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ENHANCING SIMULATION LEARNING THROUGH OBJECTIVES AND DECISION SUPPORT SYSTEMS

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ABSTRACT

This paper reviews the rationales for adding evaluative dimensions beyond that of overall performance for Total Enterprise (TE) simulations, and provides a learning appraisal system and an example decision support system for the widely used Business Strategy Game (Thompson & Stappenbeck, 1995). Concern over the lack of a relationship between learning and simulation performance is addressed through increased emphasis on learning enhancement through instructor intervention and feedback based on periodic assessment of student learning. To accomplish this, learning objectives were identified and a DSS developed to aid in learning assessment.

GENERAL

Recent research on Total Enterprise (TE) simulations questions whether learning and simulation performance are related (Gosenpud & Washbush, 1993; Washbush & Gosenpud, 1993, 1994, 1995). Because teachers generally use simulation performance as the basis for grading (Anderson & Lawton, 1992), students who perceive themselves as having learned a substantial amount from the simulation may rightfully perceive a simulation 'grade' based only on overall performance as unfair or irrelevant. Assuming that teachers intend grades to reflect learning and mastery of course concepts, lack of a correlation between simulation performance and grades for the simulation is a serious issue (Pillutla & Swanson, 1995). In their review of simulations, Keys & Wolfe (1990) concluded that the instructor must not be passive. They called for models for instructor intervention that describe the kind and quality of feedback that is most appropriate.

TE simulations generally provide performance results for each decision period as well as an end-of-game basis, but do not provide insights into the learning by students. Because of this, to assess learning researchers must develop supplemental tests (e.g., Washbush & Gosenpud, 1993, 1994, 1995). Although useful for research purposes, this approach is time consuming for the general TE user. In addition, such measures are not designed to provide timely periodic feedback to students on their learning as the simulation progresses. Instructors who want to add assessment and enhancement of learning to their TE simulations on a real-time basis, face a significant increase in the time required to manage the simulation. Given the typically heavy demands for teaching a policy course, any increased workload must be manageable and demonstrate a clear benefit.

Decision support systems (DSS) provide a helpful tool for automating analytical processes. DSS have been tested for their efficacy in helping student performance in TE simulations (Affisco & Chanin, 1989; Keys, Burns, Case & Wells, 1988; Nulsen, Faria & Roussos, 1994). They have also been used to assist students in case analysis (Kemp, Kilgore & Knox, 1994). This paper, however, looks at using DSS to aid *instructor assessment* of student learning and progress in a TE simulation.

ASSESSING LEARNING - PROVIDING FEEDBACK

Keys (1977, 1989) suggested an experiential learning model, The Management of Learning Grid. He proposed that effective instruction requires a three step process. First, the dissemination of new ideas, principles and concepts. Second, the opportunity by the student to apply the concept in an experiential environment. Third, feedback as to the result of actions taken. This of course is iterative, with feedback at each chronological step in the exercise on the relationship between actions and subsequent results. Given the increasingly comprehensive performance data provided by the top TE simulations, it is likely that some, if not many, instructors rely solely on data provided by the game to fulfill the feedback role.

This may not be sufficient, however. In a review of 60 fairly rigorous studies on simulations, Keys & Wolfe (1990) found that second to the quality of the game itself, the administration of the game is probably the most important factor in the game's success. Wolfe (1975) found that instructor guidance was necessary for learning. Others found that guidance must be applied during crucial stages of the game (Certo, 1976; Keys, 1977; McKenney, 1967). DiBattista (1986) found learning was greatest with weekly structured feedback.

The nature and content of feedback is important. Bowen (1987) contended learning has a greater impact when it is accompanied by emotion, occurs in a safe environment with adequate processing time, and is accompanied by a clear summary providing a cognitive map for understanding the experience. Comer & Nicholls (1994) argue that students do better with a structured simulation. By structuring the decision environment it forces students to think through their decisions. Structure can help students focus on the process rather than the outcomes (Gentry, Burns & Fritzsche, 1993).

The literature is fairly clear that to derive maximum learning benefit from a simulation, the instructor must be involved - providing consistent, relevant, and timely feedback to the student. Such feedback should be structured to include the instructor's learning objectives.

