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ASSESSING PARTICIPANT LEARNING IN A BUSINESS SIMULATION

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ABSTRACT

Why do we assign grades to students who participate in a business simulation or game? Is it because grading has been the only way to have students commit the necessary time needed to effectively participate in the simulation? Is the grade supposed to represent a how well the student's product or firm performed (either by profits or by some combination of factors called firm performance)? Or is the grade supposed to relate to the amount of learning that went on while the student was participating in the game? This paper questions the assessment procedures used in most games. It has been repeatedly demonstrated that there are serious flaws in assessing students based upon their product/firm performance. Perhaps using standard business practices (rewarding the wining team) may not be appropriate in learning environments. For rational participant assessment based upon learning, game designers and users must define what the participants are expected to learn and what knowledge they are expected to acquire by playing a business game. This implies that different simulations may or will teach different lessons.

WHAT DOES A GRADE REPRESENT

What is the purpose of grades and what do assigned grades represent to the receiving students, to other students in the class, to parents of the students, to business school faculty and to potential and actual employers?

It has been stated that, "Since gaming's earliest years, the literature has implicitly accepted the notion that teams that have [financially] performed well in the game have learned the most, but this basic relationship has not been investigated" (Wolfe 1990, p.293). But, Teach (1987), unreferenced in the Wolfe paper, challenged idea that financial performance equated learning and numerous papers have been published since the Wolfe paper was published that confronts this concept that the best game performance equates to the greatest learning outcome.

Gosenpud and Washburn (1996) showed in an empirical study that, "*Learning did not correlate with performance*" (quote from page 43). Burns, Gentry and Wolf came to a similar conclusion (1990) stating that, [financial] "*Performance is not a surrogate for learning*" (quote from page 261). Dickinson (2002) noted "... *extraordinarily good performance in one or a few periods may be sufficient to dominate may be sufficient to dominate cumulative earnings measures...*" (Quote from page 22)

An excellent attempt to develop a test bank to assess the learning that occurs when participating in a business simulation was reported at an ABSEL meeting (Gosen et al 1999). This paper claims to derive a test-bank, but the reported set of 40 objectives, and most of the test items themselves were only available by contacting the first author. The results of a single use of a subset of the questions developed provided very weak evidence of learning. The pretest (setting the standard of knowledge the students possessed before the course began) scored an average 53% (rounded). The post test (to measure the amount of knowledge possessed at the end of the course) averaged 60% (rounded). While these differences were statistically significant with a "p" value 0.007, the amount of difference is hardly heart warming. One would expect a much greater increase in learning given the amount of time the students spent on one semester course. But regardless of the outcome, this experiment was a great attempt. This study paved a way of thinking about the assessment of learning that takes place during a business simulation. The Gosen et al paper showed that measuring the degree of learning from the participating in a business game could be measured.

THE AUTHOR'S ASSESSMENT EXPERIENCES USING GAME PERFORMANCE

When this author began using total enterprise simulations (1963) in a university classroom setting, it was the accepted practice to use cumulative profits at the end-of-play as the student assessment tool for the game portion of a student's grade in the course. The assumption was that student's whose simulated firms were more profitable than others, gained more knowledge. That assumption became more and more challenged as my experience with business games grew. Later-on, and a change of simulations, I used a series of .assignments based upon making the game more fun as well as more relevant to the students learning goals. Even later, again after a change of simulations, I used a set of analytical analyses to enhance the learning and based student assessments on each student's ability to do successfully use analytical tools. (A first course in statistics

has been a required course for all business students at my university and that class was supposed to be taken during the student's sophomore year. The courses that used business simulations were all taught at the junior and senior level.)

A REVIEW OF GRADING BASED UPON CUMULATIVE PROFITS

The time honored method of allocating the participants evaluations based upon the cumulative profits of the firms after the last round of play is easy to do and it is easy to understand. It has great face validly and it fits with most people's view of how the world works. But is it? It assumes that leaning and performance go hand-in-hand. If has been said that games allow one to learn from their mistakes without paying the price.

