ECOLOGY/LAND USE/POPULATION GAMES AND SIMULATIONS
An Evaluation

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"Environmental and/or population education programs embody several features which make games and role-playing attractive as educational techniques. These include: the strong attitudinal component of program objectives; the complexity of the systems with which these programs deal; and the resistance to change which pervade the social and economic fabric of many societies."[1] Furthermore, ecology, land use, and population issues are naturals for simulation. Ecology is the study of the totality or pattern of *relations* between organizing populations and their environments. Land use issues focus on the cybernetic *relationships* of ecology and the relationship of social, economic, cultural, and normative factors to the environment. In a parallel pattern, simulations as a learning method foster the experiencing of *interrelatedness*.

The Purpose of this Essay

In this essay, we will compare, contrast, and evaluate eight simulation games according to content, process, and suitability for classroom use as well as for their instructional value. The games focus on land use, population, and ecology. The essay elaborates several criteria for game selection ranging from clarity of rules to flexibility and realism. We conclude with a summary of the games' strengths and limitations in a wide range of categories.

Definition

Several types of teaching techniques have evolved to bridge the gap between the conceptual level, at which traditional teaching occurs, and real-life situations. They can be arranged on a continuum as follows:

conceptual description (i.e.) lecture discussion)	case study	open-ended case situation	role play	simulation	real life

As one moves along this continuum from conceptual level toward real life, increasing amounts of realism enter the learning situation. Experiences most often classified as educational "games" fall into the categories of role play and simulation.

The *role play* emphasizes interpersonal exchange, with students assuming assigned roles that may differ considerably from their real-life roles. The role involves a situation that is only briefly outlined, and the role player has considerable freedom to elaborate on the role identity in interaction with other participants. Role play can be very emotionally involved, and it is particularly useful for learning about processes in human interaction and for considering the player's emotional responses to various situations.

A *simulation* is a more structured situation that duplicates certain real-world conditions but usually "telescopes" the time dimension. Participants play roles, but the teaching focus is shifted somewhat away from interpersonal interaction toward the issues and processes involved in the simulation and toward consideration of factors such as power, communication, persuasion, and planning strategy trade-offs. A simulation that achieves closure, usually through scoring or win criteria, comes closest to the popular concept of a "game."

Games enable us to compress the time and space components of real-life situations. This is especially important in ecological and land use issues in which the real-life consequences of decisions are often felt only years later. A "game" gives a player a chance to learn the consequences of actions and situations without experiencing them. Not only can a considerable amount of cognitive information be transmitted but also attitudes and values can be clarified and modified. Through the simulation mode, students primarily strengthen process skills such as problem solving, planning, and decision making. These features contribute to make games, role playing, and simulations an attractive teaching technique in environmental education.

William Stapp, a leader in environmental education, has identified problem solving, values clarification, and community problem solving as three crucial processes in environmental education. These three processes involve identifying and evaluating alternatives and decision making. It is clear that these same skills and processes are important components of

Editor's Note: Listings for all simulations and games discussed in this essay are in the ecology section, except for *Baldicer* in social studies, and *Predator* in science.

educational "games." In a symbiotic manner, educational "games" are a powerful method for implementing environmental education.

Criteria for Selection

The eight games we have selected deal with ecology, population, and land use issues. Each of the games has been observed, played, and evaluated in several class.
As of January 1979, all are available commercia., government agencies. All are priced at or below $25. . important, the selection of games provides a cross-section o: exposure in the areas of ecology, population, and land use. These games not only develop content and process skills but they also are fun to play.

