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SIMULATION AS AN AID TO LEARNING: HOW DOES PARTICIPATION INFLUENCE THE PROCESS?

Lucette B. Corner, Purdue University
J. A. F. Nicholls, Florida International University

ABSTRACT

This paper investigates the manner in which participation in simulation games influences learning. The 92 members of an introductory marketing class were surveyed about their responses to the simulation, the lectures, and the textbook at the conclusion of the course. The findings were mixed. Lectures and textbook seemed to influence content learning more than did the simulation. Some evidence supports the notion that the simulation influenced process learning more than the other learning tools swayed it. Students perceived that they were relatively more involved in the simulation experience, although this finding was not substantiated by indirect measures. Finally, some data suggested that student involvement had a bearing on their content learning.

INTRODUCTION

Computer simulations are used extensively in teaching business courses. There is, therefore, considerable interest in understanding the manner in which simulation enhances learning (e.g., Washbush & Gosenpud 1995). The purpose of this paper is to obtain empirical evidence that will add to the growing knowledge concerning the relationship of computer simulation to learning. First, we address the relative impact of simulation and two other important learning tools (lectures and textbooks) on two key dimensions: “content” and “process.” Then we introduce the notion of Involvement” and argue that participation in simulation is a more involving learning experience than either listening to lectures or reading the textbook. Finally, we pose the question of whether involvement in a simulation promotes enjoyment of the experience and, further, aids in cognitive learning.

CONTENT AND PROCESS LEARNING

Learning can be examined within a two dimensional framework consisting of “content” and “process” dimensions (Thatcher, 1 990). The content” dimension views learning as “ a rigorous study of a subject to greater depth, with greater sophistication, and ever more detailed information about, the subject area” (Thatcher, 1 990, pp. 274-5), while the “process” dimension views learning as “understanding the mechanisms of study, information seeking, and problem solving or decisions” (p. 275). Lectures and class discussion should be associated with the content dimension since they tend to direct students’ attention to facts and acquiring solid information. Similarly, simulations should be associated with the process dimension since they provide opportunity for hands on experience with the material. Students’ learning experience is enhanced by running simulated companies, by gaining experience in making sequential decisions, and by developing the awareness that the outcomes of decisions are influenced by the decisions of others as well as by their own actions. In support of this view, Gentry, Stoltman, & Mehlhoff (1992) have argued that involvement in simulations improves procedural knowledge (process learning), and Ullmann (1993) provided evidence from Central Europe that a simulation experience did, indeed, enhance procedural knowledge.

Participation in simulations may also enhance content learning. In support of this, Wolfe (1990) concluded that courses with simulations do at least as well as those without them in imparting the content of the course. Yahr (1995) reported that his students believed they had learned the material in a simulation course as well as in courses that did not include a simulation, while Gosenpud & Washbush (1993) found that students exposed to simulation actually made *greater* test score gains than those who were only exposed to cases and strategic theory.

INVOLVEMENT WITH SIMULATION

It is possible that simulation enhances content learning indirectly through the involvement that develops during the experience. Gentry (1990) has argued that to learn experientially, students must be actively involved in the process, and that involvement is important to success. Participation in simulation games is interesting. Gray (1973) reported that students selected games as the most interesting, over all other information delivery systems. Intrinsic interest in the simulation may deepen into involvement. Indeed, Brown (1989) provided descriptive evidence of the nature of involvement experienced by simulation participants. Such involvement may motivate students to increased efforts and provide considerable incentive to learn the course content.

ENJOYMENT OF SIMULATION

We posit that people ‘earn best when they enjoy the experience and, therefore, enjoyment may be an important part of the puzzle. Bawden (1985) suggested that experiential learning has both affective and cognitive components, and that there may be a relationship between them. We feel that students’ enjoyment of the learning experience will increase as they become involved with the simulation.

PERFORMANCE IN COURSE

We believe that students’ involvement in the simulation will ultimately affect their performance in the course and would argue that students who become involved in the game are likely to learn more, not only on the process, but also on the content, dimension. Thus, students who become deeply involved in the game may perform better than others, not only in the simulation itself, but in the course, overall. When becoming deeply engrossed in the activities of managing their simulated companies, their motivation to learn the subject matter, itself, may increase, and they may, consequently, learn on a deeper level than they would with more traditional learning tools.

