 2, and 20 multiple choice questions testing objectives 3, 4, 5, and 6 of the simulation game (see Appendix A). A pool of 38 multiple choice questions and 24 statements for the Likert scale made up the original measuring instruments used in the pilot study. An item analysis was carried out based on the results of the pilot study and 20 items were selected from the multiple choice test and 16 items were chosen for the final version of the Likert scale. A split-half reliability using the Spearman Brown Prophecy formula was computed to be 0.55 for the Likert scale (based on the 16 items chosen) and 0.37 on the multiple choice items (based on the 20 items chosen). These computations were repeated using the data collected from the East Kootenay sample and the reliability coefficients were 0.46 for the Likert scale and 0.41 for the multiple choice tests.

The simulation game was played and a post-test comprised of four personal data questions, five Likert items related to attitude towards the game and a repeat of the pre-test questions listed in the previous paragraph. While the players were completing the post-test instrument, subjective comments about the session were recorded as well as total playing time.

Data Analysis

The completed instruments were marked and the following three scores per person were recorded:

Attitude score - total score on a 16 item Likert scale with a maximum of 80 and a minimum of 16.

Knowledge score - total score on 20 multiple choice items with a maximum of 20 and a minimum of zero.

Game attitude score - total score on a five item Likert scale with a maximum score of 25 and a minimum of five.

In addition there were three game scores totalled up on completion of play as follows:

Environmental unit score - the total number of environmental units accumulated by an individual during the course of play.

Money score - total cash on hand at the end of the play.

Total score - the sum of environmental units plus money at the end of the play.

Pre-test and post-test attitude and knowledge scores were submitted to t-test to determine if any significant changes had occurred as a result of game play. Each of the six instructional objectives were also t-tested on pre and post-test scores to see if any significant changes had occurred.

Correlation coefficients (Pearson's r) were calculated among all of the following variables to determine if significant associations existed: property size; family position; years of

schooling; pre-test attitude scores; pre-test scores for objectives 1, 2, 3, 4, 5, and 6; pre-test knowledge scores; post-test attitude scores; post-test scores for objectives 1, 2, 3, 4, 5, and 6; post-test knowledge scores; game attitude scores; number of minutes of play; number of players; rank within the group; environmental unit scores; money scores and total scores.

Bivariate tables were constructed to investigate further the relationships between the variables measured. The chi-square test was used to test the significance of differences in the distributions between variables.

DEFINITION OF TERMS

The following terms were defined for the purposes of this study:

Simulation game - a learning device which is designed to represent a segment of reality and involves interactions between the learner, the game, and other players.

Simulation gaming - the technique of organizing learners to participate in a learning situation using a gaming device.

Game - completion of two full simulated years or eight simulated seasons of play.

Rural residents - actual people living on lands of 50 acres or more in size.

Participant - a rural resident owning a simulated piece of property on the game board.

PLAN OF THE STUDY

The study consists of five chapters. Following this chapter the second chapter is a review of the literature on simulation gaming which was deemed pertinent to this study. Chapter 3 describes the process of designing the East Kootenay land use simulation game and the end product, the simulation game itself. In the fourth chapter the data collected during the playing of the game with the rural residents of the East Kootenay was analyzed to determine the effectiveness of the game and how the game could be modified to make it more effective. The fifth and concluding chapter presents a summary, the conclusions and implications for further study.

Chapter 2

REVIEW OF THE LITERATURE

The literature about simulation gaming is vast. It is concerned with two broad areas, simulation gaming as applied to education and simulation gaming for use in research investigations. This review of the literature includes studies on gaming which pertain to its educational uses and which were useful in the design and evaluation of the land use planning game developed for this study.

The first section of this chapter concerns the simulation gaming technique and examines briefly the history of gaming and some of its characteristics. The next section deals with research studies which have examined the gaming process and attempted to assess its effectiveness. Existing land use simulation games are discussed in the third section of this chapter. In conclusion, the chapter discusses the literature available on the procedures of game design.

THE SIMULATION GAMING TECHNIQUE

Simulation gaming has ancient origins dating back to feudal times when war lords trained their soldiers using war games. However, its introduction into the formal educational setting is quite recent. In 1956 the American Management Association (2) introduced a business management game as an educational device. Dating from that time hundreds of

simulation games have appeared in business and industry as staff training devices. Other games covering a wide spectrum of topics appeared in other institutions as the educational potentials of simulation games were recognized. Boocock and Schild (10) in tracing the history of educational games describe three historical stages through which this device has moved. The period 1956 to 1963 was the stage of "acceptance on faith". Simulation games were seen as a cure-all for the plethora of educational ills that plagued the formal educational system. The second stage occurring between 1963 and 1966 was called the "post honeymoon". Researchers began to discern that many of the claims made about simulation games were not supported by research. Finally, the stage from 1967 to the present was labelled "realistic optimism" in which it became evident that games were useful in some but not all learning situations and that each simulation game required careful evaluation of its effectiveness.

The characteristics of simulation games can be divided into two categories, those that appear advantageous to the learning situation and those which are disadvantageous. Those deemed as positive attributes are:

1. Economy - simulation games can be less expensive in terms of time and money than using real processes.
2. Visibility - functioning processes and their results can be easily observed.

3. Reproducability - different individuals can produce the same results from manipulating the simulation.
4. Safety - if the event being simulated has dangerous consequences these can be removed from the simulation exercise.
5. Simplicity - complex processes are simplified to enhance understanding.
6. Interest and Motivation - are heightened in simulation gaming.
7. Application - simulation games allow for application and testing of knowledge.
8. Individual differences - a wide range of abilities can be accommodated in a game.
9. Decision making skills - are practised and improved by the gaming exercises.
10. Transfer - reality inherent in simulation games facilitates transfer.
11. Non-verbal abilities - latent abilities not identified by verbal learning exercises are important in many simulation games.
12. Efficacy - a sense of being able to control phenomena related to one's personal life is developed.
13. Reinforcement - games have built in rewards and punishments.
14. Feedback - rapid feedback in consequence to an act is characteristic.

15. Attention span - attention span is lengthened due to the participatory, involving nature of games.

The negative aspects of gaming are as follows:

1. Oversimplification - this results in unreal perceptions of the processes being simulated.
2. Dehumanization - decisions are made objectively without consideration of the welfare of the people who will be affected.
3. Expense - the development of a simulation game often requires a substantial expenditure of time and money.
4. Gaming atmosphere - for the instructor there is some apprehension about "fun and games" being related to learning. The student may be inclined not to take games seriously.
5. Competition - there is concern that this emphasis might repress creativity.

Both sets of characteristics lack any substantial verification and therefore research is directed at verifying the characteristics noted here for simulation games.

RESEARCH RELATED TO SIMULATION GAMING

Effectiveness of Gaming

Cherryholmes (19) examines some of the accepted assumptions concerning the effectiveness of the simulation gaming technique. He posed five hypotheses:

H_1 Students participating in a simulation will reveal more interest in a simulation exercise than in more conventional classroom activities.

H_2 Students participating in a simulation will learn more facts and principles than by studying in a more conventional manner.

H_3 Students participating in a simulation will retain information learned longer than if they had learned it in a more conventional manner.

H_4 Students participating in a simulation will acquire more critical thinking and decision making skills than will students in more conventional classroom activities.

H_5 Students participating in a simulation will have their attitudes significantly altered relative to attitude change produced by more conventional classroom methods.

Using the simulation game, "Inter-Nation Simulation", Cherryholmes attempted to carry out measures of the degree to which the above hypotheses were supported. Using the results from his study and those of six similar studies he determined that the only unanimously accepted hypothesis was H_1; that more interest would be developed by a simulation game than by more conventional classroom activities. The only other hypothesis not rejected conclusively was H_5 which stated that attitudes would change more as a result of the simulation than by conventional techniques. Cherryholmes was not able to find support for any

of the other hypotheses related to learning of facts and principles, retention of information and acquisition of critical thinking and decision making skills. In conclusion this study proposed that better results might be achieved if more effort was required of the student to verify the simulation game with reality and if students designed new games or redesigned existing games based on their validation efforts.

A study carried out by Inbar (50) focused on the effects games have on individual players. Four player characteristics which Inbar investigated in the game "Community Disaster" were; variation in player backgrounds, different predispositions (desire to learn more about a topic, voluntarily playing the game and willing to give time to participating in games), differences in experience and behavior during the game, and the characteristics of the group that played the game. His results indicated that predisposition and group characteristics had a major impact on learning and the enjoyment of games.

Research into the effects of a simulation procedure in a teacher training program was carried out by Cruickshank and Broadbent (26). The study involved two groups of student teachers; an experimental group who were involved in the simulation exercise and a control group who performed the regular practice teaching duties. The simulation exercise consisted of a series of filmed sequences of classroom situations perceived as difficult by first year classroom teachers. Student teachers were presented these filmed sequences and asked to react to them as if they were in a classroom situation.

Discussion of the reaction by the student followed and responses were modified where necessary. As in most evaluative studies the simulation exercise rated high on its motivation and participation measures as compared with practice teaching. Follow-up studies a few months after the experiences revealed no differences in attitude or behavior between the experimental and control groups.

Evaluations of Business Games

Zaltman (88) undertook a study of a business game to determine the effects of the amount of participation on learning. He compared particular roles in games which allowed different degrees of participation. The results demonstrated that the more opportunity an assumed role allowed for participation the greater the learning.

McKenney and Dill (57) studied the effects of a business management game on 650 M.B.A. program students at Harvard. The results indicated that using existing groups (i.e., groups of people who had worked together on a previous project) and homogeneous grouping by intelligence and past achievement did not produce significantly better learning effects. This study also investigated the effects of external advisors on learning resulting from simulation game play. The results indicated that as long as the advisor's role is clearly defined as an informational one and he does not attempt to manipulate game play, his presence enhanced learning.

A study by Starbuck and Kobrow (75) of the effects of advisors was carried out using 88 graduate students in industrial administration playing a business management game. Three teams had advisors and three without; the results showed no significant difference in economic gains between the two groups.

A comparison between a business game and a case study carried out by Moore (61) yielded some interesting information. A summary of his data revealed the following:

1. The case study group had a significantly higher fact mastery score.
2. A test for concept explicitness showed a non-significant difference between the two groups.
3. Tests of general structural learning game non-significant results.
4. Tests for logical reasoning ability produced non-significant results.
5. Overall learning tended to favor the case study.

A questionnaire administered to the students revealed that both the case study group and the game group perceived gaming as a more highly motivating technique. Moore points out that the motivational aspect of gaming may be more associated with the competitive process involved in gaming than with the amount of learning which results. Playing the game thus becomes an end in itself rather than achievement of the learning objectives the game set out to accomplish.

Effects of Game Presentation on Game Play

Research into the presentation and playing of a game by Baldwin (3) found that strategies which develop in games can lead to rigid patterns of play with the result that alternative approaches to play are usually left unexplored. He suggests that simulation game designers should recognize this limitation and build in rewards and directions for exploring variant strategies. Baldwin points out that in many games the instructors directed the game to the point of inhibiting imaginative play. Games often reflected the game director's expectations rather than the learners' interaction with the processes being simulated. In observing play he also concluded that successive game plays enhanced learning. Whereas the first game play was spent learning the mechanics, later play concentrated on understanding the process being simulated. He further pointed out that simulation games offering various levels of play from simple to complex provide for practice in gaming procedures while providing a more in depth experience of the processes being simulated. Similarly, changes in game parameters develops imaginative play and an opportunity to attempt new strategies. Baldwin observed that suggestive labels often inhibited or directed play (e.g., urban planning game towns labelled Superiorville vs. Nowhereville). A similar conclusion was reached in a study by Blunt (6) on a simulation for aldermen in which the central focus of the simulation was a town called "Bunkum". Blunt reports that ". . . . the jocular use of place names in the materials appeared to con-

tribute to a light-hearted approach to the learning task and some waste of time. . ." (6:8). Over-constraining rules and illogical payoffs were observed by Baldwin to inhibit game effectiveness as an instructional tool. This results in successful play remaining unrewarded and hence negative reinforcement with the result that players may learn the wrong things.