In business simulations, some teams make mistakes that put them in unrecoverable positions. The cost of mistakes is also very time dependent. That is, a mistake made in the first or second round, might be overcome, but if the same mistake were made in the late rounds of the game, the resulting disadvantages could not overcome. The number of rounds played is finite and few, even if it were possible to overcome a short term disadvantage, the arbitrary number of rounds played prevent recovery from happening.

But there are other issues in scoring participants performance based upon profits. If the same firm constantly has the greatest cumulative profits, round after round, something is amiss. That would indicate that performance in the first (or second or third) round dominates the remainder of the competition. This could be interpreted by the players (except for the first place team) that the game is unfair. It would clearly indicate that early leaders have an unfair advantage when the course grades are posted

Let's review the data for the unfairness proposition, using cumulative profits as the winning criteria. The author has used CAPSTONE (Smith 1997, 2001, 2004) in undergraduate business to business marketing classes for several years. The records of 41 of these competitions have been analyzed for firm dominance, a term Alan Patz (1990) used to describe simulation performance of the leading firm when it took an unrelenting lead early in the competition.

DOMINANCE

Dominance is a term used in economic theory, in explaining either single firm or multiple firm competitive outcomes in an oligopoly. Oligopolistic industrial structure is the typical structure modeled by business simulation competitors. Economists general define single firm dominance as when the firm has 40 percent or more market share (Scherer and Ross 1990). The economists' interest in the economic behavior of dominance is that it may result in the dominant firm gaining a monopolistic advantage and exercising market power (Shea and Chari 2002), and this may have relevance in business gaming. Williamson (1972) pointed out that "...antitrust policy has longed been plagued by the problem of continued dominance of an industry by a single firm which has obtained its position by lawful means." Thus dominance itself does not infer any collusive behavior. The research reported in this paper found no evidence that firms mutually agreed to any competitive behaviors (cheating) which would have resulted in one firm gaining a dominant position.

Huck et al (2002) conducted some experimental evidence by using a set of simulations of oligopolistic structured industries with four teams and they noted that communication was allowed regarding prices and other firm information the firms showed evidence of tacit collusion. One explanation of the reason that dominance exists in many business game may be that when participants see the position of the dominant firm and they know many of their decisions (because a large number of actions of all firms are made available to all firms in the game reports) some firms simply mimic or closely follow the dominant firms decisions and they become followers in their industry. This comment is purely speculative and was not subjected to investigation in this reported research effort.

In the research reported here, the market-shares of the dominant firms were not tracked and Patz's research, did not explicitly report the market share information of the dominant firms.

DOMINANCE IN BUSINESS GAMING

In order to make clear the term "*Dominance*" in a business simulation scenario, a hypothetical example is

Table 1
An example of dominance

	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8
Firm A	2[1]	2	1	1	1	1	1	1
Firm B	6	5	6	5	6	6	6	6
Firm C	3	1	3	2	4	4	3	3
Firm D	5	6	5	4	5	5	5	5
Firm E	1	3	2	2	2	2	2	2
Firm F	4	4	4	3	3	3	4	4

[1] Read this cell as follows: In the end of first round of the competition firm A was in 2nd place.

provided as Table 1. In "dominance" the firms performance measures are rank ordered for each round of play. If cumulative profit is the performance then, when the results of each decision cycle are available, all the firms cumulative profits are rank ordered. Table 1 displays a set of rank orders of all firms in the competition for 8 rounds of play.

Table 1 shows that Firm A became dominant in round 3 and never placed below 2nd place. Firm B was in last place (the loser) from round 5 on but attained 5th place only twice. There were some minor changes in the middle four teams' performances, but not a lot of movement. For evaluation purposes the game could have been stopped at the end of round 3 with little effect upon participants' evaluations.