TE SIMULATIONS AND LEARNING OUTCOMES

Identification of specific desired learning outcomes by an instructor may be neither obvious nor easy due to the extremely wide variety of possible outcomes. Dickinson & Faria (1994) cite previous research that has addressed many potential learning outcomes. Types of learning thought to be improved through simulations include: basic economic concepts (Edwards, 1987), financial analysis skills (Faria & Nulsen, 1976; Hall, 1987), goal setting and information processing (Philippatos & Moscato, 1969; Biggs & Greenlaw, 1976), organizational behavior and personal interaction (Cangelosi & Dill, 1965; Chisholm, 1979), performance on mathematical problems (Faria & Whitely, 1989; Whitely & Faria, 1989), and sales forecasting (Edwards, 1987; Hall, 1987).

Gentry, Stoltman, & Mehloff (1992) suggest instructors develop measures of what they are trying to teach. Gosenpud & Washbush (1994), citing Anderson & Lawton's (1992) survey results state it is implicit in what instructors measure as to what they expect students to learn. But if, as Anderson & Lawton (1992) report, 93% of instructors grade on performance, either those instructors must believe overall performance is an adequate proxy for their desired learning outcomes, or they cannot or will not define their desired learning outcomes. Surely 'winning is everything' is not a desired learning outcome for 93% of instructors. Gosenpud and Washbush (1994) acknowledge that learning measures, such as exams, may focus students' attention too narrowly. However, they conclude that as we do not know from overall simulation performance alone whether students are learning, instructors should define the types of learning that are most valuable and assess them.

Teach & Govahi (1993) surveyed 602 graduates from 36 business schools and prioritized 41 managerial skills according to usefulness to students. They found simulations were best in 1) helping set and evaluate objectives, 2) solving problems systematically, 3) making decisions, 4) forecasting, 5) adapting to new tasks, 6) managing time. Biggs, Miles & Schubert (1993) developed an instrument for measuring teaching effectiveness using six measures:
1) leadership, 2) group interaction skills, 3) business management skills, 4) personal growth skills, 5) integration and decision making skills, and 6) learning effectiveness. Gosenpud & Washbush (1994) polled instructors to ascertain what users think players should be learning. Strategic decision making ranked highest, but cash, inventory and production management also ranked high.

The capstone policy course is about strategic management, and some feel it makes sense to base learning objectives on the strategic management model. Wellington & Faria (1995) cited research that found a positive relationship between simulations and strategic management (Gosenpud, Miesing & Milton, 1984; Gosenpud & Wolfe, 1988; Miesing, 1982; Wolfe & Chanin, 1993). Strategic management was considered to exist when the simulation team developed clear goals, analyzed the external environment, understood its firm's strengths and weaknesses, developed clear strategies, monitored its firm's performance, and took corrective action.

DEVELOPMENT OF LEARNING OBJECTIVES FOR THE BSG TE SIMULATION

The literature covers a wide variety of possible learning outcomes that could be specified by an instructor. Defining many of these, such as leadership skills, group interaction skills, and time management, may be beyond what an instructor can (or would want to) reasonably address for a policy course. Strategic management model outcomes, however, are well within the purview of policy instructors and lend themselves to quantifiable and identifiable outcomes. Such outcomes could be measured and feedback provided on a consistent, timely basis.

The TE simulation used was the Business Strategy Game (Thompson & Stappenbeck, 1995), which uses shoes as the product. For a more complete description of the game, see Snyder (1995). A number of printouts are provided to the student. The two used were the five year decision plan, and the five year performance projection. The five-year decision plan includes all decision inputs by the team for the succeeding five-year period. These include production, pricing, marketing, and financial decisions. As a global simulation, decisions also deal with tariffs, exchange rates, and foreign markets. The five-year performance projection provides the team with projected income and balance sheets data, and a complete projection of typical performance data including inventories, sales, profitability, etc. Data are provided on a geographic basis as well as in corporate summaries.

In line with the strategic management model, learning outcomes initially selected were focused on the team's strategic plan and implementation. Specific outcomes measured were demand-forecast reasonableness and accuracy, financial management, production and inventory management, profitability, and reaction to environmental changes.

Demand forecast is a pivotal aspect of operating a business. Few decisions can have as great an impact on profitability as serious errors in production levels. Overproduction due to rosy sales forecasts lead to high inventory costs (many of these costs are not immediately apparent to teams). Underproduction results not only in immediate lost sales but also in a reduced competitive strength and lost future sales. The larger the stockout, the greater the future impact. Because there are typicality significant variations in market demand growth over the course of the simulation (instructor controlled), *ceterus paribus* a team's projected sales should rise and fall with market demand. To assess this, sales forecasts were converted to projected market shares. Reasonableness was tested by the consistency of projected market share. Because innovative strategies might allow for increases in market share, sales accuracy is measured by comparing forecast versus actual shoes sold.