Simon (72) examined how changing scenarios changes decision making in the course of gameplay. Using 90 university students, groups of 15 played three versions of a resource allocation game. The game involved allotting resources in such a manner as to maximize the resources that the player started with. Three forms of the game were developed; one version had the three resources identified with nonsense titles, the second was titled a war game, and the third a business game. The results showed totally different decision strategies attached to each form. Simon found that the abstract game produced lower scores and players were willing to take more risks.

Validation of the Simulation

Most educational games include the simulation of some real world process. Since a simulation is just a dynamic, functioning model its creation involves simplification and usually the compression of time. Care must be taken to ensure that the simulation does not contain serious distortions of reality which will present wrong information to the participants.

A limited amount of research has been carried out with educational games to verify the reality of the simulation employed.

Smoker (73) attempted this type of validation by running two separate games of "International Process Simulation". One game was played by a group of professional decision makers from industry, business, government and the military who represented reality. The other group was made up of 16 and 17 year old students who represented non-reality. His hypothesis was that the reality group's reactions to the game would reflect their experiences in real world decision making and if the model presented by the game was functioning properly the non-reality group would make the same responses. His data indicated a strong correlation between the two groups on what he called "past world decisions". These were decisions the members of the group had to make using the information history had provided, for example working out a plan for the resolution of the Korean conflict. He found that no correlations existed where the two groups were asked to predict future events, a similar example would be the development of a plan to settle territorial disputes resulting from landing on other planets. Discrepancies between the way groups reacted to problems of foreign and domestic conflict demonstrated a failure of the simulation to represent this area in the game. The results indicated that the simulation requires alteration in those areas that deal with future predictions, domestic conflict and foreign conflict. The

study cautions readers that there is some danger in assuming the reality of the professional decision makers' future oriented decisions.

Boocock (11), using a game entitled "Generation Gap" carried out a study to assess game validity. The game was administered to 17 child--parent pairs who completed questionnaires prior to and after the game play. Boocock used the results from the study to examine three kinds of validity; face validity, empirical validity and theoretical validity. Briefly, face validity was based on asking the participant after the game if the game simulated their real life experiences. Empirical validity was determined by comparing their responses on the pre-game questionnaire with their game play. Finally, theoretical validity was measured by assessing whether or not game play followed one or more of the following sociological theories: exchange theory, role theory and social power theory. The results of the study indicated that "Generation Gap" demonstrated some face validity for the participants, the empirical validity correlations were strong and positive and the theoretical validity was weakly demonstrated by the presence of strategies based on role theory and exchange theory. The author concludes that "Generation Gap" is a valid simulation game but further trails with changes in rules and parameters would provide a fuller test of validity.

Behavioral Measures of Game Effectiveness

Boocock and Schild (10) and others have pointed out the

difficulty in measuring the non-verbal learning that occurs which is perhaps the most significant learning in games. Anecdotal records tend to support the observation that it is often not the high achieving student who emerges the winner in simulation games. Since high achievers are usually rated as such by verbal measures it lends support to the hypothesis that non-verbal skills are necessary in gaming.

A comparison between a case study approach and a simulation gaming experience was carried out by Robinson (68). Although his results were very much the same as those reported by Moore (61) previously, he noted an interesting discrepancy between student perception of simulation game effectiveness and actual demonstrated behavior. Records of book withdrawals from the library, frequency of questions asked, and staying after class all revealed a significantly greater amount of activity in the simulation group over the case study group. Since both procedures covered precisely the same material it appears that simulation gaming stimulated more activity which could be associated with learning. The students reported from both the case study and simulation groups that they perceived gaming as being more enjoyable but that they could learn more from case studies.

Lee and O'Leary (54) report a study in which a follow-up of a three day total immersion "Inter-Nation Simulation" was carried out one month after the experience. As a result of pre-test and post-test measures they determined that a personality change had occurred as a result of the experience.

A significant number of participants demonstrated an enhanced ability to function in complex decision making environments. They also noted that game success correlated highly with game enjoyment. One observation that is made at the end of the study is that simulation games often duplicate the kinds of learning that takes place outside of the formal learning setting and perhaps a study of non-formal kinds of learning could yield useful knowledge which could enhance learning theory and its application.

Lee (53) in a literature review for a study on "Inter-Nation Simulation" says:

> "But, as the research studies have focused primarily on factual learning simulation games, in effect, have been assessed up to now primarily in terms of criteria more appropriate to traditional classroom techniques. As the main objective for using simulation games presumably is not to teach only facts, but to go beyond this to develop insights, concepts, awarenesses and skills of a kind ordinarily not possible with traditional teaching methods--this means that the potentially unique contribution of the game technique to education has not been appropriately tested." (53:16)

Summary

Two features of simulation gaming which emerge in most studies are the interest and motivation developed by simulation gaming. The lack of substantive evidence for learning effectiveness is either an inability of this technique to cause learning or more probably the failure of the research studies themselves. Robinson's study (68) in which behavioral measures yield information in conflict with the non-behavioral measures points up the difficulty in measuring the degree of learning

occurring in games. Lee (53) summarizes by stating perhaps we are not testing what games teach.

Although the research reviewed here presents no definitive answer to the question as to whether or not games are effective learning devices, some of their characteristics seem to suit them to adult education. Games are based on past experience in decision making and it is well documented that adults bring a vast amount of experience to any learning situation. Therefore, games would take advantage of the adults' experiences. Adult educators often propose that learning environments should be kept informal for the adult and gaming offers a means to develop an informal learning environment. Games are highly motivational and offer a way to develop initial interest in an area of knowledge. Some researchers have indicated that gaming potentially can accommodate people with varying levels of education and differing backgrounds and again this suits most adult learning groups. Thus, gaming can be a very worthwhile technique for the adult educator to consider when planning learning experiences for the adult.

LAND USE SIMULATION GAMES

Simulation and simulation gaming is in common usage in urban land use planning. The professional planner can employ a simulation to work out the implications of particular types of land use. Often such simulations are computer assisted to speed up the consideration of complex interactions. Duke (32) designed an urban land use game called "Metropolis". Its purpose

was to introduce young professionals to the decision making problems of urban land use planning. The emphasis in the game was placed on the physical development pattern, the effects of various community issues, and the linkages between the players, the capital improvements, and the issues. This simulation game involved extensive play in terms of time, and the pre-requisite knowledge required by the participant.

In contrast to "Metropolis" is a simulation game designed by Godschalk (42) called "Negotiate". Godschalk's purpose was to have citizens participate in the planning process. He hypothesized that increased citizen participation would lead to increased efficiency and creativeness in planning outcomes. Godschalk also proposed that the game experience would be a source of new attitudes, values and social behavior.

"Negotiate" focused on the problem of setting up a federally supported low income housing project near two developing middle income subdivisions. The players' roles consisted of two representatives from middle income groups, two from low income groups and the city planner. Problems faced are declining property values, uprooting of low income families to new housing locations, provision of municipal facilities of parks, schools and other services, the clash between two socio-economic strata and the benefits from infusion of federal money. These various problems and possible benefits are worked into the players' roles and game rules. The actual planning exercise takes place on a three dimensional scale model of the project.

Play of the game pointed up a number of frustrations for the players. They felt that the planning process was virtually completed before play started and that more playing time would be essential to develop trust between the different socio-economic groups and the planner.

Although no conclusions were reached as to attitude change and increased efficiency and creativeness in the planning process, tape recordings of the session demonstrated a good deal of self-analysis and group analysis of the reasons for taking certain stands. The designer of the game recommended longer playing time and more objective measures of success, and concluded with recommendations to modify the design of the game.

"Downtown: An Economic-Environmental Simulation Game" was designed by Long (55) to demonstrate the conflict between the economic development of a community and its environmental quality. The game employs two types of currency, environmental quality units (E.Q.U's) and money. Using these two units, it is demonstrated throughout the game that there are no clear cut solutions to community planning problems. Groups with various interests work through the town council to have their plans implemented. Equations have been worked out to show the effects of certain decisions for both the economic-environmental and governmental parts of the game. Players use existing formulas and derive new ones to demonstrate the effects of certain events. For example, economic interests and environmental interests work out the implications of changing a small park

area into a parking lot. Each group then presents its data to the town council for zoning decisions. Although Long does not present an evaluation of the game, the degree of complexity would involve a good deal of preparation and a long involved play. The use of two types of currency, money and E.Q.U's., points out the problems faced by the economic, environmental and governmental sectors of the real community.

Two ecological games which have some bearing on the problems being investigated are "Wildlife" designed by Meier et al (58) and "The Moose-Beaver-Wolf-Environment System of Isle Royale" by Meier and Doyle (59). "Wildlife" demonstrates the population dynamics of a hypothetical organism in a new environment. The value of this game is in showing how ecological principles are applied to demonstrate the interactions that could possibly occur between an organism and its environment. "The Moose-Beaver-Wolf-Environment System of Isle Royale" does much the same thing as "Wildlife" except that it demonstrates the use of real data; namely, the actual interactions that occur on Isle Royale.

The several studies discussed above are samples of ways simulation gaming has been applied to demonstrate the planning process and the application of ecological principles. Each has an unique offering: Duke (32) emphasized the decision making process, Godschalk (42) attempted to involve lay people in the planning process, Long (55) showed the effective use of two measures of currency and Meier (58,59) in both studies demonstrated how ecological principles can be gamed.

GAME DESIGN PROCEDURES

Boocock and Schild (10) point out in their book that designing a game is partly an "artistic undertaking". The implication is that there is no clear cut method which can be rigidly adhered to which will produce as an end product a successful game. However, most of the general references, such as Tansey and Unwin (79), Boocock and Schild (10), Raser (65), Abt (1) and Gordon (43), have presented a general method which provides at least a starting point for game design. Since the major focus of this study is to design a game, a by-product anticipated is the embellishment of each of the steps listed below for designing a rural land use simulation game. Glazier (41) presents the "Ten Steps of Game Design" as formulated by Dr. Clark C. Abt; they are:

1. Define the overall objectives.
2. Determine scope:
   -duration
   -geographic area
   -issues.
3. Identify key participants or actors--individuals or groups.
4. Determine the objectives of each actor.
5. Determine the resources of actors:
   -physical
   -social
   -economic

-political

-information.

6. Determine the interaction sequence among actors.
7. Determine the decision rules or criteria on the basis of which actors decide what resources and information to transmit or receive and what actions to take.
8. Identify external constraints on actions of the actors.
9. Formulate scoring rules or win criteria on the basis of the degree to which actors or teams of actors achieve their objectives with efficient utilization of resources.
10. Choose the form of presentation and manipulation and sequence of operations:

-board game

-role play

-paper/pencil exercise

-computer simulation.

The ten steps listed in Glazier, although different in minor details, exhibit much in common with procedures presented by other game designers.

Twelker (83), assuming a somewhat more generalized approach, puts emphasis on deciding the suitability of the simulation game process for what is to be taught, careful specification of behavioral objectives so as to set up measurable criteria, and the development of an intensive validation system.

The justification for using the technique before beginning and the validation of the design are important stages in the process of simulation game design.

SUMMARY

Simulation gaming as an educational technique, although having ancient origins, has only come into common usage in the formal educational system in recent years. Many claims have been made in support of gaming as an educational technique but most are subjective and are not supported by research. One notable exception is the characteristics of the interest created by games and the motivation to pursue a learning task. The studies of Cherryholmes (19), Moore (61), and Robinson (68) cited previously support this characteristic of gaming. It is also noted that the negative aspects of gaming fail to find objective support.

Three studies showed that the role of the external advisor or educational agent is an extremely sensitive one. Zaltman (88), McKenney and Dill (57), and Baldwin (3) all concluded that the educational agent must be cautious about his entry into game play because of possible detrimental effects to learning. Baldwin (3) and Simon (72) pursued the whole area of game presentation and found a need to alter game parameters, be careful of game labels, and attend to details to ensure that the intended learning was occurring.