Using data like that used in Table1, the cumulative performance of 6 teams per competition for 41 competitions were rank ordered for each of the eight rounds of play. Figure 1 is a bar chart that presents the findings as to when a firm obtained first place in cumulative profits and never relinquished that position through out the remainder of the game.

Notice that over 85 percent of the firms never relinquished their lead after 3 rounds. This shows that dominance was a major factor in the business simulations analyzed. Now that the winners have had their dominance examined, what has happened to the perpetual losers? Figure 2 is a bar chart of the last placed firms at the end of the 41 competitions.

Figure 1

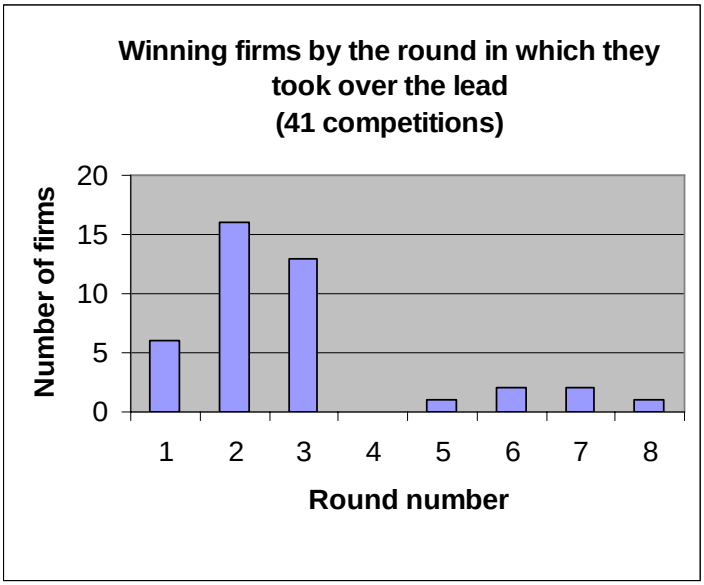


Figure 2

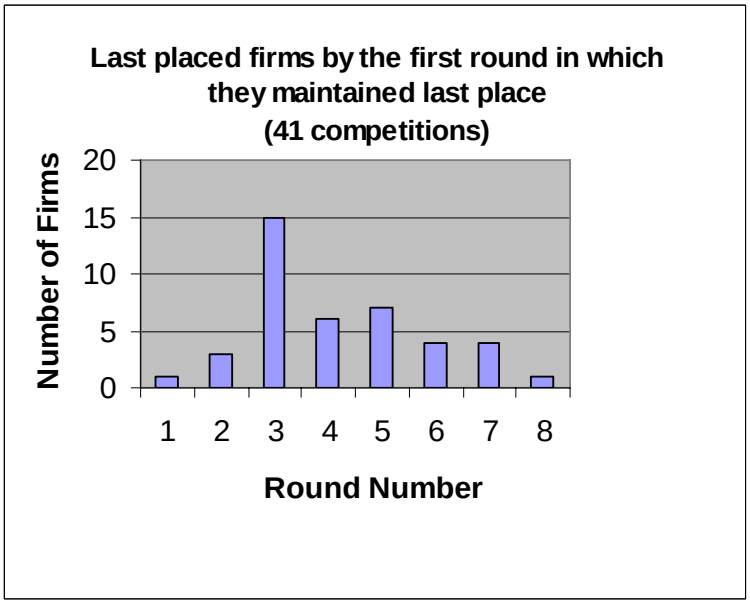


Table 2
Frequency of earning the highest per-round profits
(41 competitions of 8 rounds each (total of 328 rounds)

# of Times in First Place	Number of Firms	# of Times these firms were in last place
8	6	0
7	11	1
6	4	1
5	14	1
4	7	1
3	5	5
2	15	5
1	55	61
Never First, but were last	96	247
Never first, and never last	35	0

One firm in the 41 competitions placed last at every opportunity, that is, one firm came in last every period. Three firms placed last in all but round one and 15 firms placed last in all but the first two rounds. That is almost half (19 out of 41) of firms in the competitions were in last place in the third round and remained in last place until the end of the competition. Thus, if one were to assess participant performance based upon their team's simulated firm's financial performance, one could generally assign grades after 3 or 4 rounds instead of the 8 to 10 rounds typically played.

