TEACHING MANAGEMENT RESEARCH THROUGH COMPUTER SIMULATION

Arthur A. Whatley
Associate Professor of Management
New Mexico State University

INTRODUCTION

The past decade serves as witness to the number of changes that have taken place in management education: management principles have given way to contingency management; the lecture is increasingly accompanied by cases, experiential exercises, and field experiences; and memorization has given way to situational thinking. Changes of this nature should come as no surprise as the field has increasingly borrowed from and incorporated behavioral science findings. In fact, it is the nature of the behavioral sciences that has given rise to this turnabout in management education. Management students are increasingly aware of the value of quantification, the use of scientific inquiry and the need for objectivity in management decision making. They are also coming to know that the practice of management, as a profession, requires an understanding of the complex interactions between variables. For example, when is pay a motivator? Does the nature of the work environment affect a given pay program? How many relevant variables should be considered when making decisions about the motivational aspects of pay?

The purpose of this paper is to describe how computer simulation can be used to develop attitudes, insights, an appreciation of the philosophy and practice of science, and the value of scientifically produced information for management decision making. The project will be described from its very beginning.

EXXON EDUCATION FOUNDATION

The Exxon Education Foundation funds two types of education innovation programs. The first type supports the design development, and implementation of major education innovations. As of this writing, Exxon has funded six major innovations. Four are complete and operational. A brief description of each program follows:

1. Teaching Information Processing System (TIPS)--A computer-assisted method of monitoring each individual student's progress, identifying specific weaknesses and strengths in his grasp of the subject matter, and of prescribing corrective study.

- 2. Experimental Simulation (Exper Sim)--Use of the computer to teach research methods. Students design their own experiments, formulate their own research strategies, and perform their own analyses of the "raw data" received from the computer. (A more detailed description of this project appears later in the paper.)

3. Programmed Instruction Combined with Problem Solving (Guided Design)--Reshapes the traditional approach to higher education by having students, working in small groups, attack problems rather than masses of information. The learning process here revolves around students' efforts to devise solutions for a series of increasingly complex open-ended problems.

4. Student to Student Counseling--Provides new students with personal attention and guidance over an extended period through the use of role-playing exercises, lectures, discussions, and demonstrations.

Once a program is fully developed and functioning, Exxon then funds small (not to exceed $6,000) Implementation grants. The author has received a grant to implement the program called Exper Sim or Experimental Simulation in a course at New Mexico State University called Mgt 380--Applied Management Research. This course is required of all management majors and is a prelude to our upper division courses in groups, leadership and organization development.

EXPER SIM

In general, Exper Sim entails using the computer to teach research methods, design and procedures. Without the aid of computers, research courses usually involve the student designing a research project at the beginning of a semester and then spending the remaining time collecting and analyzing data. As a result the student is able to complete only one research project in a given semester. Exper Sim changes all of this by storing in the computer pertinent variables and data associated with a particular topic. The student formulates research hypotheses but does not have to go into the field or laboratory to collect the data first-hand. He simply enters his requests for specific data into the computer and receives instantaneous output. Time is thus created for statistically treating the data, and more importantly, for formulating additional hypotheses and engaging in further research. In this way Exper Sim allows the student to complete several research projects in a given semester.

MOTIVE MODEL

An Exper Sim model appropriate for management educationis called MOTIVE [5]. The model is built principally upon the

theoretical works of Atkinson [1, 2] and McClelland [3, 4] The structure of the model is as follows:

1. a brief theoretical sketch of achievement motivation,
2. a description of the variables in the model and
3. examples of research designs utilizing the variables in the model.

As with any simulation, the number of relevant variables in the model is judgmental. In making this judgement one runs the risk of eliminating variables that some would consider important and including variables that others would view as unimportant. In any case, the model is constructed utilizing those variables which the literature indicates to be the most important. The variables in the MOTIVE model, their random value and their range of values are as follows:

Motive Model Variables

	Variable	Abbrev.	Default Value	Possible Values
1.	Number in the Test Group	NGRP	100	1 to 100
2.	Instructions for Completing the Task	INSTR	1	1 to 4 different types
3.	Task Difficulty	TASK	MODERATE	EASY, MODERATE, HARD
4.	Sex of the Experimenter	SEXE	MALE	MALE, FEMALE
5.	Sex of the Subjects	SEXS	RANDOM	MALE, FEMALE, BALANCED, RANDOM
6.	Year in College	YR	RANDOM	1 to 4 or FRESHMAN, SOPH, JUNIOR, SENIOR, RANDOM
7.	Need Achievement	NACH	RANDOM	1 to 3 or HIGH, MEDIUM, LOW, RANDOM
8.	Need Affiliation	NAFF	RANDOM	1 to 3 or HIGH, MEDIUM, LOW, RANDOM

