INTERACTIVE SIMULATION AS A SUPPLEMENTARY INSTRUCTIONAL TOOL: ITS RELATION TO PERFORMANCE IN A BUSINESS SIMULATION

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INTRODUCTION

While the concepts of experiential learning has had a long history, it has not been until recently that systematic attempts have been made to assess the significance and value of simulation-- more particularly business gaming.

For example, Seitz and Thornton (6) found that simulation motivated students, but did not provide more learning or understanding of the subject matter than did more traditional teaching approaches. Fritzche (2) , on the other hand, indicates that a game-centered approach engendered more learning than a lecture-centered approach. Comparing yet different approaches Wolfe and Guth (8) found no significant differences in learning business policy when they experimented with the case approach versus the game approach.

Some research has also been done in an attempt to analyze what factors might account for successful performance in playing business games [Hand and Sims (3)]. Armenakis, Feild, and Holley (1) attempted to find correlates of satisfaction, learning, and success in business gaming. One of the interesting findings in this study was that experience in participating in business games does not lead to increased performance in subsequent gaming activities. It might be asked, however, if increased "experience" during the play of the game, in the form of computer aided analysis, might not enhance performance. This is the basic question addressed in this paper.

PROCEDURE

Our major purpose was to investigate the degree to which performance on a business simulation might be enhanced through the use of direct interaction with supplementary simulation experience. Sprague and Cotlar (6) have reported the use of an interactive terminal keyboard experience which they claim results in "enthusiasm and excitement among the students." The relationship to performance, however, was not discussed.

To examine this question, students in the Business Policy course at Kansas State University were assigned to teams within three "industries" to play Henshaw and Jackson's Executive Game (4)[1] Each team represented one firm within a six or eight firm industry. Students were informed that part of their grade for the course (10%) would be based on their return on investment (ROI) earned and on how they ranked within the industry. Identical presentations were made by the instructor to all three industries, thus controlling for administrator effects (5) . The industries played the game for four periods (one year in game time) as a trial. Next the game was started again and allowed to run to completion (12 periods) . The two end-of-the-first-year ROI figures were used as the measures of performance.

Students were also given the option of using an interactive simulation to aid in their decision making for the game. A

[1] Students were randomly assigned with control only for major. An attempt was made to have at least one student from each major area (accounting, finance, marketing, and management) on each team.

program was established (without student knowledge) to tally the number of times this supplementary experience was used by each firm. This measure was then correlated with the ROl results to test the hypothesis that greater use of supplementary experience will be related to higher performance in the game. Our findings follow a description of this supplementary experience, which was named SIMERACT.

DESCRIPTION OF SIMERACT

The simulation (SIMERACT) used by students to "re-create" game conditions is a modification of the Executive Game played in class. The Executive Game requires quarterly decisions from participants on eight parameters (such as price, production, marketing, etc.). In this game, results are dependent on the interaction of economic conditions, historical decisions, and the competitors' decisions within the simulated environment of the industry.

SIMERACT requires the student to input assumptions about the environmental conditions (economic index, seasonal index, and inflation rate) as well as estimates concerning three industry averages (the average expenditure in marketing, R&D, and the average industry price) . The student is then asked to input the eight decisions (marketing, R&D, price, production volume, maintenance, materials purchases, plant and equipment investment, and dividends) for his own firm.

Certain parameters (dividends, maintenance, production volume, materials purchases, and investment in plant and equipment)

for the competitors were established as constants in order to simplify the structure of the game. However, the program generates price, marketing, and R&D decisions for the competitors based on the input assumptions. One of the hypothetical competitors is given the assumed industry average figures, and the decisions for the other firms are generated randomly from an assumed normal distribution (with mean equal to the assumed industry average and the standard deviation equal to one tenth of the assumed industry average) . Finally the competitors decisions are adjusted so that the average value for all of the decisions coincides with the assumed industry average input by the student.

On the terminal, the student is presented with information resulting from these assumptions and decisions. This output includes price, dividends, sales volume, net profit, marketing expenditures, and R&D expenditures. At this point the student is given the option of receiving a print out of the accounting statements of any of the firms. (In the normal game play, these statements are received only for the students' own firm) If this option is exercised, the student receives operating, income, cash flow, and financial statements for the firm requested.

