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A STUDY OF THE RELATIONSHIP BETWEEN STUDENT FINAL EXAM PERFORMANCE AND SIMULATION GAME PARTICIPATION

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ABSTRACT

Despite the proliferation and widespread usage of simulation games in the field of business education, the pedagogical value of this instructional aid remains unclear. The present study, using a controlled setting, sought to determine whether incorporating a business simulation game in a principles of marketing course improves the acquisition of marketing knowledge. The results suggest that simulation games are an effective means by which to improve quantitative skills but are not an effective means by which to improve the acquisition of applied or theoretical knowledge.

INTRODUCTION

It has now been over thirty years since the first business simulation game was used in a college class. Since that time, the number and variety of business games has grown enormously. Interest among academics in the teaching and learning possibilities of business games has grown as well. At present, over 200 business games are being used by approximately 8,500 teachers at over 1,700 colleges (Faria, 1987). Empirical research in the area has also been extensive. Comprehensive reviews can be found in Greenlaw and Wyman (1973), Keys (1976), Wolfe (1985), and Miles, Biggs and Schubert (1986).

Despite the proliferation and widespread usage of business simulation games, a review of the literature reveals that the pedagogical value of such games still remains unclear. The present study sought to determine whether incorporating a business simulation game in a principles of marketing course improves the acquisition of marketing knowledge. Other potential benefits of game playing, such as engaging in interpersonal interaction or developing analytical skills, were not investigated.

FAST RESEARCH

Accompanying the development of business games and their increased usage has been an active research track. A great deal of research has investigated (1) the factors thought to affect the simulation learning environment and simulation performance (e.g., Brenenstuhl and Badgett. 1977; Walker, 1979; Gentry, 1980; Trinkaus, 1980; Edge and Remus, 1984; Hsu, 1984; Faria, 1986), (2) the learning aspects of the business game approach to instruction (e.g., Biggs, 1975; Biggs and Greenlaw, 1976; Edwards, 1987; Hall, 1987), and (3) the relative educational benefits of simulation games versus other teaching methods.

The majority of the research in the third area identified has compared games to cases, since both are experiential teaching tools and the case method has long been accepted by business teachers. These studies have generally compared business games, alone or in combination with other instructional methods, against cases alone or cases used with other instructional methods. The normal approach in these comparative studies is to use two sections of the same course for testing purposes. For example, one section of a policy course is taught using a simulation game while a corresponding section is taught using cases. At the end of the course, either a questionnaire or a final exam administered to the students is used to measure the learning brought about by each of the two instructional methods.

Four major review articles exist which summarize the published comparative studies of the type just described. After reviewing 22 studies published between 1961 and 1972, Greenlaw and Wyman (1973) concluded that there existed little clear evidence to indicate what was learned from business games or whether business games were a superior, or even adequate, method of instruction. Keys (1976) reviewed fifteen studies that compared simulation game sections of a class with sections using some other form of instructional approach and came to a similar conclusion. Wolfe (1985) updated the Greenlaw and Wyman (1973) study by reviewing 39 studies published between 1973 and 1983. Because of the wide variety of study conditions utilized in these studies (e.g., simple versus complex games, variable number of decision periods played, different methods of end-of-course evaluations employed), Wolfe concluded that no statement about gaming effectiveness could be made. Finally, Miles, Biggs and Schubert (1986) reviewed sixteen studies that used student self-judgment of skill acquisition through cases and simulation games as the dependent variable. They also came to the conclusion that the mixed results uncovered were difficult to interpret and compare because of the wide variety of study environments used.

As these four review articles show, the evidence as to whether business games are a more effective teaching tool than other approaches is inconclusive. As well, because of the highly dissimilar study designs employed in past research, it is difficult to compare the findings of one study with those of another. Beyond this, the previous studies undertaken suffer from several drawbacks. Principle among these are: (1) where studies compare performance of students in two separate sections of a course, there has been a lack of control across sections as to similarity of students and instructor teaching; (2) most studies have involved small numbers of students, such as 20 or 25 per section or treatment, possibly making the findings unstable; and (3) where self-judgment is used, it is very questionable as to whether students, having just completed a course, are a good judge of what they have learned.