TABLE 1 The Simulation Game

Simulation Games	Purpose	Game Effectiveness in Achieving Purpose	Summary
Algonquin Park	To develop a land use plan that will provide maximum benefit to the people of a region.	Very Effective	Players role play a multiple-use conflict about a parcel of wilderness land. Cottage owners, miners, lumbermen, and resource planners consider the economic and ecological factors required to produce a land-use plan that the Ministry of Natural Resources will accept
Balance	To create awareness, transmit knowledge, and stimulate research on environmental problems from the point of view of the family	Very Effective	Representing members of four contemporary families, players have to choose among economic, social, and family interests versus ecological values. They experience how age and family role influence their decisions.
Baldicer	To experience the interdependence of the world economy.	Effective	Participants play the role of food coordinator for 150 million people. In each round, food coordinators must earn enough food for their people. After a period of training, bargaining, and purchasing, coordinators calculate status and determine whether they are "alive" and may continue to play. Those who "die" take on a new role as the World Conscience, seeking to dramatize the plight of hunger to remaining players.
Ecopolis	To generate a better understanding of environmental problems, in particular pollution and overpopulation. To motivate real-life projects that attack environmental problems.	Effective	Representing citizen groups, players solve ecological problems of land use in their community. They are also encouraged to engage in real-life ecological projects that earn them bonus "gasps" in the game.
Land Use	To expose players to a wide range of potential uses for land and the types of information that should be considered in selecting a single, best land-use plan.	Effective	Players as members of a community develop a land-use plan for one square mile of land on the urban fringe. Players select alternative use patterns, develop plans, make proposals to the community, and vote on a plan.
Planet Management	To develop an understanding of the issues involved in managing a simplified ecosystem.	Satisfactory	Players as managers of the imaginary planet Aarun try to improve living conditions by investments in projects represented by perforated computer cards. Thus, they observe realistic results of their choices.
Predator	To understand food chains and food webs.	Satisfactory	Based upon the natural food, relationships in a temperate zone forest, predator is a card deck with each card representing a plant or animal. The several possible games are based on old favorites such as War, Concentration, and Rummy.
Redwood Controversy	To involve players as representatives of interest groups in designing a land-use plan and arguing the case before a legislative body	Very Effective	Players assume roles of senators and expert witnesses in debating and determining the size and use patterns for the Redwood National Park.

PRELIMINARY CONSIDERATIONS

Purpose and Summary Description

Table 1 states the purpose of each game reviewed in this essay, indicates its effectiveness in achieving that purpose, and gives a short summary description. Using Table 1, one can make a preliminary determination of which game or games accord with one's purposes and educational objectives.

Age Level, Group Size, Playing Time

One of the first considerations in selecting a game for classroom use is its suitability for the age, ability, and size of the class or group. A second criterion is how the time a game requires matches the time available. The playing time of a game can be influenced by many factors: the teacher's experience in game management, student exposure to simulation experiences, modifications of the game to meet special class needs, and the diverse factors that influence student ability to adjust to new educational strategies. Table 2 summarizes these considerations and should aid in choosing games appropriate for the situation.

Complexity

In Table 3, we rank the simulations according to their complexity.

The simplest games require little reading and a minimum of prior classroom preparation. The more complex games require better mathematical, reading, organizational and intellectual skills. We rank *Balance* as complex because it involves two different simulations, complex multiple roles, organizational skills, and outside projects and research. *Predator* has a fairly simple format based on familiar card games such as war, rummy, and concentration. *Baldicer* is rated moderately complex because it requires mathematical skills.

ISSUES

One of the most important concerns involved in choosing an educational game is the nature of the issues it presents and resolves. The range of issues in the eight games falls into four major categories: ecological, economic, social, and environmental quality. Table 4 indicates what issues are dealt with in each game and whether a given issue is of primary, secondary, or optional significance. Few ecology, population, or land use games are single-issue games.

SCOPE AND DEPTH OF CONTENT

Another concern in the choice of an educational game is the scope and depth of the content. This may include already existing material in game manuals and additional information. One may wish to modify the instructional value of the game. Does one want a game that primarily teaches content, or would one prefer a game that develops process skills such as problem solving? Does one prefer games that include all the required content and information for play, or would one rather have a skeletal structure that can be strengthened with

TABLE 3 Complexity

Simple	Easy	Moderate	Complex
Predator	*Land Use* *Ecopolis*	*Redwood Controversy* *Baldicer* *Planet Management* *Algonquin Park*	*Balance*

TABLE 2 Some Basic Considerations

Simulation Game and Publisher	Grade Level	Playing Time	No. of Players	No. of Groups
Algonquin Park David Dagg Pembrook, Ontario	grade 7 – adult	7 – 8 50-minute periods	5 – 35	5
Balance Interact	grades 7 – 12	15–20 days in periods of 45 min (there is also a 3 hour version)	18 – 35 (class)	4
Baldicer John Knox Press	grade 7 – adult	6 – 8 25-minute rounds or 1½ – 3 hours	10 – 20, more with modifications	1
Ecopolis Interact	grades 5 – 8	12–15 days in 45-minute periods	18 – 35 (class)	2
Land Use U.S. Forest Service	grade 9 – adult	2 – 3 hours	15 – 20	2 – 6
Planet Management Houghton Mifflin	grade 7 – adult	2 or 3 45-minute periods	2 – 10	5 maximum
Predator Ampersand Press	grades 4 – 8	30 minutes per round	3 – 49	–
Redwood Controversy Houghton Mifflin	grade 7 – adult	1½ – 2½ hours	optimum 21 range	–