Then the student is asked if other runs are desired. If so, he is asked if he wishes to change or keep his original assumptions. Next he is asked whether he would like to change any of his decisions. This process is repeated until the student wishes to terminate the run. Since multiple results are possible on one "run," the tally of the use of SIMERACT is based on the

number of times a new result is calculated, rather than on the number of times the student sits at the terminal. Figure 1 presents an example of one run of SIMERACT.

SIMERACT only simulates one quarter of play for a six-firm industry and is restrictive in this sense. The reasons for this limited design are:

1) The options already incorporated allow the student to examine a large number of interactive variables. Students can analyze the effects of variables under somewhat controlled conditions. The addition of the "time" dimension greatly increases the complexity, and might defeat the purpose of this experience.
2) The student can, and should, learn about sequences of decisions and carryover effects from the game itself.
3) The mechanics of computing and storing historical data were very burdensome from a programming point of view.

ANALYSIS AND RESULTS

In order to investigate our hypothesis, correlations were made between the ROI results of two successive plays of the Executive Game and the use of SIMERACT. Students played four quarters (one year) of the Executive Game and ROI was determined based on the present value of dividend streams and ending equity relative to beginning equity (which was the same for all teams) All firms then reverted back to time 0 and played one more year of the game. While learning from the first game would probably influence the results of the second, we attempted to determine if changes would occur and assess the possible impact of the use

of SIMERACT. By continuing into a second year from the end of year one, confounding might have occurred due to different environmental conditions or carryover effects of the different positions of firms within an industry from year one.

Table 1 presents the mean values for ROI and the use of SIMERACT for each industry.

TABLE 1

ROI AND USE OF SIMERACT FOR THREE INDUSTRIES[a]

	Industry 1	Industry 2	Industry 3
SIMERACT use, period 1	15.0	6.8	5.4
SIMERACT use, period 2	3.8	9.3	.1
SIMERACT use, total	18.8	16.1	5.5
ROI, period 1	10.3	9.6	9.5
ROI, period 2	4.1	2.2	8.0
Change in ROI	-6.2	-7.4	-1.5

[a]Mean Values

Our results showing the correlations between performance (in terms of ROI) and the usage of SIMERACT are presented in Tables 2 and 3. Industry 3 was omitted from further investigation due to the low number of uses of SIMERACT.[2]

[2] Industries 1 and 2 were six-firm industries while Industry 3 was an eight-firm industry. It is probable that these students (in Industry 3) felt that SIMERACT was not useful to them since it was designed for a six-firm industry (even though its value is, in fact, relevant for analytical purposes regardless of industry size)

TABLE 2

INDUSTRY 1 CORRELATIONS OF ROI AND SIMERACT USAGE

		1	2	3	4	5	6
1.	SIMERACT Use, period 1	1.0	-.045	.903	.269	-.322	-.700
2.	SIMERACT use, period 2		1.0	.389	.702	.876	.206
3.	SIMERACT use, total			1.0	.550	.080	-.557
4.	ROI, period 1				1.0	.643	-.422
5.	ROI, period 2					1.0	.423
6.	Change in ROI						1.0

As can be seen in Table 2, there was no relationship between the uses of SIMERACT during the first year and those of the second. Interestingly, there is a correlation of .702 between the first year ROI and the use of SIMERACT during the second year. It is possible that those with good performances in the first year felt that the use of SIMERACT might help them to keep their competitive advantage. The correlation of .876 between the second year ROI and SIMERACT use during that period indicates that SIMERACT may have aided play over time, even though ROI and SIMERACT use in period 1 only correlates .269. The correlation of change in performance with first period SIMERACT use is -.700, indicating that early users of SIMERACT hurt their performances more than they helped. The correlation between the change in ROI with total uses of SIMERACT was also negative, indicating that this did not aid performance overall.