ANALYSIS USING ANNUAL PROFITS

If dominance occurred in cumulative profits, will ranking profits by round work any better? Table 2 shows the ranking data based upon annual profits. In addition, Table 23 shows the number of times a firm which placed first also had a round in which the same firm had a last place showing.

Obviously if a firm placed 1st in 8 rounds out of eight, they never placed last. There were eleven firms that placed 1st seven times, but of these eleven there was only one case in which the firm placed last during any round of play. There were 4 firms that placed 1st six times. Of the 8 opportunities in which they could have places last, only one firm placed last one time. Of the 14 firms that had the greatest profits 5 times, only one of these firms place last once out of 42 opportunities. Of the 7 firms that placed 1st in four rounds, again only one firm placed last one time out of 28 possibilities. It is striking that out of 328 opportunities, 96 firms never placed first, but these firms placed last in 247 rounds. Thirty-five firms never placed first or last in the 328 opportunities. Thus one would conclude that the dominance phenomenon occurred in evaluating annual profits as well as when one evaluated the cumulative profits

WHAT DO THESE RESULTS INDICATE

These results apply to observations from one university and one business simulation. Similar analysis of different games need to be completed before generalized statements should be made, but these results provide some evidence, however small, that other games should be examined for this phenomenon. And, if these results are confirmed for other business simulations, measures other than profits need to designed for business simulation participants While profitability may be used in the evaluation actual firms' managers, it should not be used as an assessment tool for participants in business games. The measure is highly biased in favor of early round winners, which may or may not be related to participant learning.

USING BROAD-BASED SCORING SYSTEMS FOR ASSESSMENT

Most recent business simulations provide a broad based formula for participant assessment. Some use as many as 10 or more variables and others may use as few as five. The one of the reasons for using a broad base for assessment was done to get away from the criticism that the only thing that counts in corporations is profits and another was to broaden the scope to include more skills used in managing a firm. Virtually all current simulations now have a defined scoring mechanism and generally allow the game administrator or instructor to weight this scoring algorithm as they see fit. Below are listed just a few business simulations and there composite scoring variables.

THE BUSINESS STRATEGY GAME by Thompson and Stappenbeck (2005) uses 5 scoring dimensions. These are: earnings per share (EPS); return on equity (ROE); credit

Table 3
Stepwise Regression Results

Data set 1 N = 576			Data set 2 N = 528		
Variable	Adj. R^2	Added Explained Variance	Variable	Adj. R^2	Added Explained Variance
Profits	0.648	0.648	Profits	0.617	0.617
Working Capital	0.764	0.116	Working Capital	0.763	0.145
Forecasting	0.843	0.079	Forecasting	0.831	0.068
Financial Structure	0.905	0.062	Financial Structure	0.890	0.059
Market Share	0.935	0.030	Customer Satisfaction	0.926	0.036
Gross Margin	0.954	0.019	Wealth Creation	0.960	0.034
Wealth Creation	0.968	0.014	Market Share	0.971	0.011
Customer Satisfaction	0.985	0.017	Gross Margin	0.985	0.014
Emergency Loans	0.993	0.008	Emergency Loans	0.994	0.009
Productivity	1.000	0.007	Productivity	1.000	0.006
Durban-Watson		2.100	Durbin-Watson		2.101

All variables were significant with "p" values < 0.0005
The beta coefficients were all positive
Both Durban-Watson measures were above the D-W 0.05 upper critical value of 1.89327. (10 variables and 550 observations)

rating; image rating and stock price. This simulation has two modes of evaluation; one scores each team on how well it attains five identified corporate goals and one that compares each team to the best in the class. These evaluation scores are then reported after each round and as a cumulative score.

