

Developments in Business Simulation & Experiential Exercises, Volume 11, 1984

SIMULATION GAMING AS A MEANS OF RESEARCHING SUBSTANTIVE ISSUES: ANOTHER LOOK

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ABSTRACT

Simulation games can serve as research environments as well as for training purposes. This paper discusses the advantages and disadvantages of using simulation games to investigate substantive issues. A less-than-totally-successful example is used to illustrate the points made.

INTRODUCTION

The use of a simulation game as a research paradigm is not a new phenomenon; in fact, Cohen and Rhenman [6] stated that many of the developers of the early games were as interested in using them for research purposes as they were for training purposes. Simulation games have been used as research environments to investigate issues in a wide variety of fields, including bargaining behavior [23] and [24]; strategic planning [12]; advertising [11]; divestments [15]; decision rules [9] and [18]; leadership styles [2UJ; and retail pricing [10]. Moreover, there are a number of articles available [4], [5], [6], [8], [13], [15], [20] which do a very thorough job of discussing the pros and cons of using a simulation game as a paradigm for investigating substantive issues.

Given the publication dates cited above for the papers discussing the use of games for research purposes, it is obvious that this paper is not raising a new issue. However, it is a relatively new issue to ABSEL, one which has not been discussed thoroughly at an ABSEL conference. ABSEL members (for example, the Remus 1963 article) have published articles using simulation games as the research paradigm in which non-teaching issues were investigated, but the substantive research articles are published normally in outlets other than the ABSEL Proceedings. Thus, the purpose of this paper is to discuss the benefits, the methodological weaknesses, and some ethical issues associated with the use of simulation games as research environments. Consistent with the experiential thrust of our organization, we will discuss one experience of our own.

SIMULATION GAMES AS RESEARCH ENVIRONMENTS

Advantages. Why have many researchers expressed great hope for the use of simulation games as research environments? One reason is that simulation gaming is seen as a middle ground between laboratory and field research. We are all familiar with the strengths and the weaknesses of laboratory and field experiments; in general, the hope is that simulation games can allow sufficient control so as to insure internal validity while at the same time being sufficiently realistic so as to have some external validity. It is our opinion that simulation gaming does have some of the advantages of both, but we must acknowledge also that it has some of the weaknesses of both as well.

Another important advantage is that, for some problem areas, the alternative procedures are infeasible or at least nearly so. The most commonly cited alternatives to a simulation experiment are

questionnaire surveys and field studies [15]. There are several disadvantages to field studies. If we are attempting to study complex decision processes, they are extremely costly and largely uncontrollable. Since decision making is often slow and infrequent, it is sometimes impossible to study the whole process of decision making within an organization. If the particular behavior under study is contingent upon infrequent environmental conditions (labor negotiations, weather conditions, etc.), the researcher must react to conditions rather than control them. Finally, field studies are infeasible when they involve issues about which organizations are very sensitive (labor negotiations and divestment decisions are examples).

The other alternative, the survey method, requires the respondent to recall his decision process. While one can ask what people did fairly easily, it is much more difficult to ask them how they did it. The researcher cannot expect an organization to recall accurately the details of the interactions among the decision-makers, or the stages through which the decision evolved. Complex decisions would require an extremely extensive questionnaire, which would probably result in a low response rate. The response rate might be reduced even more if the issue under investigation involved a sensitive topic.

The use of a simulation game as a research environment can offer several advantages over its alternative methods. The cost of collecting data is far lower than that of a field study, and the simulated environment removes the sensitivity associated with the problem area. Slusher, Sims and Thiel [15] cite four other advantages: (1) high participant involvement, (2) the presence of complex decision processes, (3) the longitudinal development of small group relations, and (4) a continuing relationship with other groups. The longitudinal nature of most simulations can enable the researcher to manipulate experimentally a number of situational variables to explore the dynamic interaction and impact of these variables on group performance and satisfaction [20]. The game decision making can be interrupted, dissected and reconstructed, allowing the researcher to obtain a wealth of information on the decision process itself. Further, as noted by Slusher, Sims and Thiel [15], the longitudinal nature of the simulation game overcomes a commonly-encountered problem faced in laboratory research and in many field studies, the investigation of a process with a onetime-only encounter. Many problem areas involve long-term relationships, and a cross-sectional study may not be able to capture them. The use of a longitudinal game provides a shift in time perspective which allows subjects to avoid an emphasis solely on short-term results.

Overall, the advantages associated with the use of business games as research tools are much the same as the ones attributed to laboratory experiments when contrasted with field experiments. You have far greater control possible in the game environment, as you can make certain that situations arise. There is no such assurance when investigating real phenomena in the field. Further,

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as Bass [5] pointed out, you have the ability to replicate your studies which is lacking from field studies.