TABLE 4 Issues

Issues	*Algonquin Park*	*Balance*	*Baldicer*	*Ecopolis*	*Land Use*	*Planet Management*	*Predator*	*Redwood Controversy*
ECOLOGICAL								
ecology	P	P	O	P	S	P	S	P
land use	P	P	O	P	P	S	–	P
population	P	P	P	P	P	P	S	P
extinction	O	S	–	S	O	–	S	S
food chain and web	S	–	–	–	O	–	P	S
ECONOMIC								
agriculture/forestry	S	S	P	O	O	P	–	P
industrial	S	O	–	O	O	P	–	–
research	–	–	–	–	O	P	–	–
income	S	O	S	–	–	P	–	–
benefit/costs	P	O	–	–	S	–	–	P
development costs	P	O	S	–	S	–	–	S
utilities	S	P	–	O	S	–	–	–
SOCIAL								
education	O	–	–	–	O	P	–	–
family interests	–	P	–	S	–	–	–	–
generation gap	–	P	–	–	–	–	–	–
public health	–	–	–	–	O	P	–	–
recreation	S	S	–	S	O	S	–	P
food and hunger	–	O	P	–	–	P	–	–
ENVIRONMENTAL QUALITY								
benefit/cost analysis	P	O	–	–	P	S	–	P
water quality	O	–	–	O	O	–	–	O
air quality	O	P	–	O	O	–	–	O
mass transit	–	O	–	S	O	S	–	–
land use	P	P	–	P	P	P	–	P
parks	P	S	–	P	O	–	–	P
housing	S	O	–	O	O	–	–	P

KEY:
P – primary issue
S – secondary issue
O – optional issue at discretion of game director.

inclusions that are germane to the instructional situation? Table 5 should help one determine what games involve scope and depth appropriate for the situation.

Baldicer is rated very low in scope and depth of content, but we give the game an overall rating of very good. This apparent discrepancy can be explained in light of *Baldicer's* strength in simulating broad concepts such as inequitable distribution of world resources and the interdependence of the world economy. These concepts are difficult for most students to grasp, but *Baldicer* illustrates them clearly and forcefully.

Two games that demonstrate broad scope and good depth of content are *Algonquin Park* and *Redwood Controversy*. Both are extraordinarily useful to classes or groups exploring the issues of park formation or land-use decision making. Each game contains excellent background material on the issue of preserving open space, endangered plants, or areas and on strategies for designing and evaluating alternative land use plans. *Land Use*, produced by the U.S. Forest Service, is much shallower in content, though well designed. As a result, it can be played in less time and may function mainly as an introduction to the land use decision-making process.

TABLE 5 Scope and Depth of Content

Very Low (no material)	Low	Moderate	High
Baldicer	*Predator*	*Balance*	*Algonquin Park*
	Land Use	*Redwood Controversy*	
	Planet Management	*Ecopolis*	

Content Learning, Awareness, Social Skills

What are a teacher's aims in choosing a particular game? Is the teacher particularly interested in content learning, in fostering social skills and interactions, or in creating ecological awareness as learning motivation? Table 6 should help teachers in this aspect of game selection.

ROLE PLAYING

With the exception of the card game *Predator*, all the ecological games we review here involve some kind of role playing. Several factors concerning role play might influence

TABLE 6 Educational Objectives

Simulation Games	Content Learning	Awareness Creating	Developing Social Skills
Algonquin Park	S	P	P
Balance	S	P	P
Baldicer	–	P	P
Ecopolis	P	P	P
Land Use	S	P	P
Planet Management	–	P	–
Predator	P	–	–
Redwood Controversy	S	P	P

Key
P = primary

the teacher's decision about whether a game is appropriate to a particular class or group of players.

Structured Versus Nonstructured Roles

Roles assigned in education games may be highly detailed or skeletal in structure. A highly detailed role (generally consisting of two or more descriptive paragraphs) requires the player to identify with a clearly outlined personality. Such roles influence players' attitudes during the entire game—the opinions they express, their votes, and their final decisions. The main purpose of this kind of role playing is to foster better understanding of other people's attitudes in a given situation based upon their backgrounds and needs. For instance, adolescents might understand their own parents better after having played the father, the mother, and the young adult in the game of *Balance*. A player may learn to understand the great difficulty politicians have in coping with the task of decision making by playing *Algonquin Park* or *Redwood Controversy*.