CAPSTONE (Smith.2004) uses ten items to generate an assessment score. These include; gross margin; round profits; the existence of an emergency loans; the amount of available working capital; The firms market share; The forecasting accuracy of the team; Customer satisfaction; plant productivity; the firm's financial structure and the amount of wealth created. A score of between zero and 100 is assigned to each factor and these are added for a possible score of 1,000 points or less for each round played. CAPSTONE also provides a cumulative score.

CORPORATION (Smith and Golden 2002) uses a scoring algorithm that includes stock price and cash management, but the stock price includes marketing effectiveness, social responsibility and is heavily weighted to earning per share (which implicitly values debt load), and attention to employee HR policies.

Patz's research papers on team dominance have all dealt with the use of formula based evaluation scores as recommended by most business simulation designers. He found that dominance existed in business simulations when the games were evaluated using these broad based assessment tools. Professor Patz (1990, 1992, 1995, 1999, 2000, 2001, 2002, and 2006) utilized a large number of business games and found that the dominance phenomenon occurred when the more broad based measures of firm performance were used. He used CORPORATION (Smith and Golden 2002), MICROMATIC (Scott & Strickland 1985) THE MULTINATIONAL MANAGEMENT Thompson and Stappenbeck, 1999 and 2002 and the on-line 8th edition 2005) in his research.

Why does the broader simulation tool contain the same drawback as the cumulative and annual profit evaluation models? While that question cannot be answered directly by the research reported in this paper, there may be a very big clue.

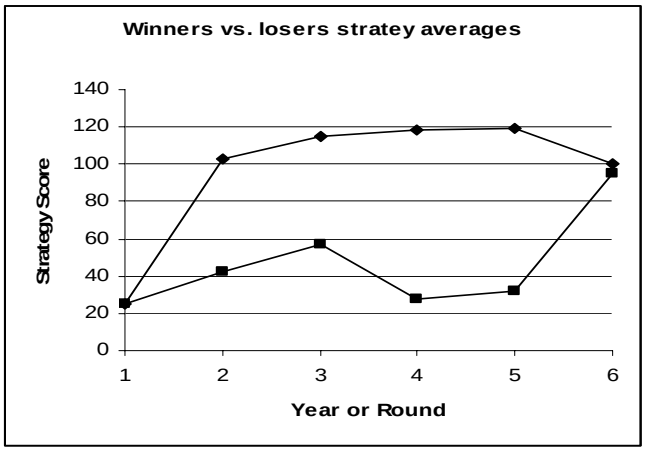
This research utilized the CAPSTONE game which combines 10, equally weighted measures, one of which was profit. Table 3 shows the outcome of a stepwise regression of these 10 measures as independent variables and the performance as the dependent variable.

Table 3 shows that profits overwhelms all of the other variables in the performance measure, thus one should expect that the multiple attribute model of firm performance would produce very similar results as the single variable profits. Please note that the above analysis used only data obtained from the CAPSTONE simulation and as such it is not generalizeable, but it does create a hypothesis that should be tested with all other total enterprise simulations.

LEARNING BY DOING

Business games or simulations utilize learning by doing in a dynamic environment. It is claimed by business simulation enthusiasts that learning by doing is usually quicker and longer lasting than learning in a conventional the lecture - then test methodologies used in conventional classrooms. The learning that takes place in these games/simulations is said to be "just-in-time" learning. That is, the students learn a concept as a solution to a problem that occurs in the simulated firm, just in time to

Figure 3
Winners and losers strategy averages



solve the problem. But, often, what happens is "just-a-little-late" learning or learning from their mistakes. In fact business games often explain their "raison d'etre" as being able to make errors in judgment and/or decision making without the costliness of the practitioner world. But the same business problems are found at different times and under different conditions for different teams, when participating in the same business game, thus at a given point in time, the learning opportunities are not common.