Profitability was assessed using net income and ROE. Financial management also affected ROE depending on the financing approach (debt or equity) used by the team. One learning outcome desired for students was the realization that *some* debt may be beneficial as an equity multiplier for a higher ROE, but too much debt is risky. Many teams initially begin with the intention of having zero debt at the end of the game. Reaction to environmental changes is assessed by comparing a team's current five-year plan with its previous five-year plans. Tariffs, exchange rate movement, interest rates, changes in market demand, etc., all should lead to predictable changes in each team's strategic plan.

DEVELOPMENT OF A DSS FOR THE BSG TE SIMULATION

The DSS presented here supports the learning outcomes developed for the Business Strategy Game (Thompson & Stappenbeck, 1995). The DSS was not designed at one time, but evolved over a number of years of playing the game and features were periodically added to provide improved analytical support. The DSS is essentially a Lotus spreadsheet that assists the instructor in evaluating student decision reasonableness, consistency, and accuracy. For each decision (usually accomplished weekly) decision data and performance projections for each team are entered into the spreadsheet along with actual industry results from running the industry decision. It takes approximately 20-30 minutes to enter the data each week depending on the number of teams.

Analytical results from the spreadsheet are provided in both numerical and graphical formats. Macros are used to automatically update graphs and save them as .pic files. A limitation of Lotus is that only six variables can be plotted at a time. As up to sixteen teams can compete in the industry, Lotus cannot depict the entire industry on one graph. This limitation is overcome by transferring the .pic files to WordPerfect, and using its graphics capabilities to superimpose the Lotus .pic files, producing a single graphic for all teams. The results provided on teams include market share projections, sales forecast accuracy, forecast change from previous period, inventory levels, and debt to asset ratio. A number of graphs summarizing industry activity are also provided, such as sales versus demand and capacity, projected sales by geographical region, and team standings.

Figure 1 illustrates a typical demand versus supply graphic. Capacity forecast demand, actual sales, and inventory are included. The curves are typical, with production and capacity increases far outstripping demand, and inventory rising. About the fifth decision (the game begins in year 11), players constrain production to control inventories, and production capacity moves to match demand.

Figure 2 illustrates a sales versus demand or industry market share forecast, and is the sum of all individual market share projections by market. This can be used at the instructor's discretion to inform teams of what total forecast industry sales are without exposing individual team strategies.