HYPOTHESES

In order to explore the foregoing ideas, we formulated nine research hypotheses.

Hypotheses 1 and 2

The first two hypotheses addressed the issue of effectiveness of learning tools as aids to the content and process domains of learning. H-i was directed toward content” learning. It assessed students’ perceptions of the usefulness of the simulation, relative to other tools, in acquiring the didactic subject matter (content learning). We expected lectures and textbooks to be perceived as more helpful to content learning than would simulation. Therefore, we hypothesized:

H-1 Students will perceive more content learning from the textbook and lectures than they will from the simulation experience.

Conversely, we expected simulation to be perceived as providing more process learning. We, therefore, hypothesized that:

H-2 Students will perceive more process learning from the simulation than they will from either the textbook or the lectures.

Hypothesis 3

The third hypothesis addressed the notion that simulation increases students’ *involvement* with the material. We hypothesized:

H-3 Students will be more involved with the simulation than with either the lectures or the textbook.

Hypotheses 4 and 5

Since involvement and enjoyment are closely related concepts, we hypothesized:

H-4 There will be a positive association between students’ reported enjoyment of the simulation experience and the degree of their involvement with it.

Because there is no reason to suppose any relationship existing between involvement in other aspects of the course (textbook and lectures) and enjoyment of the simulation, we further hypothesized:

H-5 There will be no association between students’ reported enjoyment of the simulation experience and involvement with either (a) the lectures or (b) the textbook.

Hypotheses 6-9

Overall, we felt that those students who became deeply involved in the simulation, would learn more and better the material of the course. Therefore, we hypothesized a positive association between involvement with the simulation and the students’ performance in both the simulation and the course.

H-6 There will be a positive association between students’ performance in the simulation and their involvement with it.

H-7 There will be a positive association between students’ performance in the course and their involvement with the simulation.

Similarly, because we believed that involvement in itself would serve as a spur to better performance, we expected that those students, who were more involved with the lectures and the textbook, would perform better in the course than would the others. We believed, however, that there would be no association between involvement with lectures and textbook and performance in the simulation. We therefore hypothesized:

H-8 *There will be a positive association between students' performance in the course and their involvement in both (a) lectures and (b) textbook.*

H-9 *There will be no association between students' performance in the simulation and their involvement in (a) lectures and (b) textbook.*

METHOD

A survey was conducted of 93 undergraduate students enrolled in a basic marketing course in which a simulation was used in addition to lectures and a textbook. Students completed a self-administered questionnaire describing their reactions to the textbook, the lectures, and the simulation. The questionnaire was administered to each student at the conclusion of the course. Questionnaires were numbered for matching purposes. Students were informed that the information would be used for research purposes only, that their responses would be entirely confidential' and would have no bearing on their grade in the course.

The course was taught over a seven-week period in a summer session with a class enrollment of close to 100 people. The course was taught in traditional lecture format with a required textbook as well as a simulation to help with their learning experience. Both textbook and lectures were well received by the students. The instructor was a British male with over twenty years teaching experience using a self-characterized teaching style of "relaxed Socratic, heavily laced with a dose of humor." The textbook was a standard one (Keegan, Moriarty, & Duncan, 1992). The lectures were well received by the students. According to the teaching evaluations, 95.7% of students rated the instructor good to excellent, 92.3% rated the textbook good to excellent. The reception of the simulation experience was less favorable than that of the textbook and instructor: only 6 7.4% rated it good to excellent. The details of the course evaluations are given in Table 1.

The game, itself, was straightforward and easy to understand (Smith & Golden 1987). Students were divided into groups of 3-4 persons and made decisions about the operation of a simulated company (wholesalers of high-fi items). The scope of the decisions was quite comprehensive, concerning such marketing items as price, units purchased, advertising, sates promotion, sales bonuses, R&D, channel improvement, salespersonnel, marketing research reports, etc. Students made 12 decisions, corresponding to three years of operations.

