A SIMULATION GAME TEACHING AID FOR RURAL DEVELOPMENT*

By James Nelson and Gerald Doeksen

INTRODUCTION

Teaching rural development must reflect the breadth and complexity of the real world situation. Time limitations may restrict the teacher primarily to presentation and discussion of the field's many facets, leaving little time to consider how these diverse elements interact. Even if careful course planning and strict adherence to a course outlined provide classroom time for such consideration, only advanced graduate students are likely to have sufficient expertise to readily understand the relationships, real or hypothesized, resulting from these interactions.

Alternatives in the classroom include giving these relationships only cursory, descriptive treatment, or digging into them with analytical fervor, thereby causing many students a great deal of chagrin. A third alternative is demonstrating interactive aspects of rural development with a game. Such a game is discussed in this paper.

The game is organized around a systems approach to rural development, enabling students to gain simulated experience in devising a development strategy. The game is played toward the end of the course after relevant variables and interrelationships have been discussed. Students become aware of the complicated relationships existing between demographic factors and policy activities within an area economy. Given an hypothetical situation, each student allocates annual development funds to various programs. After his model is run on the computer, a student learns how his strategy affected people within the region. Then, based on the first year's output, he allocates second-year funds among the various programs. The model is run again. This process is continued until targets are met, "public funds" for development are exhausted, or the prescribed time within the development-planning horizon has passed.

The authors utilized this game as a teaching aid in an upper-level undergraduate rural development class and found that from 5 to 10 simulated years (computer runs) were necessary to impart desired understandings of the system of rural development phenomena. The simulation approach has been used with success in other problem reas. It has not only generated enthusiasm, but has provided the experience and feedback that are important for effective learning [1].

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THE SIMULATION MODEL[1]

Socio-Demographic Information of Simulated Area

The area whose development is simulated in the game is a sub-state planning region in Eastern Oklahoma.[2] The region has a high incidence of poverty, unemployment and underemployment. There is a substantial proportion of population which, due to age or disability, is outside the work force. Socio-demographic conditions existing in the region are presented in the computer printout in Table 1. Game-area population is divided into socio-demographic categories based on income, work eligibility, age and levels of education and training.

The poor in the game area categorized as employable or unemployable, according to their ability to work, those incapable of supporting themselves by working being classified as unemployable. Unemployable poor are further categorized as working age (15-64) or above working age (65 or over). Employable poor are cross-classified by age, attainment of high school education, and possession of technical training. The nonpoor in the area are categorized by age and income level.

Unemployable poor (age 15-64) are working age but cannot hold jobs because of physical or mental disability. Elderly unemployable poor (age 65 or over) are assumed to be physically incapable of work.

Employable poor are defined as capable of holding conventional jobs in the labor market. The game offers two ways to provide jobs for employable poor. They can be employed in new jobs created in the underdeveloped region, in which case they move into nonpoor classifications, or they can move out of the area. It is assumed that jobs are available in other areas, but costs associated with moving people to those jobs are recognized. Also, it is assumed that a certain percentage of movers return to their home area every year even though no jobs await them. Thus, over time, many poor who move out to get jobs will return to poverty roles in their home areas.

Presumably, poor dependents move out of poverty only as their parents are taken off poverty roles. The simulated number of poor dependents, then, decreases as the number of poor parents decreases.

Technical Coefficients

Technical coefficients specified in the simulator determine economic and other changes which occur in the game area over the time specified.

Some of these changes are affected by development activities, while others are not. The population constitutes a dynamic environment, changing over time whether or not development activities are initiated in the area. Technical coefficients required are of four types: demographic, income, employment and development activity efficiency coefficients.

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[1] The simulation model follows the approach specified by Tinbergen [4]. To utilize a systems simulation approach to area development program evaluation, the economy of an area can be conceptualized as follows:

$f_2 [X_1, X_2, \ldots. X_n, Z_1, Z_2, \ldots. Z_m] = 0$

$f_1 [X_1, X_2, \ldots. X_n, Z_1, Z_2, \ldots. Z_m] = 0$

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$f_n [X_1, X_2, \ldots X_n, Z_1, Z_2, \ldots Z_m] = 0$

where:

X_i's are variables endogenous to the economy [number of endogenous variables range from 1 to n]

Z_j's are variables exogenous to the economy [number of exogenous variables range from 1 to m].