FIGURE 1
DEMAND VERSUS SUPPLY

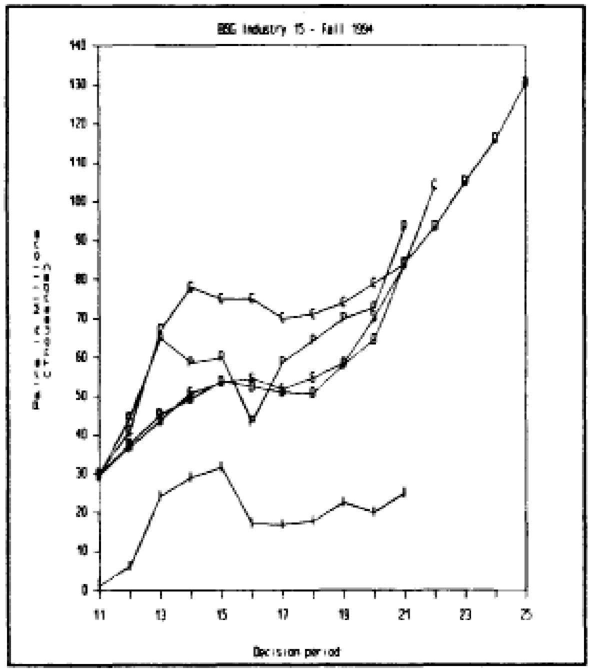


FIGURE 2
PROJECTED SALES VS DEMAND

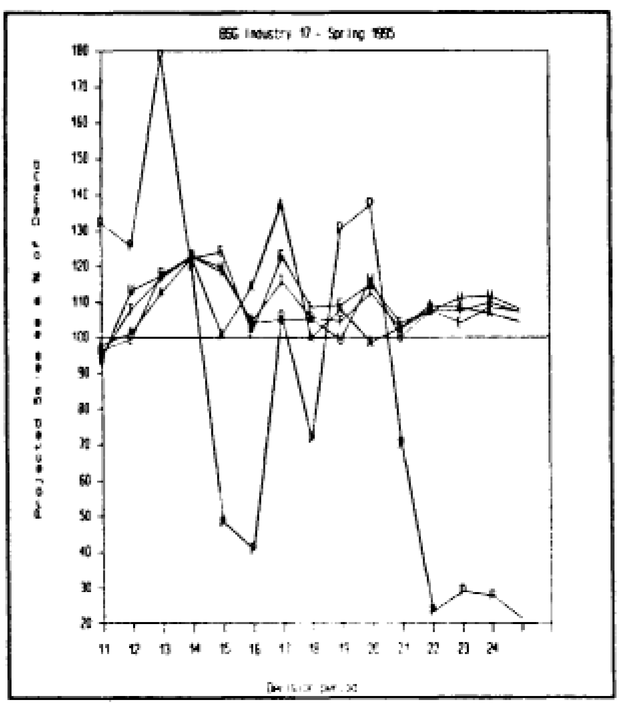


Figure 3 illustrates individual team market share forecasts. This can be used by the instructor to quickly assess a team's forecast. A relatively straight line indicates thoughtful forecasts. A rising line indicates increased share expectations and should be supported by aggressive marketing strategies. A sawtooth forecast line indicates erratic market shares, and is usually the result of inadequate planning and/or poor reaction to environmental changes. Typically industries have a great deal of ragged projections at the beginning, but forecasts stabilize by the end.

FIGURE 3
FORECAST MARKET SHARE

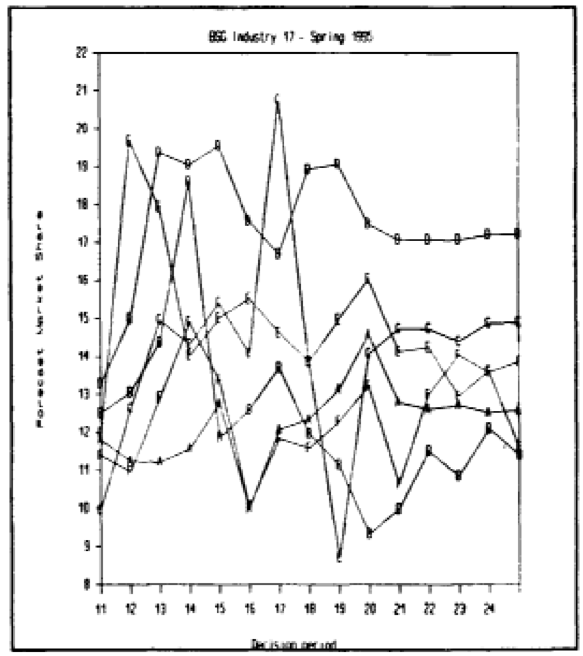
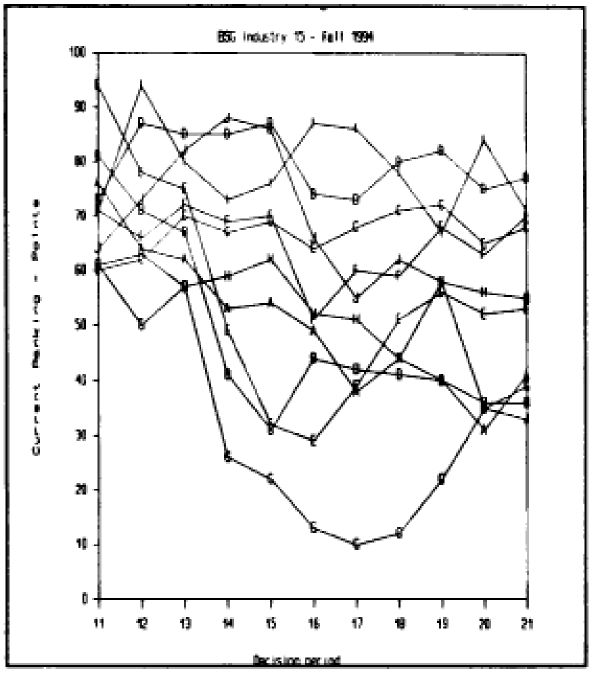


Figure 4 illustrates team standings based on ratings points. The BSG simulation calculates a combined ratings point based on sales, profit, ROE, stock value, bond rating, and strategy rating. This graphic depicts that although Team G was last for many periods, it was steadily improving toward the end.