If learning "just-a-little-late" occurs, then grading the performance of participants by the measured performance of the simulated firm may penalize those who learn the most. A great graph of strategy learning was shown in "*Total enterprise simulation winners and losers: A preliminary study*" (Patz 2001, page 194)). This graph is reproduced with approximated data below in Figure 3. The losers are on the bottom of the graph.

Does figure 3 show that the winners gained virtually no strategy knowledge after round 2 and may have even lost some "knowledge" between round 5 and 6, while the "losers," who learned by doing, learned a great deal between periods 5 and 6? Note that learning takes place in the real time interval between periods, and results are known only after the simulated round is over. Hypothesize what might have occurred if this game ran 8 or even 10 periods. Who would have learned the most? Did the winners stop learning after the first period? At the end of the 6th round do both the losers and the winners know the same amount of strategy? Did the winners really know so much at round 2 that they just quit learning?

If grades are to represent firm or product performance, then simulations need to run for only a very limited the number of rounds. That number of rounds should be about three or four. If we think there are lessons to be learned from playing the game for more rounds than that, then we need a different means of student assessment.

From reviewing the analysis performed by this researcher and by professor Alan Patz, it is clear that performance based participant assessment, as traditionally generated in total enterprise simulation has little or no relationship with assessment based upon learning.

In fact, in most business simulations, explicit statement about what one is expected to learn by participating in the game is absent.

LEARNING WHILE PLAYING GAMES

Do participants really learn something while playing a business game and is learning via a simulation as thorough as lecture or case study? Wolfe (1990) wrote an exceptionally thorough review of research on learning and business simulations and this author would recommend anyone interested in assessment and simulations read this document. However no specific conclusion as to what participants learned and the efficiency of the learning were unstated.

In 2001, a framework for evaluating simulations was developed (Schumann et al 2001). This framework contained four levels. Level 1 was the self reported reactions of the participants and it measured how the players felt about the learning experience from a survey. Level two was to be reported measures of learning by the degree the participants changed heir attitudes, improved knowledge or increased their shills. This level was to be evaluated by the use of self reported questionnaires measuring the changes in attitude and by tests to measured levels of knowledge and skill. Level 3 was behavior aspects of gaming. This level was to be measured by observations of the participants' behaviors after the simulation or game exercise. Level 4 was to be gauged by ex-post-facto measures of improvements noticed in the work products. The authors admitted that the "*...challenge in applying a level four evaluation outside of corporate training is to decide which results are relevant...*" (Quote from page 218). The same caveat can be said of level 2 and level 3.

Anderson et al (1998) asserted that, "the validity of both the educational approach and the assessment measures are dependent on the educational outcomes – the key skills needed for success. Without knowing what these [key

skills] are, we have no way of knowing whether the educational approach and assessment measures are valid (quote from page 36). This statement is the Rosetta stone needed to resolve the dilemma of assessing participant learning in gaming and simulation. That key is specifying the important skills that are to be learned when one participate in a business simulation or game.

IDENTIFYING LEARNING OBJECTIVES

Gentry, McBain and Burns (1979) as well as Peach and Hornyak (2003) recommended that instructors using simulation should first identify learning objectives before selecting a simulation. Unsaid in these comments were just how one cold identify which simulations were best at conveying what specified learning objectives. In addition, this process puts the burden of determining which simulations best teach what concepts up to the instructor. But shouldn't the simulation designers include what is to be learned from participating in their business simulation?