Educational games are usually simulation games; that is, they simulate some aspect of reality. Smoker (73) and Boocock

(11) carried out research studies to verify the reality of the simulation part of the game. This is an important part of designing any simulation game since if the simulation is not accurate it can produce the wrong learning outcomes.

Throughout the literature authors make frequent reference to the difficulty of measuring the learning which takes place as the result of a gaming experience. The suggestion is that all of what a game teaches cannot be measured be verbal means alone. Robinson (68) made some behavioral observations of a group of people participating in a simulation game and found the test results and the behavioral measures were very discrepant. The behavioral measures indicated that more learning had occurred than did the verbal measurements.

Several studies of simulation games involving land use and ecological concepts were examined. "Metropolis", "Negotiate", and "Downtown" were three urban land use games which presented three useful approaches to land use problems in the city. Duke's (32) game "Metropolis" designed for professional planners brought development patterns and social issues into play. "Negotiate" designed by Godschalk (42) emphasized the participation of the citzenry in urban land use planning. The conflict between the environment and the urban economy was the focus of Long's (55) game "Downtown". Meier's (58,59) game "Wildlife" and the real simulation on Isle Royale shows how ecological principles can be gamed.

Game designing is discussed by many authors but all admit that it is a complex undertaking requiring the development

of a procedure for specific situations. Glazier (41) presented the ten steps for designing educational games which was the guideline for the game designed in this study. These ten steps were not rigidly adhered to and the next chapter will present the procedure of design as it was modified for this study.

Chapter 3

DESIGNING THE EAST KOOTENAY LAND USE SIMULATION GAME

The process of designing a simulation game is not simple. As pointed out previously there is no one clearly defined procedure that guarantees the production of an effective learning device. Designing involves identifying the component parts of the problem to be gamed and then putting them together in a format that can be manipulated by the game participants.

The first step in designing the land use planning game involved identifying sources of information. The principal source of information was a number of studies carried out by the Canada Land Inventory in the East Kootenay. The next steps in setting up the simulation were to decide on what was to be gamed and how it was to be presented. The resources of the players then had to be identified, both the tangible resources to be used in the game and resources in the form of information.

The final stage in the design process was to put the various component parts together into a playable game. For this purpose two trial versions emerged and both were modified until a third version was developed. Although the third version was used for data collection and is called the final version, there is no doubt that more modifications to this "final version" would be required to maximize its effectiveness.

DESIGN PROCEDURE

The procedure used in designing this game resembles the procedure outlined by Glazier (41). The steps that were followed included:

1. Identification of sources of real data for use in designing the simulation part of the game.
2. Deciding on the scope of the game in terms of its goals, geographic area, time span, and issues to be presented.
3. Deciding how the simulation would be presented (game format).
4. Setting out what resources the players would have available.
5. Determining the game and player objectives.
6. Setting up a preliminary game and playing it.
7. Modifying the first game.
8. Setting up a second game based on the modifications of the first and playing it.
9. Modifying the second game.
10. Setting up a final version to be used in the East Kootenay.
11. Playing the game and collecting data on its effectiveness.

SOURCES OF DATA

The chief reason for choosing the East Kootenay area of British Columbia for this study was that the land capability analysis had been recently completed for this region by the Canada Land Inventory. This meant that a considerable volume of information was available on land use and the people of the area. Therefore, before beginning to design the game the sources of information available as a result of the land capability analysis were identified.

Collecting this information began with a discussion with various members of the Canada Land Inventory staff in Victoria, British Columbia who identified sources of background information on the Canada Land Inventory (78)(31)(29)(63)(30) and land use in the East Kootenay (44)(16)(13)(14). They also provided a great deal of information from their own experiences in the East Kootenay and provided the names of two people working in the East Kootenay who might have more insights into the problems of land use in that area, the Regional Planning Director (60) and the Regional Wildlife Biologist (28). Those people were contacted and provided valuable information which aided in the design.

The information indicated that the game should be built upon the land use capability analysis map which was available for the East Kootenay area. It was determined that land use for forestry, wildlife and agriculture presented some conflict in this region. Further, it was suggested that landowners were

not very knowledgeable as to the consequences of certain land use procedures. Landowners for the most part felt that they should be able to do whatever they wanted with their own land and what they did on their land only affected them.

GOAL

The goal of the game was to develop the participants' knowledge of and attitudes towards land use planning. The method to be employed to achieve this goal was to have players plan simulated pieces of land and experience the consequences of their land use decisions.

SCOPE

Both the land being simulated and the players who would participate in the game would be restricted to the geographic area represented by the East Kootenay Area Land Capability Analysis map prepared by the Canada Land Inventory (16). Further, the game would try to simulate a five year time span so that players would see the effects of land use planning decisions over a long period of time.

The issues to be represented in the game would be restricted to the interplay between land use for forestry, agriculture and wildlife to the exclusion of recreational, mining, and other land uses.

GAME FORMAT

Simulation game formats which initially seemed applicable were a board game, a game with some role play,

or a paper and pencil exercise. It was decided that a board game offered the best format as it would have recorded on the board the moves of each player, it would have player involvement in manipulating pieces and it would provide a less abstract presentation than a paper and pencil exercise. Role play would be part of the game but restricted to the role of a landowner of a simulated piece of land.

The first attempt at a format involved designing a game which used the participants' own land as the game board. A map of each participants' land could be drawn and players would then plan the uses of various parts of the land. This approach would probably produce a game which would be extremely meaningful to the players, but presented many difficult design problems. Firstly, there was the problem of how to construct a game which would be general enough to accommodate all types of property. Secondly, there would be so many variables involved that even if all were known it would be extremely difficult to fit them into a single game. Finally, deciding on the success or failure of the game as an instructional device would involve judging the effectiveness of individual gaming sessions since games with completely different properties would be different games. This individualized format was thus dismissed as desirable but overly difficult to achieve.

A second attempt at a specific format examined the possibility of using the whole East Kootenay Land Capability Analysis map as a game board. This exercise would involve planning large pieces of the East Kootenay area by the par-

ticipants, but a board to represent this area on a scale which could be easily worked with would be quite large. In addition, it would be an unrealistic task for a person living on a specific piece of land to apply his experience to the whole East Kootenay area. Therefore, it was decided that this approach would produce a game which would be too general.

The approach that was finally adopted was to select a small piece of the land capability analysis map and enlarge it. The area selected included all of the land capability classifications for agriculture, big game, forestry, waterfowl and native range. A two square mile section was chosen which met those requirements and was enlarged to form a two foot square game board (Figure 1). The game board was then divided into nine properties ranging in size from 550 to 1300 acres. Each property consisted of a number of land capabilities, at least one of which was a wildlife classification of big game or waterfowl.

PLAYER RESOURCES

Player resources consisted of physical resources such as money, land and agricultural produce and informational resources which were found in the land deed, consequence cards and risk cards. The land capabilities represented on all properties were sufficient to support numerous wild and domestic plant and animal species. For the sake of simplicity and managability the number of different plants and animals that could be represented on the game board was limited to five

Figure 1

Game Board

including cattle, field crops, big game, waterfowl and forests. Each resource was represented on the game board as a colored tile--brown for cattle, pink for field crops, orange for big game, blue for waterfowl and green for forests (Figure 2). The single ceramic tiles represented one unit of unspecified size and the double tiles represented ten units.

Money was also a player resource. During the play of the game participants would attempt to maximize the moneys they started with by wise land use planning. A bank was set up for the game with play money in denominations of $5, $10, $20, $50, $100, $500, $1000 and $5000.

Each property had a deed (Appendix C) and players were able to obtain information about their holding from their deed. Information on the value of a piece of land as well as the numbers of cattle, field crops, waterfowl, big game and forests that could be put on the land was on the deed.

Additional information on the planning of a piece of land was contained on Consequence Cards. Players drew a card each time they made some change to the land by removing or adding units of animals or plants. Players were to learn from the cards how different land use decisions affected their own land and the land of their neighbours. This was to show that changes in the land can have affects on land that are not predictable and to allow all players to note these consequences for future land use decisions. Another set of cards was used when a player over-populated an area with either native or domesticated plants or animals. These cards were called Risk

Figure 2

Game Board Set-up for Play

Cards. Their purpose was exactly the same as for the consequence cards; to show players the results of over-populating and to provide information for future planning.

GAME AND PLAYER OBJECTIVES

Once the format had been set out the next step was to formulate the game and player objectives. The objective was to maximize the economic returns from a piece of land and minimize the environmental disruption. The economic returns to a landowner were the result of selling plant or animal farm produce, logging and selling forests and allowing the hunting of wild animals. Improper management of the land resulted in environmental disruption such as floods, disease or famine. Players would thus have to consider both the environmental and economic effects of their land use decisions.

PRELIMINARY VERSION

This stage involved specifying the details of play which would be compatible with the format chosen, the resources available, and the player and game objectives. A playable game was formulated so that it could then be modified and fitted to the pre-determined criteria listed above and the six instructional objectives noted previously.

Number of Players

The number of players was limited by the number of properties represented on the game board. The maximum number

that could be accommodated was nine individuals or nine teams of players. Two players or teams of players would be the minimum number who could play and have the appropriate interactions occur.

Setting Up the Game Board

At the beginning of the game all properties represented on the game board would be in their natural state. The land would be forested and have wild animals present but no domesticated species would be on the game board at this stage. Game participants set out the appropriate tiles on their piece of land to make it represent its pre-agriculture condition.

Deeds provided information on how many plants and animals were on the land capability classifications of a piece of land. The number of native plants or animals was indicated by red numbers on the deed. Calculation of the ability of the land to hold specific numbers of plant and animal species involved deciding on the number that could be sustained on 50 acres based on the rationale that the higher classifications could support more than the lower classifications. The choice of 50 acres was arbitrary and the actual size of a unit was left unspecified. The calculations were based on the figures shown in Table 1. By leaving the size of the units unspecified, it was unnecessary to work out precise details on the carrying capacity of the land.

Table 1

Carrying Capacity per 50 Acres of the 11 Land Capability Classifications

Land Capability	Carrying Capacity/50 acres of Land: Forest Units/50 Acres	Big Game Units/50 Acres	Waterfowl Units/50 Acres
High Capability Agriculture	1	--	--
Moderate Capability Agriculture	1	--	--
Limited Capability Agriculture	1	--	--
High Capability Forestry	16	--	--
Moderate Capability Forestry	8	--	--
Limited Capability Forestry	4	--	--
High Capability Big Game	--	8	--
Moderate Capability Big Game	--	4	--
High Capability Waterfowl	--	--	16
Moderate Capability Waterfowl	--	--	8
Native Range	--	8	--

After the land was set up in its natural state the deeds were set out on each piece of property (Figure 2).

Seasons

Winter

The play was to take in one full year and each round of play involved a season of the year beginning with winter. To

decide who would initiate game play a pair of dice was rolled and the person with the highest score started play. The play then proceeded in a clockwise direction.

The beginning player chose a piece of property and paid the purchase price indicated on the deed. Each player thus chose a piece of land and was re-seated as near as possible to his land. Players were then given the deed to their land and $5000 in play money from which they paid the purchase price for the land.

The first move to start the game was by the person acting as banker spinning a pointer to decide on seasonal weather effects. The spinner could land on one of five options; unusually wet flooding decreases all plant populations by ten units, unusually warm weather increases big game and waterfowl by five units, drier than normal so animal and plant populations decrease by five units, conditions excellent for plant populations therefore plants increase by five units, and normal or no change. All players were to carry out the instructions indicated by the pointer. Unpurchased land was also affected by the chance effects of weather.

The player then had to decide what natural populations would be removed to prepare his land for farming. Removal was signified by turning over the colored tiles representing the plant or animal to be removed. The results of removal included acquiring some money from the bank for the sale of the native plants and animals, diminishing environmental units, and drawing a card to find out the consequences of what he had done.

The amount of money received was decided by rolling two colored dice. If the red die was highest the value of each unit sold was doubled, if the white one was high it was halved, and if doubles were rolled there was no change. The values received by the removal of populations are shown in Table 2.