In contrast to these very detailed roles are the short, unstructured roles that outline in only a few sentences the tasks with which the players have to cope. In these cases, players are asked to fulfill given roles according to their own interpretation. Their opinions and decisions in the simulation are strongly influenced by their own ideas and attitudes. Here, the main purpose of the role play is to foster a high level of responsibility that in real life would rest on the shoulders of a few representatives of society. For example, the players in *Baldicer* are in charge of the food supply for a whole country, while in *Planet Management* they are responsible for establishing the living standards of an entire planet. Making a decision in one field often leads to most unexpected results in another. This kind of role play often develops an understanding of the complex interaction of ecological processes.

Students playing the four games in the first group learn to understand the factors that influence the decisions of those people they represent in their roles, whereas the players in the two other groups of games have to cope with their given task according to their own interpretation of the role. To understand these differences better, we will look at the roles these games include (see Table 8).

TABLE 7 Role Types

Highly structured roles (lengthy and detailed)	Unstructured roles (brief-only individual task given)	The same task is given to all players
Ecopolis	*Baldicer*	*Planet Management*
Balance	*Land Use*	
Algonquin Park		
Redwood Controversy		

TABLE 8 Roles in Simulations

Simulation Games	Roles
Algonquin Park	Committee on Land Use, Forestry Management Company, Land Developers and Planners, Lawyers representing cottage owners, Mining Company
Balance	Four families, each composed of father, mother, young adult and adolescent
Baldicer	Food coordinators representing areas of the world having different quantities of food; two game directors and members of the world conscience
Ecopolis	Interested citizens: business persons, construction worker, outdoor person, elementary, high school and college students, teacher, homemaker, county commissioners, politician, secretary, writer
Land Use	Decision makers, county Board of Commissioners, member of a committee, members of interest groups and citizens
Planet Management	Representatives of management committee
Predator	No roles
Redwood Controversy	Senators, conservation group members, lumbering interest group members

Interest Factor of Roles

Many people, and surely all children, like to role play. But is the role given in a certain game unduly restraining a player's self-expression? Are the roles in a game interesting to the players? Is it possible to adapt the roles in a game to the problems of one's own community so players can cope with a

TABLE 9 Role Interest, Involvement, Flexibility

Simulation Games	Interest Factor	Personal Involvement	Flexibility to Adaptation
Algonquin	very interesting	high	high
Balance	good	adequate	moderate
Baldicer	very interesting	moderate	moderate
Ecopolis	good	adequate	moderate
Land Use	very interesting	moderate	moderate
Planet Management	very interesting	moderate	low
Predator	no roles	–	–
Redwood Controversy	most enjoyable	high	high

situation much closer to real life? How involved do players become in the roles they play? Table 9 will help one deal with these factors

In all the games, each player receives an individual role description and task, but in some of the games there is also a group role to be played. Individual role descriptions only are given in *Balance*, *Ecopolis*, and *Planet Management*. Players have individual and group roles in *Algonquin Park*, *Baldicer*, *Land Use*, and *Redwood Controversy*

Changing Roles

In some games the player's role stays the same throughout the game. In three, however, players change roles at different game sessions This enables them to identify with different aspects of the same question and thus helps them be more tolerant and understanding of the roles people fulfill in real life.

RULES

The clarity, organization, and completeness of rules are very important factors in the choice of a game. When rules are hard to understand or when too much time is spent in explanations, participants' interest and motivation may be lost. If it is only the instructor who has to read a lot of pages to prepare for the game, this does not necessarily interfere with the participants' readiness to play. A careful analysis of rules is a prime responsibility of the game director; their quality may not be apparent at first glance.

TABLE 10 Role Changes

Same Role for Entire Game	Roles Change During Game
Planet Management	*Ecopolis*
Baldicer	*Balance*
Redwood Controversy	*Land Use*
Algonquin Park	

The instructor rules for *Baldicer*, *Land Use*, *Planet Management*, and *Redwood Controvery* are outstanding for clarity and explicitness. Other games might take some experience to play fluently

It is advisable to leave a certain amount of flexibility to each group of players, encouraging them to adapt the existing rules of a game to their specific needs. The amount of instruction a game gives to the *players* is sufficient if it allows them to play and evaluate their steps without requiring the instructor to reread detailed instructions at each step.

Table 11 shows the number of pages devoted to game rules and our evaluation of the clarity and complexity of the rules for the instructor and for the players.

