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INVESTIGATING THE USE OF A COMPUTER SIMULATION AS AN EFFECTIVE PEDAGOGICAL TOOL FOR THE APPLICATION OF A STRATEGIC MODEL

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ABSTRACT

The business policy and strategy course should teach students how to analyze complex problems; lending itself well to experiential learning exercises. There has been considerable debate about the effectiveness of one of the primary experiential techniques, the computer simulation. This research investigates the effectiveness of a computer simulation designed to apply a specific pedagogical strategy model, the Market Movement Model. Results showed that the simulation was an effective tool for teaching students about specific, concrete principles of the theoretical model. But, students were less able to apply the underlying decision criteria required by the theoretical model.

INTRODUCTION

The Business policy and strategy course is the capstone course of most management programs. As such, the fundamentals of accounting, finance, production, marketing and management have been acquired by the students as prerequisites. The policy and strategy course should teach students how to analyze complex problems, given their knowledge base, and develop solutions that an organization can implement (Wolfe and Gosenpud, 1989). This type of course lends itself well to experiential learning exercises. The traditional approach to teaching business policy and strategy has been to follow the Harvard case method. However, with the advent of computers, strategy-oriented computer simulations have become the cornerstone of most strategic management courses (Patz, 1988). Simulations help instructors overcome the "one-shot" disadvantages of the case method because students are able to see how a policy evolves over time. Another important reason for the incorporation of simulations in strategy courses is that they allow students to develop their decision-making skills (Gosenpud and Washbush, 1994; Bradley and Kemper, 1991). Gautschi (1989) found that the majority of the M.B.A.s who were post-graduation found that their simulation experience as helpful in providing opportunities to work as teams. In fact, Grant (1990) suggests that AACSB require simulations in the capstone course.

While the use of computer simulations is widespread,

the effectiveness of this type of learning is the subject of considerable debate (Kemp, Kilgore and Knox, 1994; Gosenpud and Washbush, 1993). Almeida and Jauch (1992) found that, although students believe they learn as much or more from simulations, the results of studies are mixed and difficult to interpret.

As noted by Snyder (1994), there are over 15 different total enterprise simulations (the most common form of simulation used in policy courses) on the market. Most of these are generic because they must reach a wide audience. In addition, Snyder (1994) points out that they each differ in focus and content. Snyder (1993) also states that, without a basis in theory "the simulation teaches relationship without substance" and that unless feedback is provided on how variables affect the concepts, the simulation remains separate from the theory. Simulations have not been specifically designed to incorporate strategy concepts (Thavikulwat, 1991). Aside from a small number of efforts like those of Kemp, et al. (1994), few computer simulations are designed to address specific pedagogical strategic models. This paper reports the results of a research project that was specifically designed to teach students about a pedagogical strategic model, the Market Movement Model (MMM). The computer simulation was specifically designed to engage students in a decision-making situation that would require them to use their knowledge of this model to successfully complete the simulation.

THE STRATEGIC MODEL: THE M.M.M.

The market movement model was first introduced in marketing theory as the product life cycle model (Hofer, 1975; Day, 1981). This model hypothesizes that products, like people, go through an evolutionary model of birth, growth, maturity and decline. Hofer (1975) applied this theory to the more macro industry-level unit. Specifically, he proposed that industries also go through an evolutionary process defined by stages of Introduction, Growth, Maturity and Decline. In order to distinguish between the more micro product-based model and the macro industry-based model, the latter will be referred to as the market movement model (MMM).

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Each one of the stages in the MMM has industry-level characteristics that require different strategic responses. Furthermore, the practical implications of the model are that the firms must take some risks by anticipating the demands of a stage and responding to them in order to maximize profits. If participants are aware of the characteristics of the stage they are in, theoretically, they should be able to develop an appropriate strategic plan to successfully compete in each stage (Porter, 1980; Bourgeois, 1984). While there has been some debate about which particular industry-level characteristics are the most representative of the different stages, there is considerable agreement about the general categories of the important characteristics.

The Introduction phase of the MMM, often designated as the beginning of the market, requires an emphasis on research and development activities because the product is still in its formative stages (Fox, 1973). In this stage, product prices tend to be high and the competitors are few because the market and industry are relatively undefined. (Wasson, 1974).

In the early parts of the Maturity stage, the strategic emphasis shifts to expanding the firm's market share through activities such as capital investments in market research and plant and equipment (Anderson and Zeithami, 1984), product design modifications (Porter, 1980), and shifts toward mass distribution (Hofer, 1975). The price of the product is still high but continues to drop over this stage because the

product process has started to become more refined and the product starts to cost less to produce while competition tends to increase. The primary strategic objective of firms during the *latter* part of the Maturity phase of the market is to defend market position against competitors (Anderson and Zeithami, 1984). This objective is mainly achieved through product improvements and distribution approaches (Hofer, 1975). Competition has shifted to quality and cost control (Porter, 1980). Managers attempt to increase market share through brand differentiation which is publicized through extensive advertising (Anderson and Zeithami, 1984). Firms are expected to be aggressive in this fiercely competitive stage.