Disadvantages. Continuing the analogy between simulation-based experiments and laboratory experiments, one might expect artificiality to be a common criticism of simulation gaming used as a research environment. In fact, Nees [15] cites artificiality as the major criticism of simulations, due to a lack of resemblance to the real organizations and to the awareness of the subjects that they are participating in a "game." It should be remembered, though, that one of the advantages of the simulation game over the laboratory experiment is its increased realism. "Realism" can be viewed as a continuum, and just how much more closely the simulation is to the field study than the laboratory experiment depends upon the nature of the game itself and the manner in which it is administered.

Aronson and Carlsmith [1] delineated two types of realism: mundane and experimental. Mundane realism relates to how likely it is that the events occurring in a laboratory are likely to occur in the real world. Experimental realism relates to how seriously the subject takes the experiment. Simulation game designers have placed more emphasis on mundane realism, in that they try to assess the simulation's face validity by having it evaluated by experts in the area. Game users are aware that certain simulation games do a better job than others of modeling the process which we want to introduce to students. Consequently, the experienced game user should be able to find a game offering the necessary mundane realism required.

Game users are aware also of problems dealing with experimental realism, as the propensity for students to treat the simulation as a "game" and to "experiment" with their decisions has been acknowledged at many informal ABSEL sessions. To many, this tendency to experiment is a result of the lack of incentive for the subject to perform well. Nees [15] noted that the participants in her simulation do not bear the consequences of their decision. Neither were they penalized for failure, nor did they have to live with their undertakings after the simulation was over." The subjects in her study were managers participating in a management development program.

The lack of incentives issue is intertwined with another issue, namely the nature of the subject group: college students or managers. On one hand, the grade environment which exists in the classroom places an incentive on student subjects to do well. Slusher, Sims and Thiel [24] note that grade incentives can be used also for laboratory experiments, but the semester-long involvement in a competitive learning environment provides a high and consistent incentive.

On the other hand, Bass [5] discussed the high motivation level usually found among manager-subjects. While noting that the powerful motivations of real job security and real monetary reward are absent, he observed that "real managers try to do their best when confronted with simulated management problems." Incentive for play was attributed to competitive desires and to a sense of loyalty to one's team.

The best answer to the question of whether the game has experimental realism involves a comparison of the subjects' game behavior with their actual behavior. Obviously this can present serious problems in the case of student subjects as they cannot be expected to be making actual decisions for most topics under

investigation. However, there have been studies which compared the performance of manager-subjects in simulation games to their performance in the workplace. Babb and Bohl [21] found 70% of farmers' initial pricing decisions in a farm management game to be consistent with their real life decisions. However, the proportion in agreement declined over subsequent decisions. Jones and Babb [10] found that retail managers' pricing decisions agreed with their real world behavior only about half the time; however, they did find that their non price behavior was nearly identical to that used in the simulation games.

Babb, Leslie, and van Slyke [4] provide the most insight into the interaction between subjects (students vs. managers) and experimental realism. They note that there are marked differences in the game behavior of the two groups. Students are affected much more by information provided than managers apparently rely on experience. Managers follow more conservative policies than students, while students are more erratic in their decisions. Apparently students feel the need to learn something about the industry by experimenting with the game. Student performance curves differ from manager performance curves, especially early in the game. Babb, Leslie, and van Slyke [4] note that student performances move toward the level of managers' performances after a few decisions. The general conclusion, then, is that experimentation on the subjects' part does take place and that this experimentation is not likely to be done in a real world environment. However, even when student subjects are used, game behavior moves toward real life after a few decisions.

Even if we are confident about our game's mundane realism and about the experimental realism involved in its use, other problems exist in the use of a game as a research paradigm. Babb, Leslie, and van Slyke [4] note that business games require quite a number of resources, especially if suitable games are not available. Substantial inputs of time are required of both the administrator and the players. Most studies using business games involve small samples, thus creating problems associated with the statistical power of the study.

One other serious problem that may occur in simulation games is the relative lack of control found in dynamic games. Laboratory studies are typically of short duration and the randomization process should insure that the subjects face the experimental manipulation from the same frame of reference. However, in a longitudinal simulation, the player's status at any given time is a function of his previous decisions as well as the starting conditions. Thus, while the experimental manipulation itself is the same, game-induced differences in personal wealth, net worth, etc., may result in vastly different perceptions of the manipulation. Thus confounding may occur because both earlier decisions and the manipulation affect the observed behavior.

Next we will discuss one specific case of the use of a game as a research environment. This anecdotal approach is intended to present the reader with vivid examples of the benefits and of the problems associated with this type of research.