The above systems of implicit equations could be solved to yield the following explicit functional statements:

$X_1 = g_1 [Z_1, Z_2, \ldots, Z_m]$

$X_2 = g_2 [Z_1, Z_2, \ldots, Z_m]$

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$X_n = g_n [Z_1, Z_2, \ldots, Z_m]$

Some group of endogenous variables $[X_1, X_2, \ldots, X_k]$ can be selected as target variables and their desired levels determined by the goals of policy makers. Then, if some subset of the exogenous variables $[Z_1, Z_2, \ldots, Z_h]$ can be manipulated as instrument variables, some or all of the goals may be attainable. If the number of instrumental variables [h] equals the number of target variables [k], then all of the goals can be attained. If k is greater than h, the desired goals can be reached in more than one manner. If k is less than h the desired goals cannot all be attained simultaneously.

The simulation model used in this study is designed to approximate this conceptual decision making framework. For a complete explanation of simulation model, and data used in model, see [2].

[2] An instructor utilizing the game can use this example area data or enter values in the various socio-demographic categories which approximate an area with which the students are familiar.

Table 1. SOCIO-DEMOGRAPHIC DATA FOR AN EXAMPLE GAME AREA — COMPUTER PRINTOUT

STARTING SITUATION: ****************** STRATEGY 1. YEAR 1.

TOTAL NONPOOR	114104.
NUMBER OF NONPOOR OVER AGE 65	9465.
NUMBER OF HIGH INCOME NONPOOR--AGE 20--39	2931.
NUMBER OF HIGH INCOME NONPOOR--AGE 40--64	3535.
NUMBER OF MEDIUM INCOME NONPOOR--AGE 20--39	12016.
NUMBER OF MEDIUM INCOME NONPOOR--AGE 40--64	14492.
NUMBER OF LOW INCOME NONPOOR--AGE 20--39	14361.
NUMBER OF LOW INCOME NONPOOR--AGE 40--64	17319.
NUMBER OF LOW INCOME NONPOOR--AGE 15--19	1376.
NUMBER OF NONPOOR CHILDREN AND STUDENTS BELOW 19	38609.
TOTAL POOR	77090.
NUMBER OF UNEMPLOYABLE POOR--AGE 15--64	15298.
NUMBER OF UNEMPLOYABLE POOR AGE 65 AND OVER	17147.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL AND TRAINING--AGE 20--39	312.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL AND TRAINING--AGE 40--64	362.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL BUT NO TRAINING--AGE 20--39	1024.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL BUT NO TRAINING--AGE 40--64	1205.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL BUT TRAINING--AGE 20--39	1201.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL BUT TRAINING--AGE 40--64	1407.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL AND NO TRAINING--AGE 20--39	3958.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL AND NO TRAINING--AGE 40--64	4633.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL AND NO TRAINING--AGE 15--19	730.
YOUNG CHILDREN AND STUDENTS LESS THAN AGE 19	29813.

Demographic coefficients in the model include birth rates, death rates and population growth rate (including implicit net migration rates apart from those influenced by the programs) for the game area. Specified simulator income coefficients include poverty income thresholds for socio-demographic categories of the population; potential earnings for the area's poor who take jobs created by development activities; total income resulting per dollar of public funds spent on development activities; and percentage of the area's income which goes to the area's poor. The simulation requires specification of three coefficients describing the area's labor force. These employment coefficients include percentages of working age adults in the labor force, poor in the labor force who have jobs but are underemployed, and underemployed poor.

Estimates of each development activity's effects (activity efficiency coefficients) serve as a starting point for simulating total effects of strategies containing multiple development activities. Linkages become apparent. Skill training programs, for example, display low payoffs in the absence of programs to provide jobs locally or elsewhere. Development activity efficiency coefficients describe, in terms of cost effectiveness, the impacts of programs including labor mobility, industrialization, school dropout prevention, technical training and family planning.

