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TOTAL ENTERPRISE SIMULATION LEARNING COMPARED TO TRADITIONAL LEARNING IN THE BUSINESS POLICY COURSE

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ABSTRACT

This paper reports a study that examined the relationship between total enterprise simulation learning and learning developed in traditional components of the undergraduate business policy course. Also examined were the relationships between learning and simulation performance, between learning and forecast accuracy, and between simulation performance and forecast accuracy. Learning was measured using researcher-developed tests administered at the beginning, after the completion of traditional components (theory and cases), and after the simulation-only components of the courses. Significant learning was found for both the traditional and the simulation components of the sections studied. There was no relationship found between simulation learning and simulation performance or for simulation learning and forecast accuracy. Inconsistent results were found regarding simulation performance and forecast accuracy. These results suggest that the simulation effectively complements traditional approaches to the policy course and that forecast accuracy may be a proxy for simulation performance.

BACKGROUND

This paper continues a series of research studies exploring business undergraduate student learning associated with participating in the play of a total enterprise (TE) simulation. Based on our research efforts, we have concluded that simulation participants learn what the simulation has to teach (i.e., begin to master the skills and concepts presented in the simulation used) and that the simulation is a valid learning methodology. Additionally, while documenting that participants learn, we have also consistently found that simulation performance and learning do not co-vary (Washbush & Gosen, 1993, 1994, 1995, 2001; Gosen & Washbush, 1996).

This study is then a logical extension of our previous efforts to document the nature, process and extent of learning accompanying simulation play by asking increasingly complex research questions. It is also faithful to the charge we made several years ago (Gosen & Washbush, 1999) that there now exist many issues that should be researched to improve the understanding of the impact of teacher behavior on simulation learning.

Our studies have consistently been designed to analyze and evaluate learning that resulted from playing the game itself rather than evaluating the degree to which game play obtained a particular course's learning objectives. All other studies on the teaching effectiveness of business games have focused on identifiable skills or particular subject matter learning, such as the domain of strategic management, associated with a particular course. For a review of this literature see Wolfe (1997).

Because there exist twin focuses (learning in the simulation vs. learning in the course), it is reasonable to assess whether or not our methods of learning evaluation are pertinent to both domains. Such a study could attempt to answer these questions:

- Is simulation learning documented from the traditional part (strategic management theory and case analysis) of the capstone policy course?
- Does learning occur only in the traditional or simulation components of the course, or does it occur in both?
- Does there exist complementary learning between traditional and simulation components of the course?
- Is there a relationship between a group's ability to forecast sales (in units of product) and (a) simulation learning and (b) performance in the simulation?

The latter question was suggested for addition because Teach (1989) found that profitability-forecasting accuracy, a measure of learning about the firm's competitive environment, correlated with measures of profits. While Teach used profitability forecasting, this study evaluated sales-unit forecasting accuracy given that the simulation used is a single product game.

METHOD

This study was conducted during the fall and spring semesters of the 2000-2001 academic year using three sections (two in the fall) of the undergraduate business administration degree capstone administrative policy course at the University of Wisconsin-Whitewater. Within the constraints of day and time of class, individual preference and class capacity, students were assigned to these courses in a non-random manner. The primary research hypotheses, stated in null form, were:

- H1. No simulation-related learning occurs during the traditional part of the course.
- H2. No simulation-related learning occurs during the simulation part of the course.
- H3. Learning and simulation performance do not co-vary.
- H4. Learning and forecasting accuracy do not co-vary.
- H5. Simulation performance and forecasting accuracy do not co-vary.