Industry 2 had a somewhat different pattern from Industry 1. Here, the correlation between users of SIMERACT in periods 1 and 2 is .556. Higher users in period 1 tended to also use it more in period 2.. Correlations for the ROI in the first year and SIMERACT use in periods 1 and 2 are negative (contrary to the results in Industry 1) . However, similar to Industry 1, second year ROI results are

TABLE 3

INDUSTRY 2 CORRELATIONS OF SIMERACT USAGE AND ROI

		1	2	3	4	5	6
1.	SIMERACT use, period 1	1.0	.556	.773	-.682	-.237	.389
2.	SIMERACT use, period 2		1.0	.957	-.502	.515	.889
3.	SIMERACT use, total			1.0	-.621	.311	.812
4.	ROI, period 1				1.0	.346	-.572
5.	ROI, period 2					1.0	.572
6.	Change in ROI						1.0

positively correlated (.515) to SIMERACT use during period 2. Correlations between second year use of SIMERACT and the change in ROI is .889 in Industry 2 (this was only .21 in Industry 1) And, again in contrast to Industry 1, the correlation between the change in performance and total SIMERACT use in Industry 2 is .812.

SUMMARY

Even though this maze of findings leads to some conflicting conclusions, there does seem to be some evidence to suggest that supplementary experiences may aid in performance in a business

simulation. While the. correlations of ROI and use of SIMERACT in period 1 was poor (.269 and -.682 for Industries 1 and 2, respectively), the second year's correlations improved (.876 and .515, respectively) . It appears that, as higher performing players learned the game, they found that the use of SIMERACT could be an aid to their analysis. This is further suggested by the fact that the second period use of SIMERACT is correlated to the change in ROI (.206 and .889, respectively) . There is the possibility, then, that there is an understanding of the potential value of SIMERACT on the second time around.

There is, of course, the possibility of other variables confounding these results. For example, correlations in year 1 ROI and change in ROI were -.422, -.572, and -.763 for the three industries. This may be due to the regression effect--the natural tendency for those who do extremely well to do less well the second time, and vice versa.[3] Further, it was observed that cutthroat competition in the second game tended to depress ROl for all firms in all of the industries.

Nevertheless, there seems to be some justification for allowing students the opportunity of participating in independent supplemental experiences of this nature. Further progress in the form of allowing students to write or access analytical programs in conjunction with this kind of experience may aid in the development of their analytical and decision making abilities.

[3] Those instructors who rely on performance on game results alone as a major determinant of a student's grade may want to reconsider their grading procedures if this regression effect is in fact operating.