Students' Alternatives

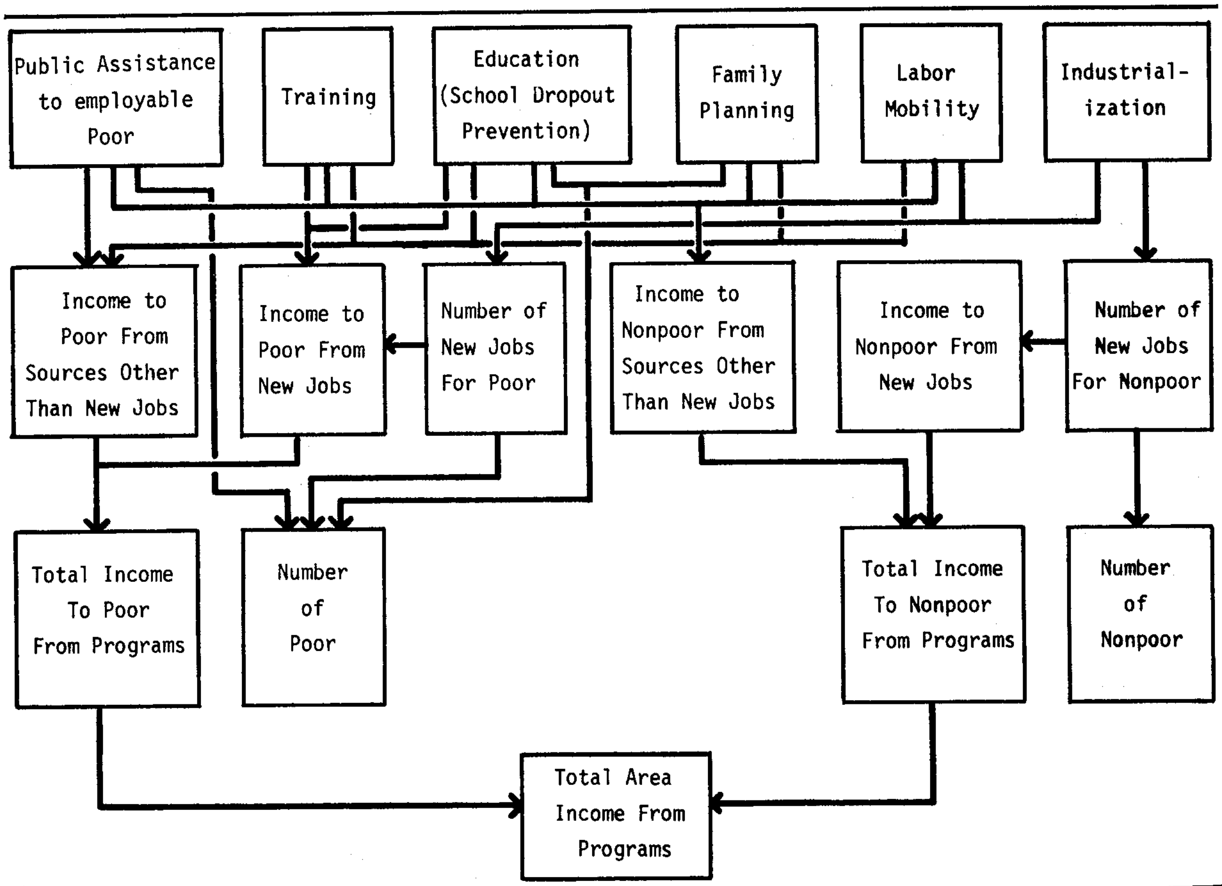
Each student is responsible for disbursing simulated development funds in the game area. These funds can be allocated among the following alternative activities:

1. To unemployable poor over age 65 (public assistance grants).
2. To unemployable poor, ages 15-64 (public assistance grants).
3. To education (school dropout prevention).
4. To technical training.
5. To family planning.
6. To industrialization.
7. To labor mobility subsidization.

These alternatives represent special development activities which can be initiated over and above "typical" public investment in an area. It is assumed that roads, schools and other services and infrastructure are adequately funded in the game area—even though in a typical underdeveloped area adequate funding of all these items may be unlikely. A schematic of the simulated effects of development activities is shown in Figure 1.

Unemployable poor are removed from poverty by continuous transfer payments. People in the employable poor categories who reach age 65 and are still not employed are assigned to the unemployable poor over age 65.