PURPOSE AND DESIGN OF THE PRESENT STUDY

The present study was designed to overcome the drawbacks

found in previous research and to determine whether student learning can be improved through the addition of a simulation competition to the normal course requirements in a principles of marketing class. The drawbacks of differing student populations and instruction as found in previous research were overcome by using treatment groups from the same large principles of marketing section. Thus, all of the students were exposed to the same instructor, lectures, films, readings, exams, and exam times. The similarity of treatment groups was measured and assured through the use of a pretest, the course mid-term exam. End-of-course performance/learning was measured through the use of an objective final exam, not by means of subjectively graded cases or student perceptions. Finally, the testing was undertaken with an audience of 189 students.

METHODOLOGY

One hundred and ninety students from the same section of an undergraduate principles of marketing course served as the respondent base for the study. Prior to the mid-term exam, the students in the class were given the opportunity to sign up to play a simulation game entitled LAPTOP: A Marketing Simulation (Faria and Dickinson, 1987). This is a simple marketing game designed for use in an introductory marketing course.

Participation in the game gave each student the chance to earn up to seven bonus grade points. These points, which were eventually added to the students' final grade in the course, were based on team and individual results. Offsetting the potential for bonus points was the additional time required by the student to read and understand the simulation game, to make decisions, and to analyze the period-by-period results.

Sixty-nine students signed up to play the simulation while 121 students chose not to participate. The data for one of the students in the latter group was randomly selected for elimination in order to have proportional cell sizes during the analysis stage of the study.

Design

A 2 3 x 3 factorial design was used to analyze the data. The first two variables are between subjects' variables while the third variable is a within subject's variable. The final exam grade served as the dependent variable.

Between Subjects' Variables. The first of these variables, Game Status (GS), is the most important variable in the study. A student's game status was either "Played" or "Did Not Play". As previously indicated, 69 students played the game and 120 students remained in the "did not play" condition.

The second between subjects' variable, Mid-term Exam Performance Level (MTL), was used as a blocking variable in order to reduce the level of experimental error (see Neter and Wassermann, 1974).

The mid-term exam contained 30 multiple-choice questions. Thirteen of these questions were classified as applied while 17 were classified as theoretical. In order to give equal weighting to each question type, the student's percentage grade for each question type was computed and averaged to determine the student's overall mid-term exam grade.

On the basis of the above mid-term grade, an equal number of students were assigned to each of the high, moderate, and low MTL categories. The cell size for each MTL level was 23 for the "Played" game-status group and 40 for the "Did Not Play" group.

Within Subjects' Variable. Question type (QT) on the final exam served as the three-level within subjects' variable. The three question types on the final exam were applied (21 questions), theoretical (26 questions), and quantitative (20 questions).

Question Classification

In order to determine the question-type classification of each of the multiple-choice questions on the mid-term and final exams, five faculty members, all of whom have taught principles of marketing, were asked to classify each question. The faculty members were asked to classify the question as quantitative if they felt that it required a knowledge of or use of a computational approach to arrive at a correct answer, to classify the question as applied if they felt that marketing knowledge was required to understand the scenario (or situation) described, or to classify the question as theoretical if they felt that it focused on ones knowledge of a particular theory or concept (but excluded computations and applied scenarios).

Dependent Variable

The grade on the final exam served as the dependent variable. More specifically, the student's percentage grade for each question type was used instead of the raw score in order to give equal weighting to each question type.

RESULTS

The data were analyzed using the ANOVR analysis of variance program developed by Games et al. (1979). When significant results were uncovered in the analysts of variance, each pair-wise contrast was investigated using the FOLUP program developed by Yancey et al. (1979).