The major strategic objective of the early Decline stage is to realize all possible profits from the firm's operations (Wasson, 1974). By this time the market has gone through several shakeouts, so the number of rivals has probably decreased (Fox, 1973). As the industry maximizes its potential and starts to realize declining market share during late Decline, competitors have the options of leadership, focusing on a segment, harvesting or liquidation. For competitors who decide to stay in the industry, cost and quality control issues become very important. Since distributors are generally reluctant to serve a declining market, a firm must expend resources maintaining its distribution system (Porter, 1980). Remaining customers are likely to have high exit barriers so they tend to become more price insensitive. These theoretical specifications have been summarized in Table 1.

TABLE ONE
THEORETICAL ALLOCATION DECISIONS

	INTRO/ GROWTH	EARLY MATURITY	LATE MATURITY	EARLY DECLINE	LATE DECLINE
PRICE	MAX	MED-HIGH	MED-LOW	LOW	MED-LOW
MKT RESMED-MAX	MED	MED	MED	O-MIN	
ACCT CTRL	O - MIN	LOW	MAX	MAX	MED
QUAL CTRL	O - MIN	MED	MAX	MAX	MED
PROD DESN	O - MIN	MAX	MED	MED	O - MIN
PLT&EQIP	MIN-MED	MAX	MED-HIGH	MED-HIGH	MIN
DIS SYST	MIN	MAX	MED-HIGH	MIN	MED-HIGH
ADVERTISE	O - MIN	MED-HIGH	MAX	MED	MIN
R & D	MAX	MED-HIGH	MED-LOW	MED-LOW	O-MIN

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The MMM is relatively straightforward about prescribing what industry firms must do when they are in specific stages of the model. The model is less clear about how to anticipate, plan for, and compete when the industry undergoes a change in its stages. The prescriptions of the MMM suggest that decision makers must incorporate some degree of risk taking in the strategies that the firms will pursue during each stage in order to compete successfully.

There are a number of problems with the theoretical assumptions of the model (Malik, 1988). In spite of these, the assumptions of the model provide the foundation for many important strategic principles and related models such as the industry evolution matrix approach to portfolio analysis (for more details, see Hill and Jones, 1992, p.286-288). The MMM was chosen as the focus pedagogical model for this research because of its relative importance to the theoretical foundation of business strategy.

THE RESEARCH DESIGN

The Sample

Ninety-five undergraduate senior business majors who were enrolled in five business strategy courses at a large Midwestern university completed the computer simulation as part of their course requirement. Each student signed a consent form indicating their willingness to participate in the research.

The Classroom Lecture

Students were introduced to MMM theoretical model through a classroom lecture. Students were told that they would be using the theory in the computer simulation and would be allowed to use their notes at that time. The classroom lecture outlined, in detail, the characteristics of the four stages of the model. Students were told that a change in the characteristics of the industry indicated a stage change in the industry. Industry sales were identified as the summary indicator of where the industry was in the life cycle. Students were also instructed as to the type of strategic responses to make in each specific stage. The instructor specifically told them what type resource allocation to particular functions would operationalize the necessary strategic response and that these decisions might involve taking some monetary risks. The lecture also covered the impact of time lags on the outcomes of the decisions that a company might make while in a particular stage. Subjects were told that the closer they followed the MMM theory's prescriptions for price setting and

resource allocations, the better their simulation performance would be. Finally, subjects were informed that their grades would be based on their relative effectiveness in maximizing their company's total earnings by the end of the simulation. In this way, an attempt was made to make the outcome of the subjects' decisions in the simulation meaningful to them.

The Computer Simulation

The computer simulation (Moch, 1988) was specifically designed to operationalize the theoretical assumptions as well as the problems associated with the MMM. The simulation was programmed to be interactive so that each student was placed in the role of C.E.O. of a small firm. The simulation required students to make resource allocations to 10 functions, which are presented in Table 2. Students were to make allocations to reflect the strategies they were implementing in a specific stage. The simulation then asked them to indicate which stage of the MMM they thought the industry was in. Students were given numerical and graphical performance feedback on their own gross and net incomes as well as on the industry average sales at the end of each decision period. Each decision period represented one quarter for the firm and there were 100 decision cycles (25 years) in the simulation. Students were also asked to keep a log of their decisions, brief notes on the reasoning behind their allocations and the stage of the MMM that they thought they were in at each decision period.