Table 2

Economic and Environmental Unit Values

Animals and Plants	Economic Values	Environmental Values
Forest	$25	25 Environmental Units
Big Game	$25	50 Environmental Units
Waterfowl	$25	50 Environmental Units
Cattle	$50	0 Environmental Units
Field Crops	$25	0 Environmental Units

Every piece of property initially had 2000 environmental units. Therefore, the decrease in environmental units was the number of each species removed times its environmental units subtracted from the total environmental value for that piece of property.

A consequence card was drawn and read out to the whole group. Any changes in natural populations resulted in a further decrease in environmental units. The content of each consequence card was labelled increase or decrease; the one that applied depended on whether the population had been

increased or decreased. As with the spinner, consequence cards influenced unpurchased lands as well as the land held by the players.

Spring

After each player had made the appropriate moves for winter, the weather spinner was spun and all players carried out the appropriate instructions. The players then decided on the domesticated animals and plants to put on their land. The number to be placed on a particular piece of land was controlled by a table of exchange values on each deed (Table 3). The values are read horizontally for each capability so that for the removal of one species it can be determined how many of another species can replace it.

All units that were put on the game board in exchange for previously removed plants or animals were paid for at the bank. The player rolled dice to determine the cost to him (red die high--twice the value, white die high--one half the value, a pair--no change). The dice were rolled to determine any natural increase in wild animal populations. A high red die indicated an increase by two units and a low white or doubles resulted in no change.

Since domesticated plant and animal species had no environmental value (Table 2) there was no change to environmental unit scores, but any natural increase of wild species resulted in an appropriate increase in the environmental score.

Table 3

Exchange Units for Replacement of a Unit of a Particular Plant or Animal Species with Another

Capability	Exchange Units: Cattle per 50 Acres	Field Crops per 50 Acres	Forest per 50 Acres	Big Game per 50 Acres	Waterfowl per 50 Acres
High Agriculture	8	6	1	4	0
Moderate Agriculture	4	8	1	2	0
Limited Agriculture	2	4	1	1	0
High Forestry	2	2	16	1	0
Moderate Forestry	2	2	8	1	0
Limited Forestry	2	2	4	1	0
High Big Game	8	0	1	8	0
Moderate Big Game	4	0	1	4	0
High Waterfowl	0	0	0	0	16
Moderate Waterfowl	0	0	0	0	8
Native Range	8	8	0	8	0

Consequence cards were drawn, the contents read aloud, and the indicated changes were made before play proceeded to the next person. If any populations were above the limits shown on the deed a risk card was drawn.

Summer

To determine the success or failure of field crops the two colored dice were rolled. If the red die was high two more field crops were added to the land of those players who already had field crops, if white was high field crops decreased by two, and if doubles were rolled there was no change.

The next step was to buy back wild populations to replace those removed by harvesting or the moves of other players. At this point players could regain environmental units that were lost previously.

The purchase of wild species involved rolling the dice to determine the value (red high--twice the value, white high--one half the value, doubles--no change in value shown on Table 2). Environmental units regained by purchase were added to the score as indicated in Table 2. Consequence cards and risk cards were drawn as necessary.

Fall

As with the other seasons, fall began with spinning the weather spinner and making the changes indicated. All field crops and one half of all remaining cattle, big game and waterfowl were then sold, with their removal indicated by turning over the units sold. Sale price was determined by

rolling the two colored dice as before. All cattle that were kept had to be provided winter feed at $20 per unit paid to the bank.

Environmental units were totalled having subtracted some if waterfowl and big game were sold. Consequence and risk cards were drawn as necessary and their effects read out.

Fall ended the first year of play. Play then resumed with winter of the second year and the seasons were repeated. The only change in the second and subsequent rounds was that to buy back any cattle or field crops that were previously sold required only a payment to the bank and turning over the tiles already on the board without need to consult the exchange value table.

At the beginning of the second and subsequent winters players could purchase additional pieces of property if they were available.

Play continued for five full years or 20 seasons.

Win and Scoring Criteria

The final score consisted of the total amount of money a player had on the final fall season of play added to the total environmental units. This score was called the total score.

To win the game a person must have had the highest total score and have maintained the environmental units at or above 1000 points.

MODIFICATIONS TO THE PRELIMINARY GAME

Playing this game with two people showed up a number of flaws in the design, the most crucial of which was the time it took to play the game. One full year on three separate playing sessions with two people took 150, 165, 155 minutes.

The first modifications suggested were those that would shorten the playing time. The following modifications were carried out:

Winter:

The weather spinner was removed from subsequent play and weather considerations were incorporated into the consequence cards. Rolling the dice was omitted from play in deciding on moneys received from the sale of wild populations and a table of values including a purchase and a sale price was substituted (Table 4).

Spring:

As with winter the weather spinner and all dice rolling was removed.

Summer:

The same changes as spring.

Fall:

The same changes as summer. In addition, all cattle had to be sold whereas wild species were not to be sold.

One other major modification resulted because of the difficulties involved in accumulating money in the game. The economic values were therefore revised as shown in Table 4.

Table 4

Revised Table of Economic and Environmental Values

Animals and Plants	Economic Values Purchase Price	Sale Price	Environmental Values
Forest	$25	$50	25 Environmental Units
Big Game	$40	$50	25 Environmental Units
Waterfowl	$40	$50	25 Environmental Units
Cattle	$50	$100	0 Environmental Units
Field Crop	$10	$25	0 Environmental Units

PILOT STUDY VERSION

The pilot study was carried out with 23 students at the University of British Columbia. Four groups played the game with a mean size of 5.8 persons per group.

After each group played the game, suggestions for improvement were noted by observers and players. Modifications were applied to the subsequent playing sessions to see if the problems noted could be overcome.

Session Number 1 (6 players)

1. The explanation of how to read the deed could be facilitated by having one of the deeds duplicated so that each player could look at the same deed during the explanation. The deed for property number 5 was duplicated for this purpose (see Appendix C).

2. Money less the price of a piece of property and the numbers of forest units, waterfowl units and big game units on the undisturbed property could be counted out in advance to speed up play. This was done with money and tiles being placed in separate envelopes for each property.
3. The person running the game had to supply continuous verbal directions of what to do in each season. Cards showing the sequence of events for each season were supplied.
4. Some consequence cards required rewriting to clarify their meaning.

Session Number 2 (4 players)

Playing time took three hours for two full years. Most of the time was spent trying to manage more than one piece of property. Therefore, players on subsequent games were restricted to owning only one piece of property.

Session Number 3 (4 players)

Consequence cards were reduced to four per resource category including two consequences for increase and two for decrease (see Appendix D). This was done so that players could learn the consequences more easily. Risk cards were also modified and reduced to five. The contents of the consequence and risk cards were listed in Appendixes D and E.

Session Number 4 (8 players)

Setting up unpurchased land with all the tiles representing trees, big game and waterfowl was unnecessary since only one property could be purchased. Some rewards on the consequence cards were too generous and were reduced.

FINAL VERSION

A set of instructions was developed and used for introducing people to the game. These instructions are outlined briefly here.

1. The purpose of the game was described as providing participants with experience in planning a piece of land and seeing how changes affected their own and neighbouring lands.
2. An East Kootenay Area Land Use Capability map was shown to the game participants and it was explained that the various colors indicated potential land uses. The relationship between the game board and the Land Use Capability map was explained and the piece of the map represented on the board was identified.
3. Each of the colors on the game board was related to the land use capability it represented. The red boundary lines for individual properties were explained.
4. The five different colors of tiles were explained as to the resource that they represented (brown--cattle, blue--waterfowl, orange--big game, green--

forests, pink--field crops). Units of ten were shown as double tiles ($\frac{1}{2}$ inch by 1 inch).

5. The table of values on the game board was pointed out and the differences between purchase price, sale price and environmental units were explained.
6. The deed for property number 5 was explained. The information on the deed included; purchase price, environmental value, size of property, exchange values and carrying capacities. The use of the deed was demonstrated by setting out property number 5 and showing how the exchange units were used.
7. The money score and the environmental units score were described. Players were shown how the total score was arrived at and that environmental units must be maintained at 1000 or more units. The use of the score sheet (Appendix F) was explained.
8. A brief explanation as to how the consequence and risk cards were used in the play was given.
9. The rules and sequence of play cards were quickly read over by all participants and explained (see Appendix G).

Chapter 4

ANALYSIS OF THE RESULTS OF PLAYING THE SIMULATION GAME

As described in the first chapter the data collection consists of pre and post-test scores for knowledge and land use attitudes, a game attitude score, and the answers to four personal data questions. In addition game scores for money, environmental units and total score (sum of money and environmental unit score) were recorded for each participant.

The analysis of results focused on examining the characteristics of the game and its effectiveness in achieving the instructional objectives listed previously. Participant characteristics were related to other variables of game play. Some subjective data were collected and presented to aid in detecting areas of the game requiring modification. Player reactions to various parts of the gaming emerged and it appears that a number of major game modifications may therefore be necessary.

Statistical tests carried out on the pre-test and post-test data were used to determine the effectiveness of the game in terms of whether or not changes in attitudes or knowledge occurred. The results indicate that only three of eight variables showed any significant change at the .10 level of significance. Knowledge and attitude test results were examined

to find the interplay between test results and player and game characteristics with the purpose of determining differential effects of the game on different types of participants. The relationships among the test results themselves were examined to determine the characteristics of the tests used.

CHARACTERISTICS OF GAME PARTICIPANTS

The game was played with nine family groups comprising a total of 40 people. Seventy-eight percent or seven of the games were played with groups of four or five participants. Group size ranged from three to seven and the mean size was 4.7 persons.

The total number of participants in the sample was divided into 19 or 47.5 percent males and 21 or 52.5 percent females (Table 5). The largest category in terms of family position was children who accounted for 45 percent of the sample. Although data were not collected on age, all of the children were over 12 years of age and some were married adults living on their parent's landholding. There were seven female (17.5 percent) and seven male household heads (17.5 percent) represented. Eight participants were classified as "others", and this represented 20 percent of the total sample. That category consisted principally of people from neighbouring ranchs and farm hands.

Because of the minimum of 50 acres of property required for eligibility to play the game, most of the participants lived on farms. The data showed that 33 or 82.5 percent of

the participants lived on farms whereas only 17.5 percent did not live on land that was farmed (Table 5).

Twenty-four landholdings (60 percent) were under 500 acres in size, nine (22.5 percent) were between 500 and 949 acres and seven (17.5 percent) were in excess of 950 acres (Table 5). The mean property size was 537.1 acres.

The educational level of the participants as measured by their total number of years of schooling produced a mean of 10.7 years for the 40 participants. The modal group consisted of people with 9 to 12 years of schooling which included 47.5 percent of the participants. The category of 0 to 8 years of schooling included 27.5 percent and the remaining 25 percent were in the 13 years and more category. The lowest number of years of schooling in the group was five years and the highest was 19 years (Table 5).

PLAY OF THE GAME

Playing Time

Playing time included the time taken to provide pre-game instructions plus the actual playing time. The mean time for game play was 137.5 minutes and the range was from 110 to 180 minutes. Three categories were used to describe the playing time; in the shortest time period of 110 to 125 minutes were 21 participants (52.5 percent), in the next 126 to 140 minutes were eight participants (20 percent), and in the longest time category 141 or more minutes were 11 people (27.5 percent).

Table 5

Summary of Player Characteristics

Characteristics	Number of Persons	Percentage of Sample
Sex		
Male	19	47.5%
Female	21	52.5%
Family Position		
Husband	7	17.5%
Wife	7	17.5%
Child	18	45.0%
Other	8	20.0%
Farm Resident	33	82.5%
Non-Farm Resident	7	17.5%
Years of Schooling		
0 - 8 years	11	27.5%
9 -12 years	19	47.5%
13 + years	10	25.0%
Property Size		
50 - 499 acres	24	60.0%
500 - 949 acres	9	22.5%
950 + acres	7	17.5%

Playing time correlated significantly and negatively with property size ($r = -.56$) (Appendix G). This indicates that the owners of larger properties took less time to play the game than did the owners of smaller properties. All players with 500 or more acres were in the shortest playing time period whereas only 21 percent of the players with less than 500 acres fell in the shortest time period.