FIGURE 1

EXAMPLE RUN OF SIMERACT

```
login
vm/370 online    ljb359 asvosu

1 cms cms
ENTER ACCOUNT NUMBER
88888888
ENTER SS NUMBER
888888888
LOGON AT 12:29:43 CDT MONDAY 10/20/75
CMS V2 PLC 13 - 07/20/75 09:28
Z-09/20/75 04:14  * SCRIPT command updated.  Type "DESCRIBE NEWSCRIPT".
FORMATTING DISK 'A'.
R;

simeract

         $JOB            ,PAGES=999,TIME=9

         $ENTRY
ENTER YOUR SOCIAL SECURITY NUMBER
319363006
ENTER YOUR INDUSTRY AND FIRM # ( EG., IND. 2, FIRM 3 = 23)
68

                                   ;   A M    S I M E R A C T

      I AM A MINI-SIMULATION TO HELP YOU MAKE DECISIONS FOR THE EXECUTIVE GAME.  I AM LIMITED TO ONE QUARTER OF
PLAY, BUT I HELP YOU TO EXAMINE THE POTENTIAL EFFECTS OF THE INTERACTION OF ECONOMIC CONDITIONS, COMPETITIVE ACTIVITIES,
AND YOUR DECISIONS.  YOU MAY TRY A LARGE NUMBER OF DECISIONS UNDER DIFFERENT ASSUMPTIONS TO EXAMINE WHAT MIGHT HAPPEN
IF THESE CONDITIONS occur IN THE GAME.
      YOU WILL INPUT ASSUMPTIONS AND FIX DECISIONS AND WILL GET INFORMATION ABOUT WHAT HAPPENS AS A RESULT.  IT IS ASSUMED
THAT YOU ARE FIRM NUMBER 1 IN A SIX FIRM INDUSTRY.  ALL FIRMS HAVE HAD IDENTICAL EXPERIENCES GOING INTO THE NEXT QUARTER
TO BE SIMULATED.  PRICING, MARKETING, AND R&D EXPENDITURES OF OTHER FIRMS WILL BE RANDOMIZED AROUND A MEAN THAT YOU ENTER.

      YOU WILL NOW BE ASKED TO INPUT YOUR ASSUMPTIONS ONE AT A TIME.  AFTER TYPING EACH ONE, HIT THE RETURN KEY.
DO NOT TYPE COMMAS IN YOUR INPUTS (EG., FIFTYTHOUSAND = 50000  NOT  50,000)
IF YOU SHOULD MAKE AN INPUT ERROR, AND NOTICE IT BEFORE HITTING THE RETURN KEY, HIT THE ALTN KEY.
I WILL MOVE YOU DOWN ONE LINE AND YOU CAN TYPE THE DATA AGAIN (CORRECTLY, PLEASE).
IF YOU NOTICE AN ERROR AFTER YOU HAVE HIT THE RETURN KEY, TYPE IN 99999999 (EIGHT NINES).


TYPE IN YOUR ASSUMED AVERAGE INDUSTRY PRICE (USE DECIMAL PT.- EG., SIXFORTY = 6.40  NOT 640)
6.35
TYPE IN YOUR ASSUMED AVERAGE INDUSTRY EXPENDITURES IN MARKETING
300000
TYPE IN YOUR ASSUMED AVERAGE INDUSTRY EXPENDITURES IN R & D
250000
TYPE IN YOUR ASSUMED SEASONAL INDEX (FROM 90 TO 115).
95
TYPE IN YOUR EXPECTED INFLATION RATE (00 TO 20)
05
TYPE IN YOUR EXPECTED ECONOMIC INDEX (90 TO 110).
102

ARE YOUR ASSUMPTIONS TYPED CORRECTLY?
 IF SO, TYPE   YES ;   IF NOT, TYPE   NO
yes


    NOW INPUT YOUR DECISIONS FOR YOUR FIRM - REREAD THE  INSTRUCTIONS ABOVE FOR ERRORS
 (ALTN OR 99999999),  AND HIT THE RETURN KEY AFTER TYPING YOUR DECISION

TYPE IN YOUR PRICE (USE DECIMAL PT.- EG., SIXFORTY = 6.40   NOT 640)
5.60
TYPE IN YOUR MARKETING BUDGET
325000
TYPE IN YOUR R & D BUDGET
275000
TYPE IN YOUR MAINTENANCE BUDGET
85000
TYPE IN YOUR SCHEDULED PRODUCTION VOLUME
480000
TYPE IN YOUR PLANT INVESTMENT
225000
TYPE IN YOUR RAW MATERIALS PURCHASES
450000
TYPE IN YOUR DECLARED DIVIDENDS
125000

 ARE YOUR DECISIONS TYPED CORRECTLY?
 IF SO, TYPE   YES ;   IF NOT, TYPE NO
yes