Learning was measured using three parallel forms of an objective-item and short-answer examination developed by the researchers during previous simulation learning studies. These tests were specifically designed to measure learning that resulted from playing the game itself (Washbush & Gosen, 2001). The examination was constructed to reflect the below listed learning objectives (based on the content and procedures found in MICROMATIC (Scott, et al., 1992), the simulation used in these studies. Learning in these studies also reflected some of the elements in the strategic management domain as identified by Wolfe and Roge' (1997) including strategy, environmental analysis, forecasting, market development and penetration, cost and differentiation strategies, and performance measures. Additionally reflected was the description of decision making in total enterprise simulation games as provided by Keys and Biggs (1990) involving business functional areas and their integration. Simulation participants were expected to be able to:

- Effectively make decisions integrating the marketing, production, and financial aspects of a business.
- Evaluate periodic performance with respect to profits, cost control and strategic impact.
- Improve business performance with respect to cost reduction, profitability, and strategic potential.
- Pose and implement effective and efficient solutions to problems encountered or opportunities that arise.
- Analyze effectively market conditions and the behavior of competitors.
- Recognize needs for strategic and tactical change.
- Develop and demonstrate a mature ability to read and interpret financial statements.
- Understand and manage cash flow with respect to sources, needs, and uses.
- Properly allocate costs on a per-unit-sold basis.
- Develop basic skills in forecasting product demand.
- Use pro forma statements and "what if" analysis to evaluate the probable impact of decisions and strategic options.

Students completed one form of the examination at each of three points in the course:

1. A pre-test given during the first week of the course
2. A mid-test given at the completion of the traditional (theory and case) portion of the course
3. An end-test given as part of a final examination at the completion of the course.

Students were self-selected into groups of three or four for purposes of simulation play. Simulation play was the sole focus of the course during approximately the last 1/3 of each course. The previous parts of the course were devoted to strategic management theory (3 weeks), case analysis (6 weeks) and an overview and introduction to the simulation (1 week). Simulation play began with a practice decision round. In addition to play, students had to write and submit brief periodic performance analysis reports and a final, overall performance assessment. The grading scale was based on 500 possible points and simulation related components were graded as follows:

Simulation Reports	100 possible points	Group	(20% of course grade)
Simulation Final Standing	75 possible points	Group	(15% of course grade)
Peer Evaluations	25 possible points	Individual	(5% of course grade)
Final Exam	100 possible points	Individual	(20% of course grade)

As noted above, the last exam was part of the course final. In addition to questions from the simulation-learning examination item pool, approximately 40% of the final exam addressed cases studied in the course. No case-related items were used in calculating learning scores.

The simulation learning tests used were forms developed in our research intended to (eventually) create an examination suitable for use in evaluating learning in any simulation environment (Gosen, Washbush et al, 1999; Gosen, Washbush & Scott, 2000; Gosen and Washbush, 2001). These were scored using standardized answer keys. Each exam raw score was recalculated as a percentage score by dividing the raw score by points possible for the form used. Simulation performance was measured using the normalized scoring routine that is a component of simulation software. The factors used to determine simulation performance within the game's scoring routine were total profits (40%), return on sales (30%), and return on assets (30%). This weighting system has been used in all of our previous simulation and learning research. Specific results of the pre and mid-tests were not provided to the students nor were those administrations debriefed.

Forecast accuracy was determined by requiring each group to prepare and turn in a forecast for sales in each market area for each decision round. Total demand for each period was determined by summing actual sales and lost sales for each area. Forecast error for each round of play was calculated by subtracting forecast sales from actual demand and converting to the absolute value. For all periods of play, the mean absolute deviation (MAD) was calculated for each group by summing the absolute errors for each period of play and dividing that total by the number of periods of play. A smaller MAD indicates greater forecast accuracy.

Consistent with our procedures in all related prior studies, learning was defined, test to test, as the difference in percentage score of the latter test minus the percentage score of the prior test. As in most of our previous studies, learning was measured individually, simulation performance was measured on a group basis. Learning was evaluated by comparing between-test percentage scores using paired, two-sample t-tests for means to determine whether or not significant differences existed. Learning was compared to simulation performance by regressing learning on performance and by regressing learning on MAD. Finally, performance, as measured above, was regressed on forecast accuracy (MAD).