Table 6

Distribution of Game Participants by Property Size and Playing Time

Property Size (Acres)	Game Playing Time (Minutes) 110 - 125		126+		Total	
	No.	Percentage	No.	Percentage	No.	Percentage
50 - 499	5	21%	19	79%	24	100%
500 *	16	100%	0	0%	16	100%
Total	21		19		40	

$x^2 = 24.13$, $df = 1$, $p < .01$

The number of players in a game would seem to be related directly to the playing time as a significant positive correlation of $r = .77$ was computed for number of players versus playing time. Table 7 shows that 16 of the 21 players (76 percent) in the shortest time category were also in the category of fewest players and only five (24 percent) were in the largest (5 to 7) player category.

Game playing time also showed a significant positive correlation with the amount of money earned by the participant

at the end of a gaming session (r=.31). Increase in playing time resulted in more money being earned by game participants.

Table 7

Frequency Table of Number of Players and Game Playing Time

Number of Players	Game Playing Time (Minutes) 110 - 125 No.	Percentage	126 + No.	Percentage	Total No.	Percentage
0 - 4	16	76%	3	24%	19	100%
5 - 7	5	24%	16	76%	21	100%
Total	21		19		40	

$x^2 = 14.59$, $df = 1$, $p < .01$

Game Scores

The scoring as described previously consisted of three individual scores. The total score was a composite of the money score and the environmental unit score. Since money was more plentiful than environmental units it was the largest contributor to the total score. The mean total score for the 40 players was 7291 points. This score demonstrated a considerable amount of variability as would be expected and the standard deviation was 2293. The mean money score was $5646 with a standard deviation of 2274. This mean score represents what would seem to be an excessively large amount of money, but since all participants began with $5000 out of which they paid from $1100 to $2600 for their land.

Participants began with 2000 environmental units (E.U.'s). Managing a piece of land requires some disruption to the environment, and since players had to maintain their E.U.'s above 1000, a mean score of 1643 did not seem unreasonable. The variability as indicated by the standard deviation was 538 points.

Game Scores in Relation to Player Characteristics

Total score showed a significant positive correlation ($r=.47$) with the number of years of schooling. This indicates that the more education a person has the higher the score he was able to achieve on the game. The bivariate frequency distribution for these two variables produced a significant chi-square at the .05 level (see Table 8). Table 8 shows that 20 percent of those with 0 to 8 years of schooling were in the highest total score category, whereas 45 percent of those in that category had 13 or more years of schooling. The lowest total score category, however, contained only one person with 13 or more years of education while 35 percent had 0 to 8 years. These figures suggest that the game needs to be adjusted to accommodate the lower educational levels and particularly those in the 9 to 12 year category who represent the mean educational level for the population.

Total score correlated with the money score with a positive significant correlation ($r=.97$). There was also a significant negative correlation ($r=-.63$) between the total score and rank within the playing group. This was expected

Table 8

Frequency Table of Years of Schooling and Total Score

Years of Schooling	Above Median Frequency	Above Median Percentage	Below Median Frequency	Below Median Percentage	Total
0-8 years	4	20%	7	35%	11
9-12 years	7	35%	12	60%	19
13+ years	9	45%	1	5%	10
Total	20	100%	20	100%	40

$x^2 = 8.62$, d.f. = 2, $p < .05$

since the total score determined the rank; the person with the highest score in the group ranked first while the person with the lowest ranked last.

Money scores demonstrated almost the same relationships with the variables as did the total scores. There was a significant negative correlation between money score and rank within the playing group ($r=-.55$) and a significant positive correlation between money score and the number of years of schooling ($r=.46$).

Unlike the money scores and total scores no significant correlations were found between environmental units (E.U.'s) and either money or total scores. There was a significant negative correlation between E.U. score and the rank within the group ($r=-.35$). This indicates that the higher a person ranked within a group the higher was his E.U. score.

Although the correlations and the bivariate frequency distributions were not significant for family position versus any of the previously mentioned scores there is a trend exhibited in the correlation matrix. All of the correlations for these three variables (money score, environmental unit score and total score) were negative and the smallest one ($r=-.23$) is within .08 of being significant which indicates a tendency towards higher scores being related to the family positions categorized on the lower end of the scale with one for husband, two for wife, three for child, four for relative and five for other. One area which reflects total score is rank within the playing group and this does correlate

significantly ($r = .37$) and positively with family position. This means there appears to be a positive relationship between those achieving first place and husbands who rank first on the family position scale and so on down the list. This tends to support the previously mentioned trend indicated between scores and family position.

Subjective Observations on Game Play

The comments recorded immediately after game play revealed some useful information for future modifications of the game. In all playing sessions it was noted that many of the Consequence Cards were too generous. Players were receiving so many free cattle as a result of consequences of their own and their neighbours' land usage that it became unnecessary for them to buy any. Players were reluctant to spend money and except for a few individuals invested very little in the play and were left with larger sums of money then would seem realistic. This would seem to necessitate the use of more monetary constraints such as land taxes and income taxes in the game play.

Family members tended to co-operate and advise one another rather than compete. The elder players often described to younger players examples of how they dealt with particular problems developing in the game on their own land. Thus, the game appeared to stimulate additional benefits other than those that were intentionally designed.

Another modification required was in terms of the ease with which players were able to regain environmental units. Often those who succeeded to rank first in the game had depleted their environmental unit scores to a negative value in the first year of the game.

One comment recorded on four of the nine game sessions was that families took the attitude "it's just a game" and did not serously consider its application to real problems on their own land. This appears to be due to a prevailing attitude about games but in part may be attributable to the amount of chance which determined success or failure in the land use simulation game. One indirect method of reducing chance would be to extend the number of rounds of play because it appeared that near the end of the last round and in discussions after the game players were beginning to perceive game strategies.

Game Attitude

The attitudes of the participants toward the game were measured by a five statement Likert scale (Appendix B) which had a maximum score of 25 points and a minimum score of five. The mean for the group was 19.4 with a standard deviation of 2.4. This indicates that most people were satisfied with the game and that there was little variability demonstrated in the set of scores.

None of the correlation coefficients or bivariate distributions showed significant relationships between game attitude and other player or game play variables.

TEST RESULTS

Table 9 summarizes the results of the pre and post-test measurements. One feature in the mean scores that is worth commenting on is the low level of the mean scores on both knowledge tests. The means seem somewhat lower than would be expected and reflects either on the difficulty of the instrument used or the failure of the game to teach information about land use planning or a combination of both reasons.

Differences Between Pre-test and Post-test Results

A significant difference was observed between scores attained for instructional objective 2 at the .10 level. That objective stated that the learner will develop a more positive attitude towards considering the effects of his land use plans on neighbouring lands.

The t-test on the knowledge scores produced a significant result at the .10 level implying that some increase in knowledge occurred. Objective 5 which was part of the knowledge test produced a significant result at the .025 level. This objective stated that the learner will be able to describe the competitive relationships existing between forestry and field crops, waterfowl and field crops, cattle and field crops, cattle and waterfowl, cattle and big game, forestry and cattle and big game and forestry.

Non-significant t-test results occurred with respect to the attitude test total score and objectives 1, 3, 4 and 6. Thus, modifications to the game resulting from this study must

Table 9

Summary of Pre-test and Post-test Results

Tests	Test Scores: Maximum Score	Mean Pre-test Score	Mean Post-test Score	Change	T-value	Probability
Objective 1 Land Use Planning Attitude	40	25.70	26.00	0.30	0.53	$p > .10$
Objective 2 Attitude Towards Effects of Land Use on Neighbours	40	26.70	27.80	1.10	1.43	$p < .10$
Total Attitude Test Score	80	52.60	53.80	1.20	1.04	$p > .10$
Objective 3 Knowledge of Land Use Capabilities	5	2.25	2.40	0.15	0.58	$p > .10$
Objective 4 Economic, Ecological Interaction	5	3.13	3.15	0.02	0.10	$p > .10$
Objective 5 Competitive Relationships	5	1.73	2.28	0.56	2.04	$p < .025$
Objective 6 Good and Bad Land Use Strategies	5	2.25	2.28	0.03	0.09	$p > .10$
Total Knowledge Test Scores	20	9.13	10.18	1.05	1.56	$p < .10$

focus especially on improving learner performance in those areas.

Relationships Among Test Results

Of the nine possible correlations between attitude pre-test and post-test scores, seven were significant at the .01 level, one was significant at the .05 level and one was not significant. The consistency indicated between pre-test and post-test scores demonstrated that very little change in attitude occurred from pre-test to post-test. This was not entirely unexpected in that attitude change generally involves a longer period of time than existed between measurements in this study.

The knowledge a person had on entering the game seemed to show a direct positive relationship to the attitude measured by both the attitude pre-test and post-test. A significant positive correlation existed between knowledge pre-test and both attitude pre-test ($r=.37$) and post-test ($r=.36$).

Objective 2 on the post-test which states participants will develop a more positive attitude towards the effects of land use on neighbouring lands correlates significantly and positively with pre-test score for objective 4 ($r=.31$) which says learners will describe the interplay of economic and ecological factors in land use planning. This implies the more a participant knew about this economic and ecological interplay the more positive was his attitude towards the effects of land use on neighbouring land after playing the game.

Table 10 summarizes the numerous significant correlations between pre and post-test objective 6 scores and other test and game scores. Objective 6 states that the learner will be able to differentiate between good and poor land use strategies. There seem to be at least two possible explanations of the correlations that are shown for objective 6 either the other measures are measuring the same things as objective 6 or a knowledge of good and poor land uses affects the degree of achievement of the variables noted in Table 10. If objective 6 is a general measure for the other scores it correlates with it suggests an alteration of the instruments and possibly the game scoring is necessary. The correlation between pre-test and post-test objective 6 of $r=.52$ which is significant at the .01 level shows that participants enter the game with a knowledge of the difference between good and poor land uses and this tends not to change as a result of the playing of the game. Therefore if the game could be modified to increase the knowledge of good and poor land uses the scores on the significantly correlated variables would increase which is of special importance on the post-test scores since by raising these scores more learning would be achieved.

Player and Game Characteristics in Relation to Test Results

Post-test objective 1 which stated that the learner will develop a more favorable attitude towards the land use planning process showed a significant negative correlation ($r=-.37$) with property size so that owners with larger properties had less favorable attitudes towards land use planning

Table 10

Summary of the Correlation Coefficients Between Objective 6 and Other Test and Game Variables*

	Test and Game Scores										
Objective 6	Pre-test Attitude Score	Pre-test Score Objective 1	Pre-test Score Objective 2	Post-test Attitude Score	Post-test Objective 2 Score	Pre-test Knowledge Score	Post-test Knowledge Score	Post-test Objective 6 Score	Game Attitude Score	Money Score	Total Score
Pre-test Scores on Objective 6	.51	.32	.46	.43	.42	.57	.38	.52	.01	.35	.34
Post-test Scores on Objective 6	.56	.47	.38	.33	.38	.31	.65	1.00	.35	.31	.34

* ___ .05 level of significance ($r \geq .31$)

___ .01 level of significance ($r \geq .41$)

than those with smaller properties. Property size showed a significant negative correlation ($r = -.31$) with post-test attitude score. Thus landowners with larger properties tended to finish the game with a less positive attitude. Years of schooling correlated significantly ($r=.32$) with the post-test results of objective 6. This objective concerns the ability of the game players to differentiate between good and poor land uses. The players with more years of schooling were better able to distinguish between good and poor land uses.

The attitude post-test scores had a significant negative correlation with the total number of environmental units scored on the game ($r = -.32$). Fewer environmental units were thus acquired by people who had developed a more positive attitude toward land use planning.

Money score correlated significantly and positively with pre-test ($r=.34$) and post-test objective 6 ($r=.31$) and pre-test ($r=.42$) and post-test knowledge ($r=.36$) score totals and post-test objective 5 scores ($r=.31$). It appears that the money score and knowledge scores were closely related, thus, the more a person knew about land use planning on entering and on completion of the game, the higher was his money score. Since the money score was the largest contributor to total score, exactly the same correlations existed for total score.