AN EXAMPLE

The Problem Area: The Effectiveness of Fear Appeals in Water Conservation. The senior author was interested in investigating the effectiveness of fear appeals (an advertisement meant to increase the level of anxiety about a problem; the desired result is that the audience chooses the recommended approach to avoid the negative

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consequences presented). The area chosen for study was agricultural water conservation, partly due to the possibility of obtaining funding and partly due to the seriousness of the problem. In the past three decades, irrigated crop acreage in the United States has almost tripled and is now consuming more than 80% of all water used in the nation. While water is a renewable resource, its availability in certain areas of the country is being threatened. In the Great Plains area, for example, aquifers (underground formations of porous, water-bearing rock which supply about 40% of the water used in irrigation) are being over-drafted 126%. In other words, for every 100 gallons taken out, only 74 are being returned (Reader's Digest 1981).

Many effective means exist for reducing water losses in transportation and for reducing the amount of water required for application to crops. However, in many cases there is little incentive to use these methods as their short-run costs appear to outweigh their short run benefits. No real controls exist for pumping, and each individual has a short-run incentive to use as much water as possible. That is, in the short run, the more water used, the greater the crop yields. This general problem of short-term individual incentives existing to over-use a renewable resource is referred to as a social trap [16]. Past research in the area has indicated that conservation may be increased by (1) regulation and/or (2) efforts to increase the salience of the long-run situation.

One means of implementing the latter approach is through the use of fear appeals. In general, the use of persuasion in reducing water consumption has been relatively unsuccessful to date [12]. Typically the appeals are not used until there are signs of an imminent crisis, when the long-run circumstances are already becoming more salient to water users. Even then it is difficult to determine the effects of the fear appeals, as they are followed frequently by the instigation of restrictive measures and/or rationing. While the consensus is that fear appeals have not been particularly effective, it is unclear whether persuasion is ineffective in general or whether the particular appeals used were ineffective. The intent of the research, then, was to investigate systematically the use of fear appeals in the promotion of agricultural water conservation.

Possible Research Environments. Field research (excuse the pun) is possible, as one can expose farmers to appeals and then note changes in their attitudes and behavioral intentions. Personal contact with the farmers is costly, as the size of the farms in the Great Plains area makes for a lot of driving. A more severe problem with field research is the lack of control over the elements, especially the amount of rainfall. Even though the appeal stressed long run problems, the lack of problems in the short run can greatly affect one's perception of the long run. For example, Mowen and Middlemist [14] conducted a study of the effects of commitment and feedback on domestic water conservation. Unfortunately, their study was done during an unusually wet summer and there was little environmental pressure on the participants to conserve water.

The simulation game offers many control advantages, as the nature of the problem can be specified in the background material provided and conditions such as rainfall can be manipulated by the game designer. While fear appeals can be evaluated quickly in a laboratory environment, the question of experiment realism is especially pertinent. Without the incentives which can be built into the game structure, it is not clear why the respondent would take the experimental situation seriously. Moreover, no behavioral

measure of water conservation is available in the laboratory, and the dependent variables would need to be limited to attitudes and intentions. The inclusion of irrigation decisions in a farm management game provides a behavioral dependent variable.

Development of the Farm Game. Simulation gaming is not a new pedagogical approach in the area of farm management at Oklahoma State University, as Walker and Eidman [25] presented their Game Farm at the first ABSEL conference in Oklahoma City. However, the Game Farm had fallen into disuse due to its complexity, the inordinate amount of time required to update its parameters, and to a rotation of instructors in the course. Some initial attempts were made to resurrect the game, but it did not include water problems since the game simulated the management of a dry land farm in the Oklahoma Panhandle. Consequently, a decision was made to design a simpler game, one which could be updated easily but yet help the students see how their decisions affected the financial statements.

Thus a new farm management simulation game [19] was designed and programmed. Students were required to operate a 1600-acre irrigated farm. Five crop alternatives were available (alfalfa, corn, cotton, milo, and wheat). The students in a junior level farm management class were given enterprise budgets for each crop which provided cost estimates, yield estimates, equipment requirements, etc., and were representative of the type of information available through agricultural extension services. Students received lectures on the use of these budgets, so it was expected that they would use this information in the determination of the optimal planting decisions. The yields and prices were the same for all students, and the trends in both were stable for the first four years of game play. The intent was to make the game play as similar as possible for all students prior to the introduction of the fear appeal. The students played the game during a two-week period, playing three years of game play the first week and the last three years the second week. At the beginning of the second week, the students were shown the fear appeals. All students were presented with the same discussion of the irrigation alternatives and the same projections as to the corresponding reductions in operating costs and water consumption. After reading the appeal, they were asked to provide manipulation checks for the probability and consequence treatments, measures of attitude and intention using five-point Likert-type questions, and then were asked to select one of four improvements (they also had the option to do nothing) to the irrigation system at the beginning of year four's play. The intent was to price all four of the alternatives so that the pay back period would be long in comparison to the period of time involved in the game play.