The data are also provided in tabular format. Other reports provided include projected share by region, sales forecast accuracy, and percentage change in this year's forecast compared to last year's. Both the tabular and graphic presentations provide the instructor with historical and trend data as well as current results.

FIGURE 4
OVERALL SCORE



LEARNING ENHANCEMENT FOR THE BSG TE SIMULATION

Learning enhancement through improved instructor feedback is provided in two ways. First, an individual weekly assessment of each team's plan provides the immediate feedback to challenge in a timely manner the assumptions and strategies undertaken by each team. Second, three major written submissions outlining the team's strategies are accomplished.

The five-year decision and projection printouts together comprise eight pages of densely packed numbers. Even the most dedicated instructor would find it challenging to review each team's reports and provide meaningful feedback to the team even once or twice during the simulation, much less every week. Using the DSS printouts, however, the instructor starts by knowing the general consistency and reasonableness of the team's plan, as well as its success. The instructor can then quickly identify to the team areas in its plan that make no sense, are impractical, or represent severe problem areas. Perhaps the greatest motivation to prepare better plans comes from the knowledge that the instructor *is* looking at each individual plan and not just waiting for the game to end to declare a winner.

The graphical printouts can be converted to overheads, and the instructor can quickly highlight and discuss issues facing the entire industry (severe overcapacity, price wars, high inventories). It seems that even though teams 'know' there is overcapacity, a simple graph illustrating the separating curves of projected capacity and demand have a sobering effect.

Experience indicates that for the first few decisions students are discovering how to play, and the industry is somewhat chaotic. Five-year plans change dramatically as reality sets in about what growth rates are possible, and competition limits choices. By the one-third point in the simulation, however, teams should have identified key strategies and be able to predict their actions over the next five years. By the two-thirds point, a well-developed strategic plan should be in place.

Accordingly, at the one third point, the written assignment is to provide the instructor the team's market share objectives and financial objectives for the next five years, and a description of the functional strategies they are pursuing. Both the number of strategies discussed and the degree of detail provided give the instructor an idea of how well the team understands both the mechanics of the game itself and the dynamics of the industry it is in. Learning is enhanced in two ways. First, the students are forced to think about the specifics of their strategies and their suitability to performing well. Second, different teams come to the simulation with varying knowledge and abilities. This report allows the instructor to provide feedback individualized to where each team is at in the game.

At the two thirds point and again at simulation conclusion, each team submits a comprehensive analysis of the industry, and a detailed description of the team's objectives and strategies. This allows students to apply to an industry in which they participate and have personal knowledge, the concepts typically presented in a policy course. The requirement at this stage is to have teams state not just *what* their advertising (or price/quality/service, etc.) strategy is, but *why* they believe this strategy is appropriate. Again, the variety of strategies employed by a team and its understanding of how that strategy links to the team's overall objectives provides insight to the instructor on learning. It allows the instructor to assess learning team by team, and provide individualized feedback.

The weekly decisions and the three written reports provide an additional basis for assessing learning. The grade for this portion is a fairly direct measure of *team* learning for the strategic management model learning outcomes selected. The overall performance measure continues as a proxy for many other learning objectives: teamwork, time management, etc. The combination provides a more complete measure of learning, and is perceived by students as more appropriate (especially for teams whose learning comes late and overall performance is low).

CONCLUSIONS AND EXPECTATIONS

The validity of this approach needs to be tested. Because overall performance in an industry depends on reacting to the dynamics of that industry, no reasonable comparisons across industries can be made. However, this approach could be tested by combining teams in an industry some of which receive feedback and some of which do not. Although this approach does make additional demands on the instructor, it has demonstrated face validity to the instructor in increased student understanding of setting objectives, developing strategies linked those objectives, and modifying strategies in response to environmental conditions. The provision of timely feedback on such issues as proper use of debt allows teams to experiment, reinforcing their learning. Many teams perceive the reports as being more under their control than game ranking, and work at the reports to demonstrate learning.

In summary, this approach addresses three issues highlighted in the simulation literature. First, it identifies specific learning outcomes the student should achieve. Second, it provides timely and relevant feedback to assist learning. Third, it provides an additional relevant basis for grading performance on the simulation other than final standing.

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