Objective 5 on the pre-test, which is concerned with the competitive relationships, correlated positively with minutes of play ($r=.37$) showing that increased playing time should increase learning on objective 5. That objective also

had a significant positive correlation with the number of people in a group playing the game (r=.44) which indicates that the more people playing the game the better was the achievement on objective 5.

A significant positive correlation existed between objective 6 (good and poor land uses) on the post-test and attitude towards the game (r=.35). The better the attitude towards the game, the higher the score on this objective. The number of players correlated negatively with the knowledge of good and poor land uses, objective 6, on the post-test (r= -.33) so that fewer players led to better results on post-test objective 6.

The rank a person achieved within a playing group demonstrated a significant negative correlation with total score on the knowledge pre-test (r= -.32). The implications of this were that the more knowledge a person had on entering the game, the better the chances of success.

SUMMARY OF THE ANALYSIS OF RESULTS

The data analysis showed that a number of significant correlations existed between participant characteristics, game play data and attitude and knowledge test scores. Playing time correlated negatively with property size and positively with the number of players, money scores, score on pre-test objective 5. Property size correlated negatively with the post-test attitude score and score on objective 1 on the attitude towards land use planning. A positive correlation

was found between the number of people in the playing group and objective 5 on competitive relationships and post-test score on objective 6 on knowledge of good and poor land uses. The number of years of schooling correlated positively with the total score on the game and post-test scores on objective 6. Knowledge as measured on the pre-test correlated positively with pre and post-test attitude score and money score. Rank within a playing group and family position was related so that family heads and their spouses tended to win the game more frequently. Objective 6 had 20 significant correlations with other variables which indicated that perhaps a knowledge of good and poor land uses is an important consideration for future modifications of this game.

Statistical tests carried out on pre and post-test attitude and knowledge scores revealed that some learning had occurred. There was a significant increase in knowledge of land use planning with a notable increase in knowledge about competitive relationships among domestic and native populations. The only change in attitude noted was related to participants' attitude towards the effects of his land use plans on neighbouring lands which was shown to become slightly more positive.

The data analysis presents a great deal of material which will ultimately be useful in modifying the existing East Kootenay Land Use Simulation Game.

Chapter 5

SUMMARY, CONCLUSIONS AND IMPLICATIONS

The concluding chapter of this study emphasizes that the nature of this investigation has been that of a pilot study. Since the game used in the study was untried on the population selected many of the difficulties with the game and its administration were unforeseen. The results of the study will help in modifying the present game and carrying out studies of this nature with similar rural populations.

There seems little doubt that the technique has utility for adult environmental education; however, it is also evident that the development of gaming requires a substantial investment of time and energy. Whether or not this investment is justified is dependent on the techniques and devices available, instructional objectives and the target population being considered. With the population represented in this study, both their physical isolation from institutional forms of education and the evidence available on their participation in adult education programs makes it appear that the time and effort in developing an effective game for instructing people about land use would be worthwhile.

SUMMARY

The purposes of the study were three-fold; to examine the usefulness of simulation gaming for environmental education,

to design a land use simulation game and to analyze the effectiveness of the designed game. The rationale behind the purpose was that environmental matters are of major public concern and people need to be well informed about them. To provide the adult populace with the education requres that new techniques need to be examined and simulation gaming was chosen as a technique that has characteristics that suit it to adult environmental education.

The hypotheses which the study set out to investigate were two. The first was whether or not the game produced any significant change in the players knowledge or attitudes. This hypothesis included the six behavioral objectives the game was to achieve. The second hypothesis proposed that there would be relationships between player characteristics, game play and test results.

The procedure used in the study involved two separate parts. A procedure for designing the game had to be identified, which included finding a source of data from which to develop the simulation. The procedure outlined by Glazier (41) which involved ten steps was adopted. As a source of data the land capability analysis for the East Kootenay area of British Columbia which had been recently completed was used.

Once the game was designed a series of playing sessions followed to work out "bugs" that were still present in the game. The next step was to design the appropriate evaluation instruments. Finally the game was taken to the East Kootenay to be played by 40 residents of properties larger than 50 acres

living in School District number 2, Cranbrook, British Columbia.

The game was taken to the homes of nine families. A pre-test was administered before the game, the game was played and a post-test was completed.

The game was to be a board game using an enlarged two square mile section of a representative area on the map. Players were to have money and tiles to represent cattle, big game, forests, waterfowl and field crops as their planning resources.

The objective of the game is to maximize the economic returns while minimizing environmental destruction. Players had to increase their money and maintain their environmental units to compete with other players to win the game.

Two preliminary designs were tested and a final version of the game was produced. The final version involved players beginning the game by buying simulated pieces of property. A maximum of nine players or groups of players could participate and a minimum of two. Following this players went through a seasonal cycle. Play began with winter at which time land had to be cleared and prepared for domesticated crops and animals. Spring followed as a time for placing domesticated species on the board. Summer followed as the time for buying back wildlife. Fall ended the first year with selling off produce. The game continued another year and the player with the highest total score (money score plus environmental unit score) and who had kept the environmental unit score above 1000 won the game.

The player characteristics showed that of the 40, 47.5 percent were male, 52.5 percent female and 45 percent were children, 17.5 percent wives, 17.5 percent husbands and 20 percent were others. The mean educational level of the group was 10.7 years. Eighty-two and a half percent of the people resided on farms and the mean land size was 537.1 acres.

The play of the game took an average of 137.5 minutes. Correlations between property size and playing time were significant at $r = -.56$. The number of players correlated significantly and positively with playing time.

The three game scores total score, money score and environmental unit score had means of 7291 points, $5646 and 1643 points respectively. A significant positive correlation of $r = .47$ between the number of years of schooling and total score was present. Total score correlated ($r = .97$) with money score. Money scores showed exactly the same correlations as total score due to their inter-relationship in the scoring procedures.

Environmental unit scores showed no significant correlations with player characteristics.

The rank within a group correlated significantly and positively with family position.

The subjective data on game play indicated a number of areas for possible game modification. Consequence cards should be less generous in giving away free cattle and environmental units were too easily regained. A reduction of chance in the game would overcome some of the problems with the attitude expressed in "it's just a game".

The mean game attitude score was 19.4 out of a possible total of 25. This score did not correlate with any of the participant or game play variables.

The t-tests produced three significant results. The attitude towards the effects of land use on neighbouring lands was increased significantly at the .10 level by the game. Players increased their knowledge of competitive relationships significantly at the .025 level. An overall increase in knowledge was attained and deemed significant at the .10 level of significance.

Test results showed relationships among themselves. Eight of nine possible correlations between pre-test and post-test attitude scores were significant. Entering knowledge correlated significantly and positively with attitude. Objective 6 dealing with a player's knowledge of how to distinguish between good and poor land uses correlated significantly with six other test scores.

Knowledge and attitude correlated significantly and positively with the following player and game characteristics; years of schooling, money scores, total scores, playing time, number of players, attitude towards the game and rank within the playing group. Negative significant correlations were found between knowledge and attitude test scores and property size and environmental unit score.

CONCLUSIONS

The data collected has shown that some learning occurred among the participants after playing the East Kootenay Land Use Simulation Game. Although learning failed to be measurable in a number of areas under investigation it should be borne in mind that it was anticipated that much of the information gathered in this study would assist in modifying this version of the simulation game to improve its learning effectiveness.

Examination of the data revealed that the participants' knowledge of land use planning had increased and specifically their knowledge of the competitive relationships among wild and domesticated species had increased. It also was found that while there was little overall change in attitude a more positive attitude towards considering the effects of land use plans on neighbouring lands developed after the game was played.

Numerous relationships among participant characteristics, game play data and knowledge and attitude test scores were discerned. These relationships described many of the characteristics of this learning device which need to be examined to see if alteration can improve game effectiveness.

Participants with more years of schooling and who were family heads were the most successful game participants in terms of winning the game. It was determined that property size influenced the playing time of the game and the participants attitude towards land use planning. The larger the property the

shorter the playing time and the more negative the attitude towards land use planning.

Money scores and attitude were related to the knowledge a person already had about land use planning. The more a person knew about land use planning the more positive was his attitude towards it and the more likely was he to achieve a higher money score and thus game success.

Instructional objective 6 on the participants ability to differentiate between good and poor land uses was found to be an important variable as far as its correlation with other variables was concerned. The numerous correlations suggest that this objective played a prominent role in the learning that occurred and the success of game play.

The simulation game studied had limited success in terms of learning effectiveness as would be expected the device had not been previously field tested. The study did supply valuable data for use in making this simulation game into a more effective learning device.

IMPLICATIONS

The implications of this study are mainly concerned with what modifications should be made to the game which was designed in the study. Any modifications suggested of course requires further play of the game to find out if they enhance the play and effectiveness of the game.

Money scores, it is suggested, are too high. This requires the placing of some further monetary constraints on the

game which can be done in a number of ways. Less money could be given to players at the start of the game, the differential between purchase and sale price could be reduced, or external monetary constraints such as taxes or in consequence cards could be added to the game, to decrease the amount of money earned.

Correlations between game success and years of schooling would appear to indicate that the game requires some decrease in complexity to accommodate the lower educational levels. The way this could be done is not entirely clear, perhaps simplification of the vocabulary and less complex arithmetic operations.

The subjective data collected suggests consequence cards need to less liberally dispense free cattle, regaining environmental units is to easy, and the attitude "it's just a game" is a negative influence. Overcoming the problem with the consequence cards is quiet simple and requires only modifications of the rewards within the cards. However, making environmental units more difficult to regain poses a more difficult problem. Possible solutions are to have severe financial penalties for allowing environmental units to drop below a certain level or perhaps reduce value of the units when they are re-acquired. The only modification for the attitude "it's just a game" is to reduce chance events and provide logical explanations for any chance events that do occur.

The objective on discriminating good and poor land use strategies seems an important one. Perhaps more emphasis should be placed on this in the game. At the end of each annual cycle judgement could be passed on the land use strategies employed to that point.

Finally not related to modifications to this game the study has demonstrated that a land use planning game has potential as a device for use in adult environmental education. Although the potential is not fully realized in this game it is probably more due to the failure of the game design at this point in its development than the inability of this technique to produce the desired results. Simulation games generally have had a history of use with adults. Business games, war games and political games are commonly used in adult education. The reasons for their use with adults is probably related to the practicality adults demand of their learning experience. Games tend to demonstrate theoretical knowledge applied to real situations rather than talking about it in the abstract. Adults can use their vast store of practical knowledge and experience to solve problems presented by games and also have a chance to apply new knowledge at various stages of the game. Also not to be ignored is the informality of this approach which is of special benefit to those whose experiences with formal education has left them with a negative attitude to classroom--lecture type learning techniques. Finally games of the simple non-computerized form are easily taken into the home of the clientele, as was done in this study, thus overcoming a hurdle which often limits participation in adult education ventures.

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APPENDIX A- PRE-TEST INSTRUMENT

PART A - EAST KOOTENAY LAND USE SIMULATION GAME EVALUATION STUDY.

Group # ____
Person # ____
Card # 1

Instructions: Please check one of the five categories (from strongly agree to strongly disagree) for each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Landowners should be able to do what they wish with their land.	—	—	—	—	—
2. Land use planning is just common sense.	—	—	—	—	—
3. Our national parks should be preserved in their natural state with roads and buildings prohibited.	—	—	—	—	—
4. What I do with my own land is my own business.	—	—	—	—	—
5. Land users must attempt to minimize possible bad effects on neighbouring lands.	—	—	—	—	—
6. Farming operations should not have to change their plans to accommodate some wildlife population.	—	—	—	—	—
7. All landowners should have registered land use plans approved by a qualified land use planner.	—	—	—	—	—
8. Landowners with high capability land for agriculture should not sell their property for building developments.	—	—	—	—	—
9. Wildlife populations damaging cash crop or competing with cattle must be removed.	—	—	—	—	—
10. By planning land use it is possible to foresee environmental problems.	—	—	—	—	—
11. Individual landowners have no responsibilities toward wild animal populations.	—	—	—	—	—
12. When economic interests conflict with ecological interests the decision should be made in favor of economic gain.	—	—	—	—	—

PART A

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
13. I would be willing to sit down and work out a land use plan with a professional land use planner.	—	—	—	—	—
14. The land uses of one piece of land have no effect on neighbouring lands.	—	—	—	—	—
15. Building programs that disrupt the ecology should be abandoned and the land returned to its natural state.	—	—	—	—	—
16. Any land can be successfully farmed provided enough money and time is available to develop it.	—	—	—	—	—

PART B - EAST KOOTENAY LAND USE SIMULATION GAME EVALUATION STUDY

Group # ____
Person # ____
Card # 1

Instructions: Please select the BEST answer for each of the following questions.