THE SAMPLE

A relatively large proportion of the students were female (only 42% male). They were relatively mature. The ages ranged from i 9 to 44 years, with a median age of 23. The majority were Hispanic (60% Hispanic, 24% American Anglo, 9% Asian, and 7% American Black). However, 68% were born in the United States. Approximately 80% were employed either full- or part-time.

Table 1
Summary of Course Evaluation

Learn Aid	n	Evaluations				$\bar{x}$
		Ex.	Good	Fair	Poor	
Instr.	92	64	24	4	0	3.65
		69.6%	26.1%	4.3%	0.0%	
Text	92	44	40	8	0	3.37
		47.8%	43.5%	8.4%	0.0%	
Sim.	92	29	33	18	12	3.39
		31.5%	35.9%	19.6%	13.0%	
Course Overall	92	39	48	5	0	2.86
		42.4%	52.2%	5.4%	0.0%	

Scale: Excellent = 4. Good = 3, Fair = 2, Poor = 1

Measurement

Students responded to the same set of items regarding their reactions to each of three learning aids: (1) lectures, (2) textbook, and (3) simulation. Items were generated based on a review of the literature and by conceptualizing about the constructs. All responses were in Likert-type format, ranging from "1" for "strongly disagree" to "5" for "strongly agree." The items were pretested with a group of students enrolled in the same course the prior semester. Based on a review of their responses to the preliminary questionnaire, the wording of the items was refined, and the questionnaire assembled in final form.

Perceptions of Content Learning Aid was measured by students' responses to a single item " helped me learn the material of the course." Perceptions of Process Learning Aid was measured by two items:
(1) " helped me think through the problems that a real manager faces,' and (2) helped me to understand how decisions work together through time. Involvement was measured by three items:
(1) "1 became very involved with….," (2) "I find myself thinking of at odd times," and (3) 1 spent more time than I intended with - The first of these items was a general rating of felt involvement" on which the students indicated how involved they perceived themselves to be with the learning tool. Items 2 and 3 were derived from Brown's (1989) study of commitment and involvement in games. Both items were found to discriminate between the most and the least frequent players of simulation games. Item 3, "I spent more time...' did not seem to be appropriate in the context of the lecture, and therefore was not included in the group of items describing the lecture.

Enjoyment of simulation was measured by responses to a single item "How much did you enjoy participating in the simulation' scored on a scale of from 0 to 10, anchored by 0 for "did not enjoy' and '10" for "enjoyed very much. Performance on simulation was measured by grade received on simulation and was calculated by multiplying points earned in profits and market share. Performance in course was the sum of points earned on: exams (160 potential points), quizzes (200 potential points), simulation (120 potential points), and class participation (20 potential points). The two measures of performance were highly correlated ($r = .9611$, $p < .001$).

RESULTS

The first four hypotheses were tested by repeated measures analysis of variance, using the SPSS MANOVA program (Table 2).

H-1 was supported. Students perceived significant differences in receiving help in learning material of the course between the simulation and both the lectures (F_{192} 6.47, $p < .013$) and textbook ($F_{1,92} = 23.92$, $p < .001$). Thus, the students found the simulation to be the effective tool in helping them learn the didactic material of the course.

H-2 was partially supported. Students perceived that the simulation gave them greater opportunity to think through the problems real managers face than did either the textbook ($F_{192} = 6.47$, $p < .013$) or the lectures ($F_{102} = 8.62$, $p < .004$). The students, however, reported no difference in helpfulness of either the simulation, textbook, or lectures in understanding how decisions work together through time (textbook: $F_{192} = .52$, $p > .472$; lectures: $F_{192} = .51$, $p> .478$).

H-3 received partial support. Students reported greater felt involvement with the simulation than with either the textbook ($F_{192} = 10.14$, $p < .002$) or the lectures ($F_{192} = 34.75$, $p < .001$). Students reported they thought about the simulation at odd times more than they did about the textbook (F_{192}= 24.73, $p < .001$), but not about the lectures (F_{192} = 1 .06, $p > .305$). Students apparently thought about both the simulation and lectures at odd times, but not about the textbook. Students did not, however, report spending more unintended time with the simulation than the textbook (F_{192} = 1 .64, $p < .203$).