Study Results. The substantive results were disappointing, as few significant effects were found. Moreover, the manipulation checks indicated that the treatments were not viewed as being significantly different. In terms of the game's acceptance, the study was more worthwhile as the students enjoyed the experience. The class instructor had been somewhat reluctant to use the game because his previous experience with simulation gaming had not been entirely positive. With enthusiasm for this game was evidenced by the fact that he revised it himself later by adding the alternative of raising cattle as well.

Problems Encountered. Earlier, in the section on Possible Research Environments, several reasons were given for the choice of the simulation game as a research paradigm. However, several problems were encountered. One problem dealt with time

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constraints caused by the need to design and program the simulation, develop and pretest the fear appeals, design the measurement instruments, and collect the data during the same semester. These time constraints were due to the fact that the study had to be done during the 1981-1982 fiscal year and that the instructor who agreed to participate taught the course in the fall semester only. In addition, the simulation was programmed on the CMS system, which was used for the first time that semester. Thus the programming problems were increased due to our unfamiliarity with the operating system. During the use of the game in the class, severe problems occurred also due to insufficient printer capacity and to system malfunctions during some of the laboratory sessions. Originally our intent was to have each student run three years of game play during his laboratory section. Our initial test runs indicated that this was feasible, but we did not consider the hang-ups created when 13 users are attempting to print their output on the only available printer. As a result, we had to reset our goal to have each student run one year of game play in the laboratory session and then have him run the other two years on his own later in the week. Obviously this resulted in a loss of control for our study, although we were able to monitor all of the account numbers to insure that the students had played the first three years before seeing the experimental treatment in period four. Apparently our problems with the CMS system were not unique, as the system was dropped shortly thereafter. These system problems are unique to the simulation gaming approach.

A second control problem was caused by the variety of decisions made by the students in the first three years of game play. We had believed that the background data and the program structure (enterprise budgets, game rules, relatively stable yields and prices, etc.) would result in a uniform set of decisions, especially since there was a fairly obvious set of allocations that would maximize one's net worth. The "obvious" proved to be "obscure" to many of the students, and a wide variety of game performances were observed after the end of year three. The students were assigned to treatment cells so that the mean net worths for the cells were approximately the same. However, the financial status of the farms did vary substantially and it is likely that the amount of cash on hand at the beginning of year four did have an effect on the manner in which the costs of irrigation alternatives were viewed. It is not clear how the variability in the students' decisions in the early periods can be controlled, unless the actual decisions are dictated by the game administrator. This would seem to negate much of the value of using the simulated decision environment.

Another limitation to the study was the relatively small cell sizes ($n = 9$), which were limited by the size of the farm management class. Consequently the low level of statistical power meant there was a high probability of a beta error in this study.

Ethical Problems. The use of a simulation game as a research environment can present ethical problems, as the instructor may be faced with a conflict of interest should the research requirements get in the way of the teaching value of the simulation. In fact, the research vs. teaching controversy would seem to indicate that conflicts would be inevitable. Our experience was not consistent with that line of thinking.

Past ABSEL papers have discussed ethical issues when education research is done using a simulation game [21] and when choosing a project topic for the live case approach [7]. Both of these types of research seem to have more inherent problems than does the use of a simulation game to investigate substantive issues. Substantive

research in a simulated environment may require students to take additional paper and pencil tests, but the amount of time required is negligible. At least all of the students can face the same learning environment, which is not true in most education oriented experimental research. In such research it is possible for one's grade performance in the class as well as one's overall learning to be affected differentially by the varying pedagogies used in the experiment. The experimental manipulations used in researching substantive issues will have much less effect on one's learning.

Similarly there would seem to be more room for serious harm to occur in the selection of a live case project, especially when the class project involves a firm with which the instructor has a consulting relationship.

We did not have problems in our particular application, even though some of us involved in the study were much more concerned with the research aspects of the study while the instructor was much more concerned with the teaching aspects. There was a great deal of cooperation and the study went smoothly despite the hardware problems.

SUMMARY

This paper discussed the advantages and disadvantages of using a simulation game as a paradigm for investigating substantive issues. While the advantages that games have over laboratory and field research are quite appealing, there are serious problems that need to be dealt with as well. Several of these problems have been discussed previously in the literature; this paper discusses them in relation to one particular application of the approach. Our belief is that the use of simulation gaming is a viable approach for investigating substantive research issues. For the problem in which we were interested, it was by far the most feasible approach. However, there are a number of design factors that need to be dealt with which are relatively unique to this paradigm.

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