1. Land capability refers to: ( )

   a) uses the land is being put to presently.
   b) what originally grew on undisturbed land.
   c) the land's natural ability to support native or domestic plants and animals.
   d) the land's potential for agricultural production.

2. Moderate capability big game land has: ( )

   a) only the ability to support big game.
   b) the ability to support big game and cattle.
   c) the ability to support big game, cattle, field crops and forests.
   d) the ability to support big game, cattle and forests.

3. High capability agricultural land can support: ( )

   a) more cattle than big game.
   b) as many cattle as big game.
   c) fewer cattle than big game.
   d) more big game than cattle.

4. High capability forestry land can support ( )

   a) waterfowl, cattle and forests.
   b) big game, and cattle.
   c) field crops, forests, cattle and big game.
   d) waterfowl, forests, field crops, big game and cattle.

5. Land capabilities are the result of: ( )

   a) natural conditions.
   b) man-made conditions.
   c) economic conditions.
   d) traditional uses.

6. The cost of maintenance of environmental quality: ( )

   a) is the responsibility of the landowner.
   b) is the responsibility of the government.
   c) both.
   d) neither.

7. Increasing environmental quality often: ( )

a) increases profits.
b) decreases profits.
c) does not affect profits.

8. The economic gain and environmental quality are: ( )

a) frequently in conflict.
b) never in conflict.
c) only occasionally in conflict.

9. Big game and waterfowl populations have: ( )

a) no economic value.
b) great economic value.
c) some economic value.

10. Maintaining a high degree of environmental quality: ( )

a) costs landowners a lot of money.
b) costs the landowner nothing.
c) slightly increases the landowner's costs.

11. Forest removal can result in: ( )

a) increase in big game animals.
b) decrease in big game animals.
c) better soil conditions.
d) fewer cattle.

12. Big game and cattle compete for: ( )

a) sources of water.
b) the same food supply.
c) none of the above.

13. Increase in cattle can cause: ( )

a) decrease in waterfowl.
b) increase in forests.
c) decrease in forests.
d) increase in field crops.

14. Decrease in field crops can cause: ( )

a) increase in cattle.
b) decrease in forests.
c) decrease in waterfowl.
d) increase in big game.

PART B

15. Increase in big game can cause: ( )

a) decrease in cattle.
b) decrease in field crops.
c) increase in cattle.
d) increase in field crops.

16. Exceeding the carrying capacity of land and bringing in extra feed for cattle is: ( )

a) good land use.
b) bad land use.
c) neither.

17. Changes in the land which affect a neighbours' land are: ( )

a) good land use.
b) bad land use.
c) neither.

18. Converting all land of any capability to agriculture uses is: ( )

a) good land use.
b) bad land use.
c) neither.

19. Using limited agriculture land for field crop production is: ( )

a) good land use.
b) bad land use.
c) neither.

20. Removing waterfowl by draining wetland to increase field crop production is: ( )

a) good land use.
b) bad land use.
c) neither.

PART C - EAST KOOTENAY LAND USE SIMULATION GAME EVALUATION STUDY

Group #	_____	1, 2	_____
Person #	_____	3,5	_____
Card #	_____	6	2
Property Size	_____	7,10	
		11	_____

Please fill in the appropriate information below:

A) 1. Male _____ 12 1. _____

2. Female _____ 2. _____

B) What is your position in the family?

1. Husband _____ ... 13 1. _____

2. Wife _____ 2. _____

3. Child _____ 3. _____

4. Relative _____ 4. _____

5. Other _____ 5. _____

C) How many years of school have you completed? 17,18 _____

19 _____

_____ years.

D) Was more than $250 worth of agriculture produce sold from this land in 1971? 20 1. _____

2. _____

1. Yes _____

2. No _____

PART D - EAST KOOTENAY LAND USE SIMULATION GAME EVALUATION STUDY

Group # ____
Person # ____
Card # 2

Instructions: Please check any one of the five categories (from strongly agree to strongly disagree) for each statement.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	This game was enjoyable.	—	—	—	—	—
2.	I wouldn't mind playing this game again.	—	—	—	—	—
3.	This game isn't really like the real problems landowners face.	—	—	—	—	—
4.	I would recommend this game to my friends to play.	—	—	—	—	—
5.	I think every landowner should have a chance to play this game.	—	—	—	—	—

PART A - EAST KOOTENAY LAND USE SIMULATION GAME EVALUATION STUDY.

Group # ____
Person # ____
Card # 1

Instructions: Please check one of the five categories (from strongly agree to strongly disagree) for each statement.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Landowners should be able to do what they wish with their land.	—	—	—	—	—
2.	Land use planning is just common sense.	—	—	—	—	—
3.	Our national parks should be preserved in their natural state with roads and buildings prohibited.	—	—	—	—	—
4.	What I do with my own land is my own business.	—	—	—	—	—
5.	Land users must attempt to minimize possible bad effects on neighbouring lands.	—	—	—	—	—
6.	Farming operations should not have to change their plans to accommodate some wildlife population.	—	—	—	—	—
7.	All landowners should have registered land use plans approved by a qualified land use planner.	—	—	—	—	—
8.	Landowners with high capability land for agriculture should not sell their property for building developments.	—	—	—	—	—
9.	Wildlife populations damaging cash crop or competing with cattle must be removed.	—	—	—	—	—
10.	By planning land use it is possible to foresee environmental problems.	—	—	—	—	—
11.	Individual landowners have no responsibilities toward wild animal populations.	—	—	—	—	—
12.	When economic interests conflict with ecological interests the decision should be made in favor of economic gain.	—	—	—	—	—

PART A

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
13. I would be willing to sit down and work out a land use plan with a professional land use planner.	—	—	—	—	—
14. The land uses of one piece of land have no effect on neighbouring lands.	—	—	—	—	—
15. Building programs that disrupt the ecology should be abandoned and the land returned to its natural state.	—	—	—	—	—
16. Any land can be successfully farmed provided enough money and time is available to develop it.	—	—	—	—	—

PART B - EAST KOOTENAY LAND USE SIMULATION GAME EVALUATION STUDY

Group # ____
Person # ____
Card # 1

Instructions: Please select the BEST answer for each of the following questions.

1. Land capability refers to: ( )

a) uses the land is being put to presently.
b) what originally grew on undisturbed land.
c) the land's natural ability to support native or domestic plants and animals.
d) the land's potential for agricultural production.

2. Moderate capability big game land has: ( )

a) only the ability to support big game.
b) the ability to support big game and cattle.
c) the ability to support big game, cattle, field crops and forests.
d) the ability to support big game, cattle and forests.

3. High capability agricultural land can support: ( )

a) more cattle than big game.
b) as many cattle as big game.
c) fewer cattle than big game.
d) more big game than cattle.

4. High capability forestry land can support ( )

a) waterfowl, cattle and forests.
b) big game, and cattle.
c) field crops, forests, cattle and big game.
d) waterfowl, forests, field crops, big game and cattle.

5. Land capabilities are the result of: ( )

a) natural conditions.
b) man-made conditions.
c) economic conditions.
d) traditional uses.

6. The cost of maintenance of environmental quality: ( )

a) is the responsibility of the landowner.
b) is the responsibility of the government.
c) both.
d) neither.

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7. Increasing environmental quality often: ( )

a) increases profits.
b) decreases profits.
c) does not affect profits.

8. The economic gain and environmental quality are: ( )

a) frequently in conflict.
b) never in conflict.
c) only occasionally in conflict.

9. Big game and waterfowl populations have: ( )

a) no economic value.
b) great economic value.
c) some economic value.

10. Maintaining a high degree of environmental quality: ( )

a) costs landowners a lot of money.
b) costs the landowner nothing.
c) slightly increases the landowner's costs.

11. Forest removal can result in: ( )

a) increase in big game animals.
b) decrease in big game animals.
c) better soil conditions.
d) fewer cattle.

12. Big game and cattle compete for: ( )

a) sources of water.
b) the same food supply.
c) none of the above.

13. Increase in cattle can cause: ( )

a) decrease in waterfowl.
b) increase in forests.
c) decrease in forests.
d) increase in field crops.

14. Decrease in field crops can cause: ( )

a) increase in cattle.
b) decrease in forests.
c) decrease in waterfowl.
d) increase in big game.

PART B

15. Increase in big game can cause: ( )

a) decrease in cattle.
b) decrease in field crops.
c) increase in cattle.
d) increase in field crops.

16. Exceeding the carrying capacity of land and bringing in extra feed for cattle is: ( )

a) good land use.
b) bad land use.
c) neither.

17. Changes in the land which affect a neighbours' land are: ( )

a) good land use.
b) bad land use.
c) neither.

18. Converting all land of any capability to agriculture uses is: ( )

a) good land use.
b) bad land use.
c) neither.

19. Using limited agriculture land for field crop production is: ( )

a) good land use.
b) bad land use.
c) neither.

20. Removing waterfowl by draining wetland to increase field crop production is: ( )

a) good land use.
b) bad land use.
c) neither.

APPENDIX C - DEEDS FOR SIMULATED PROPERTIES

Property 1

600 Acres

Land Value $1200 Enviro-Value 2000

Capabilities	Exchange Units				
	Cattle	Field Crop	Forest	Big Game	Waterfowl
Moderate Agriculture	4	8	1	2	0
Limited Agriculture	2	4	1	1	0
Moderate Big Game	4	0	1	4	0

Property 2

900 Acres

Land Value $1800 Enviro-Value 2000

Capabilities	Exchange Units				
	Cattle	Field Crop	Forest	Big Game	Waterfowl
Moderate Agriculture	4	8	1	2	0
Limited Agriculture	2	4	1	1	0
Moderate Forestry	2	2	8	1	0
Limited Forestry	2	2	4	1	0
High Waterfowl	0	0	0	0	16
Moderate Waterfowl	0	0	0	0	8
Moderate Big Game	4	0	1	4	0

Property 3

1250 Acres

Land Value $2500 Enviro-Value 2000

	Exchange Units			
Capabilities	Cattle	Field Crop	Forest	Big Game	Waterfowl
Moderate Forestry	2	2	8	1	0
Limited Forestry	2	2	4	1	0
Moderate Waterfowl	0	0	0	0	8

Property 4

1300 Acres

Land Value $2600 Enviro-Value 2000

	Exchange Units			
Capabilities	Cattle	Field Crop	Forest	Big Game	Waterfowl
High Agriculture	8	16	1	4	0
Moderate Agriculture	4	8	1	2	0
High Forestry	2	2	16	1	0
Moderate Forestry	2	2	4	1	0
Limited Forestry	2	2	4	1	0
High Big Game	8	0	1	8	0

Property 5

1000 Acres

Land Value $2000 Enviro-Value 2000

	Exchange Units				
Capabilities	Cattle	Field Crop	Forest	Big Game	Waterfowl
High Agriculture	8	16	1	4	0
Moderate Agriculture	4	8	1	2	0
Moderate Forestry	2	2	8	1	0
Limited Forestry	2	2	4	1	0
Moderate Big Game	4	0	1	4	0

Property 6

900 Acres

Land Value $1800 Enviro-Value 2000

	Exchange Units				
Capabilities	Cattle	Field Crop	Forest	Big Game	Waterfowl
High Agriculture	8	16	1	4	0
Limited Agriculture	2	4	1	1	0
High Waterfowl	0	0	0	0	16
Moderate Big Game	4	0	1	4	0

Property 7

550 Acres

Land Value $1100 Enviro-Value 2000

Capabilities	Exchange Units: Cattle	Field Crop	Forest	Big Game	Waterfowl
High Agriculture	8	16	1	4	0
Moderate Agriculture	4	8	1	2	0
High Waterfowl	0	0	0	0	16

Property 8

1050 Acres

Land Value $2100 Enviro-Value 2000

Capabilities	Exchange Units: Cattle	Field Crop	Forest	Big Game	Waterfowl
High Agriculture	8	16	1	4	0
Moderate Agriculture	4	8	1	2	0
High Forestry	2	2	16	1	0
High Waterfowl	0	0	0	0	16
Native Range	8	8	0	8	0

Property 9

950 Acres

Land Value $1900 Enviro-Value 2000

Capabilities	Exchange Units: Cattle	Field Crop	Forest	Big Game	Waterfowl
High Agriculture	8	16	1	4	0
Moderate Agriculture	4	8	1	2	0
High Waterfowl	0	0	0	0	16
Native Range	8	8	0	8	0

APPENDIX D - CONSEQUENCE CARDS

Forest Consequence Cards

Card 1

Increase:
Extra range land in reforested area unavailable for grazing. Decrease cattle and big game by 2 units on your's and neighbouring lands.
Decrease:
More rangeland available. You and your neighbours get 4 free units of cattle or big game.