	Variable	Abbrev.	Default Value	Possible Values
9.	Fear of Failure	FRF	RANDOM	1 to 3 or HIGH, MEDIUM, LOW, RANDOM
10.	Length of Test	LEN	10	1 to 60
11.	Need Achievement (raw score)	XNACH		Continuous
12.	Need Affiliation (raw score)	XNAFF		Continuous
13.	Fear of Failure (raw score)	XFRF		Continuous

After studying the theory of achievement motivation and the list of manipulable variables, the student is then prepared to try designing a research project. For example, the student might want to know whether or not the subject's sex is related to achievement motivation. In this case a 3 x 2 design could be set up whereby need achievement (NACH) is specified as high, medium and low, and the sex of the subjects (SEXS) is specified as male and female. All other variables would not be specified and thus would be assigned their default value as described above.

The output from such an experiment follows. The entire research design is described first and a segment of the simulated data appears second.

THE FOLLOWING VARIABLE SETTINGS ARE CONSTANT ACROSS ALL CONDITIONS:

TASKDIFF=MODERATE SEXE=MALE YEAR=RANDOM
NAFF= RANDOM FEARF= RANDOM
NGRP= 100.0 INSTRUCT=l. 000 LENGTH=l0.0

VARIABLE SETTINGS FOR CONDITION A
SEXS=MALE
NACH= 1.000

VARIABLE SETTINGS FOR CONDITION B
SEXS=FEMALE
NACH = 1.000

VARIABLE SETTINGS FOR CONDITION C
SEXS=MALE
NACH= 2.000

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  VARIABLE SETTINGS FOR CONDITION D
          SEXS=FEMALE
          NACH= 2.000

  VARIABLE SETTINGS FOR CONDITION E
          SEXS=MALE
          NACH= 3.000

  VARIABLE SETTINGS FOR CONDITION F
          SEXS=FEMALE
          NACH= 3.000

  ENTER NO. OF SUBJECTS IN EACH GROUP
>>STAT=ALL
STATISTICS OPTIONS ENABLED:
  MEAN
  VARIANCE
  SUMSQRS
  COV
  CORR

 ENTER NO. OF SUBJECTS IN EACH GROUP
100


     The raw data associated with condition A appear below:

WHATLEY
13:54:46   FRIDAY FEBRUARY 27, 1976
GROUP NUMBER   1
CONDITION(S):   A
NUMBER OF SUBJECTS:   100

TEST      SCORES
        59.0        87.0        63.0        63.0        57.0
        78.0        84.0        61.0        43.0        52.0
        65.0        41.0        33.0        50.0        58.0
        67.0        60.0        44.0        68.0        34.0
        28.0        69.0        77.0        42.0        73.0
        54.0        74.0        38.0        67.0        78.0
        73.0        39.0        39.0        52.0        66.0
        57.0        17.0        76.0        63.0        84.0
        29.0        45.0        75.0        36.0        52.0
        55.0        58.0        57.0        99.0        61.0
        88.0        60.0        77.0        51.0        62.0
        74.0        67.0        49.0        44.0        63.0
        87.0        40.0        49.0        78.0        34.0
        79.0        42.0        57.0        61.0        66.0
        92.0        103.        70.0        79.0        46.0
        53.0        75.0        72.0        88.0        62.0
        40.0        61.0        72.0        28.0        85.0
        70.0        104.        42.0        60.0        90.0
        82.0        81.0        78.0        4.00        37.0
        88.0        45.0        55.0        35.0        58.0
```

NO. OF SS WITH COMPLETE DATA:100

VARIABLE: TEST
MEAN: 60.82
VARIANCE: 365.0
STD. DEVIATION: 19.11
SUM OF SQUARED OBSERVATIONS: 406046.
COST: 330.0

At the option of the instructor, a cost simulation can be used along with the research simulation. The cost simulation assigns various cost "points" to different aspects of the design. For example, it costs 10 points for each group tested in the experiment. Each subject in any experiment costs 2 points. If some control is added, say for the sex of the subject, it costs 10 extra points per subject for each control. The purpose of the cost simulation is to introduce the student researcher to the inescapable fact that research projects always entail a cost, and that large and more sophisticated projects cost more than smaller projects.

DATA ANALYSIS USING EXPER SIM

The models currently available in Exper Sim are contained in a “parent” program called the Supervisor. The Supervisor allows the user-researcher to specify the model of interest and then design the research for exploration of the model. After the research has been completed and the data collected, the question of data analysis arises. At the present time, the Supervisor program contains a statistical routine (called by the STAT command) which allows the user-researcher to request that certain statistics be calculated. All the models in the Supervisor calculate some descriptive statistics in a routine manner. The MOTIVE model, for example, automatically calculates means, sum of squares, variances, and standard deviations as illustrated in the output on page 5.

At New Mexico State University we are trying to develop an interface between the Supervisor and SPSS (Statistical Packages for the Social Sciences)--a most complete and up-to-date set of analytical tools designed specifically for the social sciences. There is a routine in the Supervisor which stores the data generated in the experiments until such time that the user-researcher calls it. It is at this point that we hope to interface SPSS with the stored raw data.

THE STUDENT AND EXPER SIM

I hope the reader is beginning to feel the magnitude of the challenge Exper Sim holds for the typical junior management

major---one who is afraid of and knows very little statistics, thinks; of a scientist as one who deals only in "hard" disciplines, and is often suspicious of the computer. Because I am still in the process of collecting empirical evidence to support the effectiveness of Exper Sim, I can only report my perception of how this approach impacts on students.

After a brief review of basic statistics, sampling theory, research design, and the philosophy and practice of science (one month of a standard four and half month semester), the student is ready to be introduced to the idea of computer simulation and how it specifically applies to management research. Gradually, the student is introduced to the computer terminal, given instructions (in APL) for submitting a research design through the terminal and given a brief period of time for becoming familiar with the system.

As greater sophistication is gained in using the MOTIVE model, all students are asked to play the role of a researcher in a scientific community. They are to conduct their research and then present it to their peers for review and criticism. This is a most effective way for teaching students how scientific knowledge is developed and how difficult it can be to design an "acceptable," "tight" piece of research.

CURRENT MODEL DEVELOPMENT

As of this writing, over twenty implementation grants have been funded by the foundation. Recipients from a wide diversity of areas are represented with psychology the most numerous. The author and Professor Paul Lorton, University of San Francisco, have received the only grants in business.

Although the MOTIVE model described above was intended for exploration and study by psychology students, I have found little or no difficulty in having management students use it. Along with the MOTIVE model, the author is currently developing models in job satisfaction and leadership that should be operational by May of this year. All of the activities in model development are coordinated through Dr. Dana Main, the originator of Exper Sim. The long term goal (within five years) is for Exxon to financially support a clearing house for the dissemination and coordination of information related to a multitude of models. This would allow an Exper Sim user to learn of other models available in his field and to make available, in publication form, models of his own creation. Conceivably, these efforts could lead to a point at which business students in an Exper Sim course would have several models from which to choose their research topic. In this way, their personal interests in a particular topic could be met as opposed to forcing the MOTIVE model on everyone in the class. It would be, in effect, a form of individualized instruction.

- Exper Sim is specifically designed for general application regardless of discipline. As long as the discipline is structured around relationships between variables, Exper Sim should be applicable. The only areas in which Exper Sim may not be appropriate are music, drama and perhaps history. But all areas of management and business in general are appropriate disciplines for using Exper Sim.

SUMMARY

I urge you to carefully consider the possibilities of implementing Exper Sim at your institution. Given the paucity of outside funding sources for business education, even $6,000 (the maximum for an Exper Sim grant) seems sizeable. Part of the grant can be used for compensation for released time, secretarial services, and travel monies--all of which are hard to come by at most institutions.

If you are interested in submitting a proposal, write to:

Karen Korshin
Exxon Education Foundation
111 W. 49th
New York, New York 10020

She will provide you with materials describing the Foundation, various programs it supports and specific instructions for submitting a proposal.

You may, as a preliminary measure, want to learn more about Exper Sim before you decide whether or not to go for funding. In this case write to:

Dr. Dana Main
Division of Behavioral Studies
West Virginia College of Behavioral Studies
Institute, West Virginia 25112

It should be mentioned here that Exper Sim can be implemented at minimal dollar outlay without grant support. Of course it is better to have Exxon help. But, just in case you submit a proposal and it is not funded, Dana Main will still provide all the necessary Exper Sim materials for around fifty dollars. Nonfunded use of Exper Sim necessitates a lot of your time (1/4 release time for a semester) in addition to a considerable amount of programming assistance. However, it can and is being done.

Exper Sim is an exciting and innovative way for teaching several topics: student interaction with the computer, applied statistics, applied research, and the material upon which the model being used in built. It engenders enthusiasm and interest

by students for the scientific process and it produces realistic data for business decision making. I hope you will consider adopting Exper Sim at your university.

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4. McClelland, D. C. and D. G. Winter, Motivating Economic Achievement, (New York: Free Press, 1969).

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