DEBRIEFING

One of the most important aspects of any well-designed educational game is the debriefing session. During this period, game participants step out of their simulated roles and settings into their normal group roles. They are then in a position to discuss roles they have played, decisions they have made, techniques that proved to be successful or ineffective, conflicts between personal values and assigned roles, anxieties created by game participation, the validity and realism of the simulation, and possible extensions of the game to solving group problems. These and a host of other matters may become focal points for maximizing the instructional value of participating in the gaming session.

Structuring the debriefing session is an important task of the game director, and a good set of guidelines can be very useful in starting and maintaining this important activity. Some games provide very thorough debriefing guidelines. Others give a limited number of suggestions. Still others give no guidelines at all. Table 12 summarizes our rating of the debriefing guidelines provided with each game in terms of quality and quantity.

TABLE 11 Clarity and Organization of Rules

		Rating of Clarity, Organization, and Completeness			
Rules for the Instructor	Number of Pages Devoted to Rules	Inadequate	Adequate	Good	Outstanding
Algonquin Park	4			X	
Balance	40		X		
Baldicer	15				X
Ecopolis	34			X	
Land Use	4				X
Planet Management	2				X
Predator	3		X		
Redwood Controversy	3				X
Rules for the Players	**# of Pages**	**Inadequate**	**Adequate**	**Good**	**Outstanding**
Algonquin Park	1			X	
Balance	10			X	
Baldicer	3		X		
Ecopolis	12			X	
Land Use	1			X	
Planet Management	1	X			
Predator	–				
Redwood Controversy	2				X

TABLE 12 Debriefing Guidelines

Inadequate (no debriefing questions)	Adequate	Thorough
Predator	*Algonquin Park* *Balance* *Ecopolis* *Land Use* *Redwood Controversy*	*Baldicer* *Planet Management*

STRATEGIES FOR IMPROVING CLASSROOM IMPLEMENTATION

In reviewing and selecting games, one will undoubtedly be thinking of ways to integrate the game into the curriculum. As a part of the process it would be wise to consider strategies for improving classroom implementation.

Baldicer is a solid, usable game. In playing it, however, we have found that it helps to place posters describing game rules and activities around the room as convenient reference points for students. We have also found that the enthusiasm of students often makes it difficult to get them settled quickly so play can move to the next round, and so one poster reads "NOISE POLLUTION FINE–5 BALDICERS." A quick reference to the noise pollution poster stops unwanted discussion immediately.

Game designers and producers frequently include large quantities of detail in the rules section. As a result, students must often spend long periods of time analyzing the rules before play can proceed. In many cases, however, the rules can be summarized in a few sentences, and if these abbreviated rules are put on a card in the game box, students can start playing much more rapidly. As their need to know about the intricacies of the rules develops, they can make coherent use of the detailed rules provided in the game.

Slides, films, and other media are often effective devices for introducing or following up a simulation activity. *Redwood Controversy* and *Algonquin Park* can be enhanced greatly by exposing students to the recreation, industrial, commercial, and environmental components of the areas in which the games are set.

As one reviews games, keep thinking of ways to improve implementation of the gaming session. Creativity can improve all games, and some that are basically mediocre may in fact be used in ways that make them worthwhile instructional activities.

FLEXIBILITY

Of the multitude of factors that affect the part a game plays in the instructional process, one that can be extremly significant is game flexibility.

A rigidly structured game must be played with a set number of players and specific rules and resources. A flexible game permits the director to modify one or more of the following components: roles, rules, issues, locations, number of players, age of players, and game resources. Many of these factors have been described in previous tables in this essay.

TABLE 13 Game Flexibility

Inflexible	Slight Alteration Possible	Flexible
Planet Management	*Ecopolis* *Predator* *Redwood Controversy*	*Algonquin Park* *Balance* *Baldicer* *Land Use*

As a case in point, such a simple factor as the number of players that can use a board game can dramatically affect the game's usefulness. If a game requires exactly four players, it functions only with multiples of four, no matter how many sets of the game are available. In a group of 15 students, 3 would be excluded from playing. However, if a game can incorporate 4 or 5 players, then a greater number can play. As shown in Table 2, the game we review in this essay can accommodate a wide range of player numbers.

Table 13 classifies the eight games into three groups according to their flexibility.