Card 2

Increase:
Reforesting prevents soil erosion you receive 25 EU's for each unit of forest purchased.
Decrease:
More rangeland available. You and your neighbours get 4 free units of cattle or big game.

Card 3

Increase:
Extra range land in reforested area unabailable for grazing. Decrease cattle and big game by 2 units on your's and neighbouring lands.
Decrease:
Cut over area is no longer available to control spring runoff. Floods destroy 5 units of forest on your's and neighbours' lands.

Card 4

Increase:
Reforesting prevents soil erosion you receive 25 EU's for each unit of forest purchased.
Decrease:
Cut over area is no longer available to control spring runoff. Floods destroy 5 units of forest on your's and neighbours' land.

Waterfowl Consequence Cards

Card 1

Increase:
Conservation measures have prevented possible destruction of this local population. Add 25 EU's for each unit of waterfowl increased.
Decrease:
Less damage to field crops results because of fewer ducks and geese. You and your neighbours receive 3 free units of field crops.

Card 2

Increase:
Ducks destroy crops pay your neighbours with field crops $20/unit each unit of waterfowl increased.
Decrease:
Disease and winter kill destroys 5 additional units of the population. If whole population wiped out 200 additional EU's lost.

Card 3

Increase:
Conservation measures have prevented possible destruction of this local population. Add 25 EU's for each unit of waterfowl increased.
Decrease:
Disease and winter kill destroy 5 additional units of the population. If whole population is wiped out 200 additional EU's are lost.

Card 4

Increase:
Ducks destroy crops pay your neighbours with field crops $20/unit for each unit of waterfowl increased.
Decrease:
Less damage to field crops results because of fewer ducks and geese. You and your neighbours receive 3 free units of field crops.

Big Game Consequence Cards

Card 1

Increase:
This increase maintains the population at a healthy level you receive an additional 50 EU's/unit increased.
Decrease:
Severe winter kills off 2 additional units of big game.

Card 2

Increase:
Drought reduces feed available for grazing all populations of big game and cattle on the board decrease by 2 units.
Decrease:
Severe winter kills off 2 additional units of big game.

Card 3

Increase:
Drought reduces feed available for grazing all populations of big game and cattle on the board decrease by 2 units.
Decrease:
Competition for rangeland is decreased so you and your neighbours get 5 free units of cattle.

Card 4

Increase:
This increase maintains the population at a healthy level you receive an additional 50 EU's/unit increased.
Decrease:
Competition for rangeland is decreased so you and your neighbours get 5 free units of cattle.

Field Crop Consequence Cards

Card 1

Increase:
Water used to irrigate field crops lowers the water level in waterfowl areas. Decrease waterfowl by 5 units on your's and neighbours' lands.

Card 2

Increase:
Poor capability lands for field crops, all those except moderate and high agriculture and native range, require fertilizer at an additional $10/unit of field crop purchased.

Card 3

Increase:
Field crops better quality than normal this year. Keep this card and collect 2 times value of field crops at sale time in the fall.

Card 4

Increase:
Field crops provide more feed for waterfowl. Waterfowl populations on your's and neighbours' land increase by 2 units.

Cattle Consequence Cards

Card 1

Increase:
Cattle on lands classified as limited agriculture or any forestry classification require a feed supplement costing $25/unit of cattle bought. Pay the bank.

Card 2

Increase:
Cattle spread disease to big game animals. Reduce big game populations by 2 units on your's and neighbours' land.

Card 3

Increase:
One all land immediately next to a waterfowl area the cattle disturb the nesting sites. Reduce waterfowl by 3 units.

Card 4

Increase:
The market is high for livestock products you raise. Keep this card and collect twice market value at sale time. This card must be returned to the pile next fall whether used or not.

APPENDIX E - RISK CARDS

Card 1

Disease spreads through population over produced. You and your neighbours lose 5 units of whatever was over produced.

Card 2

Neighbours and you lose 100 EU's due to damage to land caused by over production.

Card 3

If cattle or big game are over the limit or over grazing decrease cattle and big game on your's and neighbours' land by 5 units. If waterfowl are over the limit decrease your's and neighbours' field crops by 5 units.

Card 4

Land reduced to one half its carrying capacity for 1 year. Remove over produced animals and number of animals equal to one half carrying capacity.

Card 5

Severe weather conditions decrease your population by overproduced amount plus 5.

Card 6

No change.

APPENDIX F - GAME SCORING SHEET

GROUP NO. _____ PERSON NO. ____

CARD NO. _____

	Money	EU's	EU's + Money
Year 1			
2			
3			
4			
5			

Keep a running total of EU's. At end of each year put total EU's in above chart. It is ONLY in the final year that it is necessary to count up money and total of EU's + money.

2000

APPENDIX G - PLAYER INSTRUCTION CARDS

Rules

1. You may negotiate with your neighbour as to the planning of his or her land.
2. Your EU's (environmental units) must be above 1000 by the end of the game.
3. Risk - if you exceed the limits in numbers of forest, big game, waterfowl, cattle or field crops for a given piece of land you must draw a risk card every turn the population is maintained beyond the limits.
4. Four or fewer players may buy only properties: 4, 5, 6, or 8.
5. More than 4 players: the person getting the highest number on a role of the dice gets first choice with the person next highest getting second choice and so on.
6. Only one piece of property may be purchased.

Winter

1. Decide which wild populations you wish to sell to make room for cattle and field crops:
   sell big game,
   sell waterfowl,
   sell forests.
   Turn over a unit when it has been sold (white side up).
2. Record the number of Environmental Units (EU's) lost by selling wild populations (forests, big game, waterfowl).
3. Draw appropriate consequence card or cards.

Spring

1. Buy field crops and cattle to put on land from which forests and big game have been removed.
2. Draw appropriate consequence card or cards.

Summer

1. If you have cattle you must buy 1 unit of field crop for each unit of cattle.
   *You may buy it from yourself (just turn over the number of pink blocks equal to number of units of cattle you have).
   *You may buy them from your neighbour at a price he decides.
   *You may buy them from the bank at twice the sale price ($50/unit).
2. You may buy back big game, waterfowl or forests. Remember to add EU's gained to your score.

3. Draw appropriate consequence card or cards.

Fall

1. Sell field crops,
   sell cattle.

2. Total up EU's and cash on hand.

APPENDIX H -- Over

APPENDIX H

CORRELATION MATRIX FOR PERSONAL CHARACTERISTICS OF PARTICIPANTS,

	1	2	3	4	5	6	7	8	9	10	11	12	13
1.	1.00												
2.	-.21	1.00											
3.	.02	-.10	1.00										
4.	-.15	.23	.09	1.00									
5.	-.09	.25	-.01	.74	1.00								
6.	-.14	.15	.15	.81	.25	1.00							
7.	-.31	.21	.02	.65	.54	.48	1.00						
8.	-.37	.10	.04	.44	.48	.25	.76	1.00					
9.	-.21	.23	.00	.59	.38	.57	.89	.40	1.00				
10.	-.08	-.12	.22	.20	.22	.08	-.00	-.06	.05	1.00			
11.	-.21	.09	.13	.37	.14	.40	.36	.23	.36	.07	1.00		
12.	.04	-.02	.04	.02	.09	-.09	-.01	.08	-.09	-.04	.45	1.00	
13.	-.16	.08	-.01	.14	-.02	.26	.21	.07	.31	.15	.48	-.01	1.00
14.	-.30	.05	-.11	.07	.11	.19	.21	.13	.22	-.20	.64	.13	.35
15.	-.29	-.03	.23	.51	.32	.46	.43	.22	.42	.01	.57	.20	.09
16.	.13	.01	.20	.25	.16	.20	.14	-.09	.29	.18	.41	.23	.33
17.	-.11	.28	.28	.04	.15	-.05	.03	-.04	.13	-.01	.22	.02	.13
18.	.21	.03	-.15	.02	-.14	.13	.02	-.10	.14	.12	.16	.08	.36
19.	.13	-.15	.07	-.02	-.11	.02	.01	-.09	.09	.01	.30	.25	.19
20.	.12	-.11	.32	.56	.47	.38	.33	.05	.38	.35	.31	.17	.21
21.	.29	-.28	.06	-.26	-.14	-.28	-.32	-.30	-.25	.20	.05	.16	.20
22.	-.23	-.23	.46	-.10	-.09	.25	.26	.19	.26	.19	.42	.02	.19
23.	-.16	-.30	.47	.04	-.12	.18	.18	.12	.20	.24	.43	.06	.23
24.	-.56	-.03	-.12	-.11	-.11	-.04	.22	.26	.14	-.09	.24	-.11	.28
25.	-.45	.21	-.26	-.23	-.19	-.20	.14	.08	.17	-.26	.25	-.04	.26
26.	-.13	.37	-.35	.06	.27	-.13	.04	.05	-.02	-.28	-.32	.00	-.29

*___ significant at .05 level ($r \geq .31$),

TEST SCORES, SCORES ON INDIVIDUAL OBJECTIVES, AND GAME SCORES*

14	15	16	17	18	19	20	21	22	23	24	25	26
1.00												
.20	1.00											
.29	.38	1.00										
.01	.18	.55	1.00									
.08	.05	.61	.16	1.00								
.57	.13	.63	.05	.24	1.00							
.02	.52	.65	.17	.20	.21	1.00						
-.19	.03	.14	.10	.18	-.04	.14	1.00					
.28	.35	.36	.16	.04	.31	.31	-.08	1.00				
.23	.35	.39	.18	.08	.29	.34	.15	.97	1.00			
.37	.16	-.05	.07	-.00	.04	-.23	-.19	.31	.26	1.00		
.44	.11	-.00	.09	.09	.15	-.33	.09	-.02	-.04	.77	1.00	
-.07	-.17	-.11	.10	-.01	-.13	-.23	-.35	-.55	-.63	.21	.29	1.00

List of Variables:--

Variable	Description
1.	Property Size
2.	Family Position
3.	Number of Years of Schooling
4.	Pre-test Attitude Score
5.	Pre-test Score for Objective 1
6.	Pre-test Score for Objective 2
7.	Post-test Attitude Score
8.	Post-test Score for Objective 1
9.	Post-test Score for Objective 2
10.	Attitude Towards the Game
11.	Pre-test Knowledge Score
12.	Pre-test Score for Objective 3
13.	Pre-test Score for Objective 4
14.	Pre-test Score for Objective 5
15.	Pre-test Score for Objective 6
16.	Post-test Knowledge Score
17.	Post-test Score Objective 3
18.	Post-test Score Objective 4
19.	Post-test Score Objective 5
20.	Post-test Score Objective 6
21.	Environmental Unit Score
22.	Money Score
23.	Total Score
24.	Number of Minutes of Play
25.	Number of Game Participants
26.	Rank Within the Playing Group

= significant at .01 level ($r \geq .41$).