H-4 to H-9 were tested by examining the Pearson correlation coefficients between the variables of interest. The results are summarized in Table 3. H-4 was supported. Significant correlations were found between all three simulation involvement variables and enjoyment of the experience (involvement: $r = .6782$, $p < .001$; thinking: $r = .5108$, $p < .001$; time-spent: $r = .3834$, $p < .001$). H-S received only partial support. Enjoyment was not significantly correlated with either (a) felt involvement ($r = .1403$, $p > .185$) or (b) unintended time spent with the textbook ($r = .0591$, $p > .578$), but a small significant correlation appeared between enjoyment and thinking of the textbook at odd times (r = .2 644, $p < .011$). Similarly, at a .10 level, there were significant correlations between enjoyment and both (a) thinking about the lectures at odd times ($r = .1816$, $p < .085$) and (b) felt involvement with the lectures ($r = .2334$, $p < .026$).

H-6 and H-7 were partially supported at the .10 level. One of the simulation involvement variables, felt involvement, was significantly correlated with performance in the course ($r = .1369$, $p < .098$), while another, unintended time, was significantly correlated with performance on the simulation ($r = .1420$, $p < .090$). None of the other correlations were significantly different from zero. H-8 received no support. There were no significant relationships between the involvement variables for either textbook or lecture and performance on either the simulation or the course. H-9 was supported. None of the correlations between the involvement variables and performance in simulation were significantly different from zero.

Table 2
Results of Test of Hypotheses 1 – 3
Mean Values

		text	lect.	sim.	Direction of mean diff
H-1	Content Learning				
	Helped learn material of course	6.237	5.849	5.409[a]	T > L > S
H-2	Process Learning				
	Helped think through problems that a real manager faces	5.516	5.495	4.935[b]	S > T = L
	Helped understand how decisions work together through time.	5.72	5.731	5.839	T = L = S
H-3	Involvement				
	I became very involved with ….	5.269	4.817	5.914[a]	S > T > L
	Find myself thinking about …. at odd times	3.828	4.688	4.925[a]	S = L > T
	I spent more than intended with ….	4.753	-	4.473	S = T

[a] p < .001, [b] p < .01

DISCUSSION

The primary purpose of this paper was to obtain empirical evidence that would help in understanding how simulation serves to enhance learning. First, we addressed the relative impact of simulation and the two other learning tools on both learning dimensions: "content" and process." The results suggested that from the students' perspective, at least, the lectures and textbook are identified with the content dimension of learning and there was also some limited support for it being identified with the process dimension, although, surprisingly, there were no differences between the perceptions by the students of the simulation's helpfulness in understanding "how decisions worked together through time." This was unexpected to us since we felt that one of the primary factors distinguishing simulation from the other learning tools was its ability to address the time dimension in the learning process. The impact on the students of a new, up-to-date text-book together with lively class discussions may have influenced the findings.

Table 3
Involvement, enjoyment and Performance Variables
Zero Order Correlation Coefficients

	Enjoy.	Sim. Perf.	Course Perf.
Simulation			
Felt Involvement	.6182[a]	.1298 [d]	.1369 [d]
Odd Times	.5108 [a]	.0124	.0124
Unintended Time	.3834 [a]	.1420d	.1297
Textbook			
Felt Involvement	.1403[d]	-.0363	.0075
Odd Times	.2644[b]	.0536	.1051
Unintended Time	.0591	.0548	.0444
Lectures			
Felt Involvement	.2334[c]	.1126	.1132
Odd Times	.1816 [c]	.0738	.1186

[a] p < .001, [b] p < .01, [c] p < .05, [d] p < .10

Our next concern was whether participation in simulation could be demonstrated to be more involving to students than either of the other tools and we found some evidence that students more involved, but once again, this was by no means clear-cut. While the students clearly ***thought*** they were more involved with the simulation, the indirect measures ("thinking about it at odd times and spending unintended time") did not support it. Students reported thinking about simulation and lectures at odd times. Perhaps this had to do with the way they responded to lectures or to the personality of the instructor who, judging from the comments on the course evaluations, was perceived as both stimulating and entertaining. Students, also, did not report spending more "unintended time" with the simulation than with the textbook. This result may simply reflect the general level of motivation of these introductory students, who may have felt that time spent with either textbook or simulation was, by definition, unintended.