Figure 1. A SCHEMATIC OF SIMULATED PROGRAM EFFECTS



Funds allocated to education are used to keep students from dropping out of school. Those allotted to technical training are used to train untrained poor. These activities do not directly provide income to poor people. However, education or training may be a requirement for employment, and when people are employed they often receive higher incomes if they have high school education or other training.

Funds allocated to family planning are used to make information and contraceptives available to the poor and reduce the birth rate. Such a reduction tends to decrease the number of poverty-bound young children and students.

Funds assigned to industrialization and labor mobility subsidization make jobs available to the poor. These jobs have priority over training programs, for, if jobs are available, untrained poor will take them rather than utilizing training programs. Jobs made available by industrialization and labor mobility subsidization go first to the best educated, best trained and youngest poor. Industrialization jobs are filled first, then those outside the region made accessible by labor mobility subsidization. Wages paid people taking new jobs vary according to levels of education and training.

Funds for industrialization also create new jobs for the nonpoor. It is assumed that some of these new jobs are filled by local nonpoor (their vacated jobs are filled by the poor) and some by nonpoor migrating into the area. While funds allocated to activities other than industrialization do not create permanent jobs, such expenditures do create income for both nonpoor and poor in the area. This income varies as expenditures vary.

All development allocations are assumed to have indirect as well as direct effects. In the case of allocations to industrialization, direct jobs created are assumed to be permanent and are expected to generate indirect jobs in the area. The total jobs created (direct and indirect) result in increased income. Jobs created by industrialization in previous years remain after the industrialization programs are terminated. Simulated income to residents who obtain jobs outside the region (from labor mobility allocations) is considered continuing income. However, since the jobs are outside the area, no indirect income results. Allocations to other development activities create both direct and indirect income for the game area; but, since no permanent jobs are created, such income is of a temporary nature. It continues only as long as the activities or programs are continued.

To illustrate a student's decisions, the form he must complete each year is presented in Table 2. Based on initial conditions in the region as specified in Table 1, the student allocates the money available for various programs.

Table 2. FORM ON WHICH STUDENT SPECIFIES HIS FUND ALLOCATION

Name *Mr. Smith* Year *1*

Allocation to:

Unemployable poor over age 65	$29,000,000	(1-10)	Student Number
Unemployable poor, age 15-64	42,000,000	(11-20)	
Education	150,000	(21-30)	*21*
Training	1,500,000	(31-40)	(78-80)
Family Planning	600,000	(41-50)	
Industrialization	1,750,000	(51-60)	
Labor Mobility	0	(61-70)	

Having determined that judicious allocation of about $75 million annually to seven development programs could act as an agent of poverty amelioration. Students attempt to maximize regional welfare. Each indicates his allocations on the form illustrated in Table 2, after which a keypunch operator easily transfers the student's choices to a computer card. The simulation game is then run on a 360-65 computer. With 20-25 students playing, cost per run is less than $10. Turnaround time depends on a number of things, but access to a keypunch machine and the computer facilitates a 2-hour per run completion time.

Results of Student's Allocation Decisions

The results of student decisions are presented in Table 3. From a total of 77,090 simulated poor in the starting situation, 28,314 remained after allocations were made. The student's decisions, then, successfully removed a large number from the unemployable poor category, due to his large allocation to public-assistance grants. However, assistance was provided for only 1 year. In the next simulated year, without new allocations to public assistance, these unemployable poor would be back in poverty.

First year allocations removed only a few employable poor from poverty. These received jobs created because of allocations to industrialization. Some young poor stayed in school because of education allocations, remaining outside the young, uneducated, employable poor group. Also, some untrained employable poor received training made available through the student's allocations. These training recipients, however, simply moved into other classifications of simulated poor since there were no jobs available for them. The student, although fairly successful in temporarily removing from poverty those simulated poor incapable of supporting themselves by working, has still not provided much assistance to those unemployed and underemployed poor who are capable of working but for whom no jobs are available.

Based on conditions at the end of year 1, a student makes allocation decisions for year 2. The simulation game is run again and results interpreted, the process being continued for a designated number of years or until certain goals are attained. For class purposes, the game is played from 5 to 10 years.