TELLING STUDENTS WHAT THEY ARE EXPECTED TO LEARN

In recent years, textbooks have begun to explicitly tell a student what they are expected to learn, chapter by chapter. In *Business Marketing*, Dwyer and Tanner (2006), every chapter starts by explicitly stating learning objectives and defining specific tasks the student is expected to learn from his/her reading of the text. In finance, Ross, Westerfield and Jordan (1998) every chapter ends with a chapter review, self-test problems and critical thinking questions that reinforce the learning points of the chapter. Burns and Bush (2002) start each chapter in their marketing research book with a highlighted box titled "Learning Objectives." Schneider and Sollenberger (2006) have a managerial accounting text in which every chapter starts with a section entitled "Learning Objectives. Throughout their strategy text, Thompson, Strickland and Gamble (2007) have boxed and colored statements printed in the margins of the book called Core Concept, which point what the student is supposed to learn from the various sections of the book. Thus, grading a student in one of the functional areas of business schools relies upon testing the students on his or her knowledge and understands of the learning objectives stated in the texts. If Textbooks specify explicit learning objectives, should not business simulation define learning objectives as well?

CONCLUSIONS

Games should explicit state that a participant would learn the importance of managing cash flows, controlling inventory, managing the relationships between price, promotion, and the entire battery of marketing relating expenditures, (equalizing the marginal rates of return across the marketing expenditures) understanding the wants and needs of the customer and in some cases the customer's customer. It should be pointed out that logistics are an important part of marketing and why. Many aspects of manufacturing, especially maintenance and the relationship of these expenditures to output are taught by games. Simulations allow for experiential learning to teach many things that are difficult to teach vis-à-vis lecturing. We need to emphasize and specify what is learned, not assume it happens by osmosis or some other natural process. If the learning points are shown to the participants, then the more standard testing procedures can be used to identify the learning that has taken place during the experiencing the game.

It seems as if only one simulation provider goes part of the way. Management Simulations, Inc., producers of CAPSTONE have just released as assessment tool for their business game. This is at least a start. They still need to specify the learning points in their student manuals.

Business simulations are similar to distance education in that mush of the time the participants are gathering their information off the internet outside of the classroom and they make their decisions outside the confines of the classroom. Penn State University along with Lincoln University (1999) recommended the following four processes for an on-line environment.

1. Enable students to self-monitor progress
2. Give regular feedback to students
3. Support peer learning and assessment
4. Design self-assessment practice

With minor changes in the way game administrators debrief business simulations and providing some guidance for the participants on interpreting the outputs of round results, the experiential learning would be greatly enhanced and this gain in knowledge is testable on an individual student basis.

The way business games or simulations are currently used need to change in multiple ways. In the short run, game designers must provide some material that explains what the participants are to experience and what they are to learn as the result of "playing" their business simulation or game. These materials need to include what the participant is expected to observe and link these expected observations to the learning objectives. The learning process needs to be vividly characterized; it must not be subtle.

There needs to be feedback provided in the simulation that shows when errors in forecasting demand occurs and show that this error causes either too much or too little ending inventory. The first resulting in shortfalls in cash and the latter resulting in lost sales. This feedback can be very mechanical and programmed into the games. A more difficult task will involve having the computer detect poor strategies and/or changing strategies, resulting in either better performance or worse firm performance.

The dominance characteristic that has been found in many computerized business games (and may be present in all games designed using an oligopoly industrial structure) may be a fundamental long-run problem that can only be changed by completely redesigning the business game structure. It is not mandatory that business games represent

oligopoly market structures. Games could be designed where the firms must interact with each other. Ernie Cadott produced a version of MARKETPLACE that had a Manufacturer-Distributor relationship built into the game. It required personal negotiations between the manufacturing teams and the distribution teams. The results of the negotiations were then incorporated into the simulation, but, that feature was removed in a latter version. It seems that the game designed have forgotten that the goal of simulation play, at least in university classrooms is education – teaching out student how and why business operations work. There are many aspects of businesses that are not currently addressed. So many that the current business simulations are far from realistic and may allow many players to misinterpret of what a business executive really does while on-the-job or what he/she needs to know..

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