Involvement in the simulation clearly was associated with enjoyment of the experience. The correlations between enjoyment of simulation and all three-simulation variables were relatively large and significant. It was interesting that enjoyment of simulation also correlated significantly with "thinking at odd times' about both the lectures and textbook, as well as with felt involvement" in the lectures (although the magnitude of these correlations was considerably less than those between enjoyment and involvement with simulation). Once again, there may have been some halo" effect from the responsiveness to the lectures that caused the degree of involvement to covary with the enjoyment of the simulation experience. Recall that in the course evaluations, these students rated both instructor and textbook higher than the simulation. We are not certain how enjoyment fits into the puzzle. Enjoyment seems highly related to involvement. Indeed, in their study of a structured reporting environment Comer & Nicholls (1994) interpreted enjoyment as a surrogate for involvement. But we feel the two constructs are slightly different. It is, for example, entirely possible to be "involved" in an experience and not to "enjoy" it.

The final issue of interest was the relationship between involvement with the simulation and performance. Here we found some evidence that involvement not only enhanced simulation performance, but there also might be some positive association between it and course performance. While the correlations were not large, they were significant (at the .10 level). There was virtually no comparable association between involvement with ***either*** of the der two learning tools and performance on ***either*** simulation or in the course. In order to explore the relationships a bit more, we examined the association between involvement and performance using enjoyment as a control variable. When holding enjoyment constant, the correlation between felt involvement and performance on the simulation became significant ($r = .1574$, $p < .069$), while that between unplanned time and performance in class increased both in magnitude and in level of statistical significance ($r = .1750$, $p < .05$), suggesting that enjoyment might have some moderating impact on the relationship between involvement and performance.

The significant relationship between simulation performance and involvement is interesting and suggestive of some association between involvement and process learning. Gosenpud & Washbush (1994) have argued that process learning is difficult to measure, and we concur. While performance in simulation is not a measure of process learning, it might be viewed as an indicator. During the course of the game, students were monitoring how well they were doing in the simulation, which suggests they were going through the process of working with the material to achieve their goals (in this case a grade). Thus, some process learning must have been going on. It is not clear whether success in this simulation, however, implies mastery of any material.

The presence of a relationship between involvement in simulation and performance in course is interesting when viewed in the context of Gosenpud & Washbush's (1994) finding that performance on the simulation is not related to learning in the course. This prompted us to further investigate whether the simulation component in the final grade was responsible for the apparent correlation between involvement in simulation and course performance. We, therefore, subtracted the simulation component from the final grade and repeated the analysis. Only one correlation emerged that was statistically significant, and that was between "unintended time with simulation and course performance. This time, however, the direction of the relationship had reversed ($r = -.1366$, $p < .098$). This suggested to us that, contrary to our original notion (involvement with the simulation motivates students to learn better), participation may actually have a distraction effect on content learning. We probed into this further by examining the zero-order correlations between the new and the original performance variables. These were large and significant, but negative in direction ("new variable' x "performance in simulation': $r = -.8782$, $p < .001$; new variable" x original "performance in course variable: $r = -.7112$, $p < .001$).

LIMITATIONS OF STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

Our findings are, at best, inconclusive. Clearly, the study has limitations. Work needs to be done in the area of measurement. The concept of involvement needs to be better explicated. Behavioral measures should be devised to get a better handle on the involvement of the participating students. Our measures may have been picking up unintended effects when applied to learning tools other than simulation. An effort should be made to measure process learning (e.g., Washbush & Gosenpud, 1995).

The sample of non-marketing majors may not have been appropriate for the study, possibly because they were not very interested in the subject matter and may have looked on the simulation simply as extra work. The course was given intensively, in a short summer session, which may have put unusually heavy time pressures on the students and so precluded commitment. The study should be replicated during the regular school year, with a more traditional group of students at a different stage in their educational process.

Nonetheless, we feel encouraged by our research. We believe that involvement in simulation is a promising concept, worthy of further study as a variable that enhances the impact of participation on the learning experience. Further work is clearly needed.

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