A game director can change games such as *Baldicer*, *Balance*, and *Land Use* a great deal to make them more effective for use by a specific group. Real geographical areas and their food-famine profiles can be substituted for the nonspecific regions assigned in the *Baldicer*. In addition, special outside assignments can help players (that is, countries) work hard and increase their available food. *Land Use* can be restructured to address local land use planning problems so it becomes extremely relevant to local community groups in and out of the classroom.

A game that is flexible provides a creative director with a wide range of instructional options. Modifications are time consuming, but the result of creative change can frequently benefit the players, the director, and the group as a whole.

SKILLS, ACTIVITIES, AND INTERACTIONS

In choosing a game, one will need to determine whether it offers practice in skills and activities that suit one's educational purposes. As Table 14 shows, the eight games vary considerably in the number and intensity of skills their participants practice.

Sequence of Activities

Most simulation games consist of several rounds of activities that evolve during play. Table 15 presents an overview of the sequence of activities and interactions in each of the eight ecological games we are reviewing.

RESOURCES AND SCORING

Game resources are often an important consideration in determining which games are appropriate for a group. The handling of money, tokens, and other player resources may prove to be a worthwhile and interesting experience for some students and an impediment to progress for others. One should select a game carefully to see that the resources it includes maximize player involvement.

TABLE 14 Skills and Activities

Skills/Activities	*Algonquin Park*	*Balance*	*Baldicer*	*Ecopolis*	*Land Use*	*Planet Management*	*Predator*	*Redwood Controversy*
Information Processing								
analysis	S	S		S	P	P		
gathering information	S	P	S	S				S
planning goals, strategies	P	S		S	P	P		P
extensive reading and research	S	O		S	O			O
individual problem solving	O		P		O			O
Proposals and Lawmaking								
designing/revising proposals	P	S	S	S	P			P
promoting proposals	P	P	S	P	P	P		P
opposing proposals	P	P		P	P	O		P
writing proposals	P	O	O		P			P
voting on proposals, laws	P	P		P	S			P
Group Activities								
group problem solving	P	S	P	S	P			P
debate persuasive argument	P	P		P	P			P
speaking group presentation	P	S		P	P			P
small group discussion	P	P	S		P			P
class large-group discussion	O	S		P	O			O
challenging before a group	S	S						S
Human Relations								
competition	P		P		P			P
persuading/influencing	P	P	P	P	P			P
bargaining/negotiating	P		P		O			O
helping/supporting	S	S	P	S				O
interviewing	O	O		O				
electing	P				S			
forming coalitions	O	S	S	S	O			O
Role Playing								
specific individual	S	P		P				P
work function			P	S		P		P
group member	P	P			P			P
switching roles		P		P				
Resource Management								
survival		S	P	S		S		
maximizing resources	P	S	P	S	P			P
managing resources	P	S	P	S	P	P		P
Evaluating (Exclusive of Debriefing)								
self-evaluation		S		S		P		
evaluation of peers		P		P	S	S		
Miscellaneous Activities								
map reading	S	S		S	S			S
land-use planning	P	P		P	P	P		P
graphing/charting	O				O	P		O
decision-making skills	P	P		P	P	P		P
mathematics skills	P	S	P	S				

Key

P - Primary
S – Secondary
O – Optional

TABLE 15 Sequence of Activities

Simulation Game	Sequence of Activities
Algonquin Park	(1) Read roles, (2) intergroup discussion, (3) prepare basic strategies, (4) prepare presentation of strategies, (5) prepare defense of plant, (6) interest groups report, (7) government committee completes land-use policy, (8) secret election of committee, (9) assess each group's fate, (10) discuss activities and goals
Balance	(1) The valley 150 years ago, small animals, simulations, (2) players receive roles and student guide, (3) introduce real-life ecology projects for earning "gasps," (4) family groups meet, (5) air pollution: large-group representations and votes, class family discussion, real self discussion, work on research and planning, (6) water and power: same sequence as step 5, (7) land use: same sequence as step 5, (8) debriefing, evaluation, discussion
Baldicer	Six to eight rounds of six phases each: (1) work period, (2) social forces factor cards (chance), (3) tally period, (4) planning, (5) purchasing and trading, (6) assessment; debriefing after last round
Ecopolis	Ecosystem of Ecopolis and survival simulation; start of real-life projects for earning "gasps"; Crisis 1. Our Land in Crisis—group one discusses, group two evaluates; Crisis 2. Over-Population—group two discusses, group one evaluates; forum preparations to choose main ecological problem; forum day; scoring and essay evaluation
Land Use	(1) Individuals list possible uses for hypothetical parcel of land, (2) decision-making groups determine specific use in stated categories, (3) groups evaluate impact of their proposed uses, (4) groups develop proposal and presentation for their concepts, (5) Board of Commissioners holds public hearing for proposal review, (6) evaluate proposals and approve one, (7) group discusses plans, processes, and ramifications of proposals
Planet Management	Open class discussion of projects that would make Earth a better place to live; ten rounds repeating following steps: (1) read project guide to choose up to five projects (invest up to $10 million), (2) record projects and money spent, (3) chance factor (coin flipping) leads to card computer, (4) evaluate computerized results, (5) record results on game ledger and/or graph; final group evaluation of "winner" and class discussion on future of life on planet Clarion
Predator	Several formats available (similar to rummy, concentration, solitaire); timed version: (1) deal cards, (2) first player chooses another and asks for showdown, (3) at signal, both lay down one card, (4) if one card "eats" another, that player takes eaten card, stand-off if neither "eats other," (5) steps 2-4 repeat with next player, (6) also possible to challenge player and take specific card, (7) repeat process for 30 minutes
Redwood Controversy	(1) Introduction and background, (2) role assignment, (3) witnesses testify before Senate, (4) Senators make first statement of intention to vote, (5) recess for discussion, (6) voting (2/3 to pass), (7) discussion and re-voting until one proposal passes, (8) debriefing and discussion