RESULTS

Table 1 displays results for t-tests conducted for each of the groups studied. Learning scores were developed comparing test 2 to test 1, test 3 to test 2, and test 3 to test 1. In all sections studied, significant learning occurred between tests, and test 3-2 learning was generally greater than test 2-1 learning. Thus, learning occurred in both the traditional (strategic theory and case analysis) and simulation-only parts of the courses. This suggests that the simulation validly represents the content of the theory and case analysis components of the policy course. This is consistent with the findings of Wolfe (1976) that simulations are externally valid, and this argues strongly that simulations are effective complements to other learning activities in business policy courses. Null hypotheses 1 and 2 were rejected because significant learning occurred during both components of the course and overall.

Table 1
Learning Test Results

Fall 2000			
Sect 1	**Test Means**	**Variance**	**N**
Test 1	54.136	83.096	26
Test 2	59.653	49.880	26
Test 3	66.667	75.663	26
t tests	**t**	**Prob. (2-tail)**	
Test 2 – Test 1	3.366	0.0025	
Test 3 – Test 2	3.565	0.0015	
Test 3 – Test 1	6.006	0.0000	
Fall 2000			
Sect 2	**Test Means**	**Variance**	**N**
Test 1	50.993	124.212	38
Test 2	57.382	65.082	34**
Test 3	65.015	56.013	38
t tests	**t**	**Prob. (2-tail)**	
Test 2 – Test 1	3.675	0.0008	
Test 3 – Test 2	5.087	0.0000	
Test 3 – Test 1	8.338	0.0000	

**4 students did not complete the second test

Spring 2001 Sect 3	Test Means	Variance	N
1	49.346	106.878	30
2	54.843	147.048	30
3	62.549	54.714	30

t tests	T	Prob. (2-tail)
Test 2 – Test 1	2.736	0.0105
Test 3 – Test 2	4.027	0.0004
Test 3 – Test 1	7.662	0.0000

Table 2 displays results for analyses regressing performance on learning. The regressions performed compared performance to test 2 - test 1 learning, test 3 - test 2 learning, and total learning (test 3 - test 1). For Section 2 (fall 2000), there were two cases (performance regressed on test 2 – test 1 learning, and performance regressed on total learning) where there occurred significant, positive relationships between learning and performance. In these cases R2 was 0.15 (adjusted R2 was 0.12) and 0.18 (adjusted R2 was 0.15) respectively. In no other instances over the nine regressions was there any significant Beta relating performance to learning. In general, these results were consistent with those of our previous studies. Null hypothesis 3 was therefore accepted because there was no consistent relationship between learning and simulation performance.

Table 2
Regressions: Performance on Learning

Fall 2000, Sect 1 Learning	Learning *Beta*	Slope Sig.	R^2
Test 2 – Test 1	-0.641	ns	0.0556
Test 3 – Test 2	-0.344	ns	0.0230
Test 3 – Test 1	-0.701	ns	0.1078

Fall 2000, Sect 2 Learning	Learning *Beta*	Slope Sig.	R^2
Test 2 – Test 1	0.964	0.0231	0.1506
Test 3 – Test 2	0.064	ns	0.0004
Test 3 – Test 1	1.179	0.0083	0.1775

Spring 2001, Sect 3 Learning	Learning *Beta*	Slope Sig.	R^2
Test 2 – Test 1	-0.414	ns	0.0035
Test 3 – Test 2	-0.369	ns	0.0025
Test 3 – Test 1	-1.018	ns	0.0155

Table 3 displays results for analyses regressing forecasting accuracy (measured by unit-sales forecast MAD) on learning in the same manner as noted above for performance. Compared to the learning-performance results, there was one significant relationship between learning and MAD (MAD regressed on test 2 – test 1 learning), and in this case R2 was 0.13 (adjusted R2 was 0.10). In no other instances over the nine regressions was there any significant B relating MAD to learning. Null hypothesis 4 was therefore accepted because there was no consistent relationship between learning and forecast accuracy.