PLAYER EVALUATION

Players of this "area economic development" game compete for success in developing a game area. Each receives a final grade which indicates his ranking with others. Success is measured by the efficiency with which players can eliminate simulated poverty and generate simulated incomes

Table 3. RESULTS OF A STUDENT'S DECISIONS FOR YEAR 1 AND EXAMPLE GAME AREA — COMPUTER PRINTOUT

ENDING SITUATION:
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TOTAL NONPOOR	164672.
NUMBER OF NONPOOR OVER AGE 65	10609.
NUMBER OF HIGH INCOME NONPOOR--AGE 20--39	3064.
NUMBER OF HIGH INCOME NONPOOR--AGE 40--64	3499.
NUMBER OF MEDIUM INCOME NONPOOR--AGE 20--39	12541.
NUMBER OF MEDIUM INCOME NONPOOR--AGE 40--64	14346.
NUMBER OF LOW INCOME NONPOOR--AGE 20--39	16359.
NUMBER OF LOW INCOME NONPOOR--AGE 40--64	17489.
NUMBER OF LOW INCOME NONPOOR--AGE 15--19	1208.
NUMBER OF NONPOOR CHILDREN AND STUDENTS BELOW 19	39965.
NUMBER REMOVED FROM POVERTY BY WELFARE	
UNEMPLOYABLE POOR--AGE 15--64	14762.
UNEMPLOYABLE POOR AGE 65 AND OVER	16223.
CHILDREN	14607.
TOTAL REMAINING POOR	28314.
NUMBER OF UNEMPLOYABLE POOR--AGE 15--64	469.
NUMBER OF UNEMPLOYABLE POOR AGE 65 AND OVER	417.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL AND TRAINING--AGE 20-39	71.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL AND TRAINING--AGE 40--64	116.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL BUT NO TRAINING--AGE 20--39	561.
NUMBER OF EMPLOYABLE POOR WITH HIGH SCHOOL BUT NO TRAINING--AGE 40--64	1061.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL BUT TRAINING--AGE 20--39	1549.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL BUT TRAINING--AGE 40--64	1855.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL AND NO TRAINING--AGE 20--39	3510.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL AND NO TRAINING--AGE 40--64	4155.
NUMBER OF EMPLOYABLE POOR WITH NO HIGH SCHOOL AND NO TRAINING--AGE 15--19	714.
YOUNG CHILDREN AND STUDENTS LESS THAN AGE 19	13835.

for the people of the area. This efficiency (or lack of it) is measured equally in three ways:[3]

1. By the number of game-area people remaining in poverty at the end of the simulated time period.
2. By the number of game-area people left in poverty at the end of each simulated year (computer run) and time period.
3. By the ratio of present value of game-area income generated by development activities to present value of funds allocated to such activities over a prescribed time period.

Each of these measures is evaluated in terms of the efficiency of the most efficient player. Thus a typical "grading curve" is established for each of the three measures. These grades are then averaged for each player and an aggregate percentage grade for each player determined.

The game's competitive element is amplified by the fact that players compete for job-development efficiency, based on levels of education and training of potential job recipients. If the poor population in a given year has greatly higher or lower education and/or training profiles than those in other player's areas, then industrial development funds in the area will have respectively more or less efficiency.

SUMMARY

The field of rural development deals with many complicated interrelationships of physical and socio-economic change. The multi-variable interaction in the economics of rural development is difficult for most students to conceptualize. The game was developed as a tool to demonstrate this interaction and assist students as well as rural development practitioners (extension agents, local government officials and community leaders) in understanding rural development: It is a system of highly interrelated activities, which, to be effective, must be comprehensive and goal-oriented rather than segmented and program-oriented.

Using this game, plans formulated by students for a specific time interval and a defined underdeveloped area can be fed into a computerized simulation model which provides a printout. These

[3] For the classroom, equal weight was given to each measure of efficiency. However, these could be weighted in any weighing scheme desired.

plans consist of allocations of public-development funds among alternative development activities. Printed outcomes indicate economic and socio-demographic results of the student's plans.

Players compete for effective economic development of a game area by attempting to eliminate poverty and generate income. Each player's development strategy is independent of that of others, but results are evaluated against other players' results.

The authors have utilized this game in the classroom. Interest and enthusiasm were generated. But, more importantly, students' understanding of rural development as a system of multi-faceted interactive variables was enhanced.

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