The industry sales figures generally followed the pattern that

TABLE TWO
RESOURCE ALLOCATION DECISIONS
(maximum values in parentheses)

PRICE PER UNIT (100)
ALLOCATION FOR ACCOUNTING CONT (20K)
ALLOCATION FOR QUALITY CONTROL (25K)
ALLOCATION FOR PRODUCTION DESIGN (60K)
ALLOCATION FOR PLANT AND EQUIP (150K)
ALLOCATION FOR DISTRIBUTION SYS (25K)
ALLOCATION FOR MARKETING RESEARCH (25K)
ALLOCATION FOR ADVERTISING (50K)
ALLOCATION FOR RES AND DEVEL (75K)

would be expected by the MMM theoretical model. To make the simulation more realistic, there were time lag effects programmed to impact the decisions made by the students. Specifically, the students' allocation decisions did not immediately impact their performance, but had a delayed effect.

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The Results

The researchers examined the documentation of the decision process kept by each student. The self-reported MMM stage corresponded to the actual programmed stage 100% of the time once the industry was firmly within that stage. Students, however, had a great deal of difficulty during the transition time and in identifying when the stage had actually changed during the initial decision periods. This corresponds with the MMM's theory which is very vague about the industry specifics during transitions. In general, students, surprisingly, tended to be extremely conservative with their actual dollar amounts of allocations when, theoretically, they should have been very liberal. Rarely would a student spend the maximum amount allowed in a particular functional category even if the theory called for this type of expenditure. Students' written comments and post-simulation debriefing responses indicated that the reason for this related to a bottom line, profit maximization goal. While the allocations did not meet the researchers' definitions of maximum, when the theory called for high allocations, students did increase the amount of their allocations relative to allocations in other stages.

According to their documentation, the majority of the students followed a strict, self-imposed budget throughout the simulation to achieve a profit maximization goal. This is interesting because the students were trying to maximize profit through decisions based on an avoidance criteria while the MMM is based on profit maximization through proactive, calculated risk-taking criteria. Success in the simulation, operationalized as net income, was contingent upon how well the firm followed the MMM philosophy.

While the students' notes reflected that most of them were aware that there were time lag effects to their decisions, their actual decision allocations did not indicate that they changed their decision-making behavior to try to address the time lags.

CONCLUSIONS

As stated in the introduction, business policy and strategy courses have attempted to implement experiential learning through the use of case studies and/or computer simulations for quite some time. Most of the strategic computer simulations provide the players with broad, generic strategic situations. For this reason, instructors are unable to use the simulations as an experiential illustration of specific

strategic theory models. This may be the reason that there has been so much continued debate over the effectiveness of simulations as a learning tool. This research project was designed to investigate the appropriateness of using computer simulations as this type of specific experiential tool.

The results of this research found that students were able to apply the basic concepts of the theoretical model in their decision making while participating in the simulation. The students' strategies reflected those prescribed by the model during the course of the simulation. Where the prescriptions were clear, students had little trouble directly using the theoretical principles. Similarly, when the prescriptions were unclear or inadequate, students' decisions reflected this pattern as well. These results clearly support the effectiveness of computer simulations as experiential tools to allow students to learn about specific, concrete principles of theoretical models in a dynamic situation.

While the students were able to follow the "nuts and bolts" of the MMM theory in their decision making, the majority were unable or unwilling to adopt the risk taking criteria to decision making which provides a foundation for the prescriptions of the model. In other words, according to the model, you must spend money to achieve outcomes--even if it means that, at times, you may lose money in the short run. Instead, the majority of the students employed an informal risk aversion criteria to their decision making even though this criteria led to poor performance. These results suggest that, while students are able to apply concrete theoretical principles, they have a lot more trouble applying the underlying decision criteria that a theoretical model like the MMM requires. Future research should investigate this differential ability to apply theoretical principles. Patz's (1989) research suggests that M.B.A.s, because of their work experience, may be more likely to use the underlying decision criteria because they see computer simulations as a way to apply the knowledge they have learned. One of the reasons that undergraduates were less likely to use a risk taking strategy might be that they could not see the application aspect of simulations. Patz (1989) found that undergraduate students saw simulations as an exercise to acquire skills.

In addition, the students were not able to account for the time lag effects on their decisions even though they were aware of them. Most of the students did not even make an attempt to integrate the impact of the time lags in their actual resource allocation decisions. Both of these factors underscore the

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inability of students to change their basic decision making criteria while engaged in the simulation. This suggests that future research should examine the relative effectiveness of experiential tools in teaching students how to identify, understand, and actually apply the process criteria that drive a theoretical model.

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