Table 3
Regressions: MAD on Learning

Learning	Learning *Beta*	Slope Sig.	R^2
Fall 2000, Sect 1			
Test 2 – Test 1	6.928	ns	0.0109
Test 3 – Test 2	-6.406	ns	0.0134
Test 3 – Test 1	-1.422	ns	0.0007
Fall 2000, Sect 2			
Test 2 – Test 1	-26.119	0.0350	0.1312
Test 3 – Test 2	21.380	ns	0.0561
Test 3 – Test 1	-12.759	ns	0.0271
Spring 2001, Sect 3			
Test 2 – Test 1	1.571	ns	0.0012
Test 3 – Test 2	-2.238	Ns	0.0023
Test 3 – Test 1	-0.624	Ns	0.0001

Table 4 displays results of analyses regressing performance on MAD. Here, the results were mixed. For the two fall 2000 sections, there were no significant relationships between standing and forecast accuracy, but for spring 2001 the MAD coefficient was significant. However, definitive conclusions about simulation and forecast accuracy were not found, and therefore null hypothesis 5 was accepted. The fact that the spring 2001 semester included 13 periods of play versus 8 and 9, respectively, for the fall 2000 sections may explain the inconsistencies found. One suspects that a larger number of periods of play will permit players to gain experience-based expertise in forecasting. These results would seem to be consistent with those found by Teach (1989).

Table 4
Regressions: Performance on MAD

Academic Term & Section	N	Periods of Play	MAD *Beta*	Slope Sig.	R^2
Fall 2000, Sect 1	26	8	-0.008	Ns	0.0353
Fall 2000, Sect 2	38	9	0.005	Ns	0.0161
Spring 2001, Sect 3	30	13	-0.101	0.0001	0.4142

DISCUSSION

The consistent and significant learning documented over the traditional and simulation components of these course sections was the most interesting finding. These results strongly suggest that the policy course is, at least, a natural complement to theory and case-based studies in the policy course. In general, users of TE simulations have acted on an assumption that traditional instruction in strategic management and the use of simulations are complementary pedagogically. Additionally, Wolfe and Roge' (1997) have documented that there is a substantial amount of common ground covered by both traditional and simulation modalities, but that some games are more effective in covering typical strategic management subject matter and concepts. The results of the analyses presented here provide empirical evidence that complementary learning does in fact occur, and they argue for studies examining this phenomenon more expansively and precisely.

Secondly, these results suggest that the simulation may be more equivalently useful than is assumed by policy course instructors in terms of learning compared to the traditional policy-course format. The simulation may be, in fact, a learning method that may stand alone (or nearly so) in the policy-course setting. If this is true, instructors might be well advised to build the policy course experience with a focus on the simulation as the primary activity of the course, supplementing it with some traditional components as might be appropriate or necessary. Studies exploring this approach seem warranted.

Thirdly, as expected, these results confirmed our previous consistent findings that simulation-based learning and simulation performance do not co-vary. These persistent findings indicate that that question need not be a primary focus of continuing research. Instead, they do argue that the ongoing development of a standardized generic test of simulation learning is still a worthwhile project. Additionally, such a validated instrument would be invaluable in assessing the broader implications for the simulation suggested in the previous paragraph.

Fourthly, there is also the possibility that learning improvement over three test cycles may be, in part, a result of repeated testing. However, that need not be seen as undesirable. If, in fact, the process of measuring intended learning contributes to such learning, that could be seen to be a valuable and desirable consequence. Thus, studies that attempt to evaluate simulation learning might well be designed to assess whether or not repeated examination-based learning assessments contribute to and enrich the learning environment of the simulation.

Finally, continuing to assess the extent to which measures of forecasting accuracy may have learning implications are warranted. Unfortunately, the analyses documented here did not consistently indicate a correlation between learning and forecasting accuracy. At best, the analyses suggest that forecasting accuracy may be a proxy for other measures of simulation performance. One would like to believe that people who learn to forecast accurately (whether in terms of sales units or profitability) in TE simulation environments are in fact learning valuable strategic analysis and synthesis competencies. One would like to believe that such learning would occur on a regular basis, but the results here suggest otherwise. Thus, in the end, we ought ask, why do such outcomes not occur?

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