Scoring is a major concern in game selection. Some games are designed to foster intense competition among players; each move advances or retards the individual's or group's progress in accumulating the points, money, or tokens that place them in a specific position relative to other players or groups. Winning or losing becomes the focus of action for every individual. Competition and scoring can be a strong motivating device for most students, but we advise caution. One should determine the impact of winning or losing on the prospective players.

Many games make use of feedback schemes, group discussions, and proposal development to stimulate and maintain player interest. The way these games are constructed makes explicit individual and group scoring techniques unnecessary as motivational devices.

TABLE 16 Resources and Scoring

Simulation Games	Resources	Scoring
Algonquin Park	No resources	No scoring
Balance	GASPS (Goal and Satisfaction Points)	Score sheet; individual and family scoring personal evaluation. Highest wins.
Baldicer	BALDICERS (Balanced Diet Certificates). Units of food unequally distributed. Food Machines and Super Food Machines	Winners are survivors.
Ecopolis	GASPS (Goal and Satisfaction Points)	Score sheet; individual scoring highest GASPS win.
Land Use	No resources	No scoring
Planet Management	BOX — monetary resources, project cards	At the end of fifty years (ten rounds) teams assess their own progress and compare their planetary status with other teams. Class decides criteria for winning.
Predator	No resources	Player with most cards wins.
Redwood Controversy	No resources	No scoring

Table 16 summarizes the resources and scoring systems the eight environmental games use.

MODEL VALIDITY

Because simulation games are, by definition, models of real-life situations, it is important to consider the validity of a game and its model before selecting it as an instructional resource. One can determine model validity by analyzing the game's structure to see how closely it fits reality. Are the roles of significant interest groups and decision makers realistically presented (as discussed in Table 9)? Are decision-making activities structured so the game's approaches to problem analysis, proposed design, and evaluation fit the schemes used in real environmental decision-making activities? Is chance inserted into the game in a way that represents the nonpredictable influences that affect decisions, or is it used inappropriately to accomplish some other purpose such as speeding up the game? Do the game's techniques enhance player activities as realistic, informed, active participation, or do the techniques distort the process that is being simulated?

Table 17 describes our review panel's interpretation of the overall validity of the games.

The games we rated high for model validity are simulations that involve students in problem analysis, proposal design, small and large group discussions, persuasive argumentation, and evaluation of alternative problem solutions. The issues they address are true to life, and the simulations are carefully designed and effectively implemented

TABLE 17 Model Validity

Adequate	High
Baldicer	*Algonquin Park*
Land Use	*Balance*
	Ecopolis
	*Predator**
	Redwood Controversy
	Planet Management

*Predator is a game with high model validity, but it is not a role-playing simulation game

Land Use is rated as adequate because of the limited amount of information it presents to describe the situations it simulates. By adding background material and role information, one can improve the validity and realism of the game. *Baldicer* is also rated adequate because the assignment of resources (Baldicers) identifies only three discrete groups, and this does not reflect the food distribution patterns of the real world. In addition, all roles are identically and simply defined. As the game develops, population units faced with starvation enter into negotiation and active, sometimes hostile, schemes to obtain resources. Finally, the game play leads to outcomes that fail to reflect the wide spectrum of real-world responses to insufficient food resources. This weakness in model validity is balanced by the high interest it generates and by the high level of participant interaction.