  HERE ARE THE SIMULATED RESULTS OF YOUR DECISIONS, GIVEN THE FOLLOWING ASSUMPTIONS
  AVERAGE PRICE =   6.35  AVERAGE MARKETING EXPENDITURE =   300000.  AVERAGE R&D EXPENDITURE =   250000.
   SEASONAL INDEX =   95. INFLATION RATE =   5.0  ECONOMIC INDEX =  102.
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FIGURE 1 (continued)

EXECUTIVE GAME INTERACTIVE SIMULATOR
MODEL 2 PERIOD 1 JAS PRICE INDEX 101,2 FORECAST,ANNUAL CHANGE 7.5 0/0
SEAS.INDEX 95. NEXT QTR. 100. ECON,INDEX 103. FORECAST,NEXT QTR. 106.

INFORMATION ON COMPETITORS

	PRICE	DIVIDEND	SALES VOLUME	NET PROFIT	MARKETING	R&D
FIRM 1	$ 6.40	$ 125000.	685562.	$ 105561.	$ 325000.	$ 275000.
FIRM 2	$ 6.42	$ 100000.	670973.	$ 70106.	$ 363433.	$ 260360.
FIRM 3	$ 6.29	$ 100000.	671091.	$ 70815.	$ 267353.	$ 100053.
FIRM 4	$ 6.37	$ 100000.	608756.	$ 56606.	$ 287306.	$ 260838.
FIRM 5	$ 6.26	$ 100000.	516623.	$ 117830.	$ 276500.	$ 285760.
FIRM 6	$ 6.35	$ 100000.	695052.	$ 81183.	$ 300000.	$ 250000.

DO YOU WISH TO SEE THE FINANCIAL STATEMENTS FOR ANY OF THESE FIRMS?
IF SO, TYPE YES; IF NOT, TYPE NO
yes

TYPE IN THE NUMBER OF THE FIRM YOU WANT TO LOOK AT (A SINGLE DIGIT PLEASE FROM 1 TO 6)
5

FIRM 1 5

OPERATING STATEMENTS

MARKET POTENTIAL	516623.	
SALES VOLUME	516623.	
PERCENT SHARE OF INDUSTRY SALES	18.	
PRODUCTION,THIS QUARTER	525000.	
INVENTORY,FINISHED GOODS	59377.	
PLANT CAPACITY,NEXT QUARTER	418986.	

INCOME STATEMENT

RECEIPTS,SALES REVENUE		$ 3245724.
EXPENSES,MARKETING	$ 276509.	
RESEARCH AND DEVELOPMENT	285769.	
ADMINISTRATION	507800.	
MAINTENANCE	90000.	
LABOR(COST/UNIT EX.OVERTIME $ 1.62)	826815.	
MATERIALS CONSUMED(COST/UNIT 1.54)	810591.	
REDUCTION,FINISHED GOODS INV.	-75132.	
DEPRECIATION(2.500 0/0)	207500.	
FINISHED GOODS CARRYING COSTS	29680.	
RAW MATERIALS CARRYING COSTS	60000.	
ORDERING COSTS	50000.	
SHIFTS CHANGE COSTS	0.	
PLANT INVESTMENT EXPENSES	9000.	
FINANCING CHARGES AND PENALTIES	0.	
SUNDRIES	84700.	3011735.
PROFIT BEFORE INCOME TAX		233680.
INCOME TAX(IN.TX.CR. 0. 0/0,SURTAX 0. 0/0)		105650.
NET PROFIT AFTER INCOME TAX		117830.
DIVIDENDS PAID		100000.
ADDITION TO OWNERS'EQUITY		17839.

CASH FLOW

RECEIPTS,SALES REVENUE		$ 3235226.
DISBURSEMENTS,CASH EXPENSE	$ 2018075.	
INCOME TAX	105650.	
DIVIDENDS PAID	100000.	
PLANT INVESTMENT	300000.	
MATERIALS PURCHASED	1000000.	3526674.
ADDITION TO CASH ASSETS		-289400.

FINANCIAL STATEMENT

NET ASSETS,CASH	$ 757600.
INV. VALUE,FINISHED GOODS	178132.
INVENTORY VALUE,MATERIALS	1390600.
PLANT BOOK VALUE(REPLACE.VAL.$ 8753798.)	8392500.
OWNERS'EQUITY(ECONOMIC EQUITY 11079130.)	10717860.

DO YOU WISH TO SEE THE FINANCIAL STATEMENTS FOR ANY OF THESE FIRMS?
IF SO, TYPE YES; IF NOT, TYPE NO
no

DO YOU WISH TO MAKE OTHER TRIAL RUNS? IF SO, TYPE YES ; OTHERWISE TYPE NO
no

I HOPE THIS EXPERIENCE WILL BE HELPFUL TO YOU IN THE EXECUTIVE GAME - GOOD LUCK

PLEASE TYPE - LOGOFF - I AM EXPENSIVE IF NOT DISCONNECTED. THANK YOU.