PACKAGING

Games come in assorted colors, sizes, boxes, folders, envelopes, manuals, and kits (and unfortunately, packaging often influences sales more than game content). In our opinion, games should be packaged in strong containers. Playing boards, role cards, and other resources should be durable and of good quality. Costs should be kept to a minimum so that supplying games for an entire group does not become a monumental financial problem. *Planet Management*, for example, has an 89-page Data Book which should be available in multiple copies to evaluate each round, but only one copy comes with the game set.

When buying a game, one generally expects to find all of the required playing materials in the purchased package. If any material must be duplicated, the package should include high-quality masters for reproduction. If additional materials are needed, the instructor's manual should include a prominent and concise statement of what they are and where one can get them.

Table 18 provides information on the packaging, cost, completeness, and durability of the games we have reviewed.

TABLE 18 Packaging

Game	Kind of Packaging	Cost Per Kit or Book	Completeness	Durability & Reusability
Algonquin Park	Large envelope containing all game materials — kit.	$15.00, $10.00 if prepaid	complete	average
Balance	Manual	$14.00	requires duplication	average
Baldicer	Kit — Box containing manuals, work yield inventories, score sheets and posters	$25.00	complete	average
Ecopolis	Manual	$14.00	requires duplication	average
Land Use	Manual	$.95	requires duplication	average
Planet Management	Kit — Box containing manual, punch cards, computer data.	$22.56	complete	high
Predator	Deck of cards	$5.00	complete	average
Redwood Controversy	Kit — Box includes game manual, role cards and maps	$14.25	complete	average

CONCLUSION

When all is said and done, game selection is a highly individualized process. A game that proves eminently successful with one group can be a crashing bore with another. The differences frequently center around the entering levels of the players, the relevance of the game to situations the players encounter, and the players' needs, interests, and abilities.

Spend an hour or two analyzing a game with the criteria we have outlined in this essay before deciding to use it. Then compare the needs and abilities of the group with the instructional possibilities the game provides. Areas that need modification should be identified and changed. Then devise a classroom implementation scheme and work out debriefing guidelines in detail. After one has taken these steps, the characteristics of the game will be familiar, and productive play may begin.

Ultimately, objective evaluation and subjective evaluation meet. There are aspects of games that can be analyzed in detail, while others simply elicit like or dislike. Table 19 summarizes the strengths and limitations we have found in these eight simulation games on population, ecology, and land use.

Note

1. Katherine Finseth and Larry Schaeter, "Simulation Gaming and Personal Decision-Making," *Current Issues in Environmental Education–II*, ed. R. Marlette, (Columbus, Ohio: ERIC Center for Science, Math and Environmental Education, 1976), p. 35

TABLE 19 Strengths and Limitations

Simulation Game	Strengths	Limitations
Algonquin Park	wide range of well-defined roles can be played with a wide range of players well-defined content and information for play develops environmental awareness strong emphasis on the individual role in decision making lengthy and detailed role description	requires seven to eight periods for play
Balance	model validity high role play interesting flexibility high changing roles enable players to see different points of view real-life projects are part of the game	rules and introduction lengthly evaluation complicated takes several weeks to play simulation within simulation might not appeal to students
Baldicer	rules and time limits well defined very effective in creating awareness effective in illustrating interdependence of world economy flexible high player involvement game director's rules outstanding debriefing guidelines thorough	does not work in small groups depth of content for players roles limited requires four to five class periods or two hours to play
Ecopolis	model validity high adaptable to actual problems interesting challenges real-life projects are part of the game	takes several weeks to play evaluation complicated simulation within simulation might not appeal to students
Land Use	realistic involvement in developing land use plan simple to introduce and play very effective in creating awareness effective development of social skills rules and time limits well defined	requires minimum of fifteen players limited exposure to the content of land use management limited information on situations game purports to simulate
Planet Management	rules very clear and simple model validity high game graphs helpful in post-game discussion	flexibility low use of card computer slows game considerably role play limited
Predator	single-issue simulation inexpensive	single-issue simulation limited player involvement
Redwood Controversy	strong emphasis on ecological issues effective in developing environmental awareness teaches social skills through active player participation well-defined, interesting roles rules are well written and easily followed excellent model validity	requires a large group of players—optimum twenty-one many players only marginally involved in several stages of simulation