Data-Transformations and the Assumptions of the Analysis of Variance Model

As the initial analysis of the final exam scores indicated that the data violated the assumptions of the analysis of variance model pertaining to the within subjects' variable, the percentage grade values were converted to Z-scores on a variable-by-variable basis (i.e., by question type). This approach to data transformation resulted in equal means and standard deviations across question type, thereby removing any within subjects' QT main effect, which might have existed. The transformed data met all of the assumptions of the analysis of variance model. This meant that the conventional F-test and the normal error terms of the analysis of variance model could be used for analysis purposes.

Analysis of Variance of Final Exam Scores

The analysis of variance of the final exam scores reveals only three significant results: the MTL main effect [$F(2, 183) = 26.42$, $p < .001$], the GS x QT first-order interaction [$F(2, 366) 4.05$, $p < .05$], and the MTL x QT first-order interaction [$F(4, 366) = 7.62$, $p < .001$]. The following effects were not significant at the .05 level: GS [$F(1, 183) = 1.54$], GS x MTL [$F(2, 183) 1.27$], QT [$F(2, 366) 0.00$], and GS x MTL x QT [$F(4, 366)$ a 1.13].

The failure to obtain significant results for the Game Status (GS) main effect means that playing versus not playing the simulation game did not help or hinder a student's overall performance on the final exam. The failure to find a significant Game Status (GS) x Mid-term Exam Performance Level (MTL) interaction means that a student's overall final exam performance was independent of the combined effect of the student's mid-term performance and game participation. The non-significant results for the Question Type (QT) main effect was expected because of the nature of the transformations carried out on the data. Finally, the failure to find a Game Status (GS) x Mid-term Exam Performance Level (MTL) x Question Type (QT) interaction means that a student's performance on the final exam is independent of the combined effect of the level on each of these variables.

The significant Mid-term Exam Performance Level (MTL) main effect indicates that there is a relationship between a student's performance on the mid-term exam and his/her performance on the final exam. Specifically, the investigation of the nature of this main effect by means of a follow-up analysis focusing on each pair-wise contrast finds that those who performed better on the mid-term exam also performed better on the final exam (see Table 1). It was because of the expectation of this result that using MTL as a blocking variable was deemed an appropriate means by which to reduce the experimental error.

TABLE 1
MULTIPLE COMPARISONS (VIA TUKEY WSD TECHNIQUE) OF FINAL EXAM SCORES FOR THE MID-TERM EXAM PERFORMANCE LEVEL (MTL) MAIN EFFECT

MTL Pairwise Contrast	Means Compared	Obtained t-value
High - Low	0.460 - (-0.477)	7.27*
High - Moderate	0.460 - (-0.020)	3.41*
Moderate - Low	-0.020 - (-0.477)	3.85*

Notes: df = 183, critical t-value = 2.36, and FWI = .05. The MS_{e} = 1.57 was used as the error term. All means are Z-scores.

"*"indicates pairwise contrast is significant.

While the results of the follow-up analysis of the MTL main effect are interesting, more insight can be gained by investigating the significant Mid-term Exam Performance Level (MTL) x Question Type (QT) interaction. The results of the follow-up analysis for the applied and theory questions are consistent with the results for the MTL main effect. That is, those who performed better on the mid-term exam also performed better on the final exam in these areas. However, with respect to the quantitative questions, those who performed at an overall moderate or high level on the mid-term exam performed equally well on the quantitative questions and both of these groups performed significantly better than those who were classified as low performers on the mid-term exam (see Table 2).

The final, and perhaps most interesting, significant result to investigate is the Game Status (GS) x Question Type (QT) interaction. The follow-up analysis of this effect indicates that performance levels on the applied and theoretical questions on the final exam were the same for those who played the game versus those who did not play the game. However, with respect to the quantitative questions, those who played the simulation game performed significantly better than those who did not play the game (see Table 3).

TABLE 2
MULTIPLE COMPARISONS (VIA TUKEY WSD TECHNIQUE) OF FINAL EXAM SCORES FOR THE MID-TERM EXAM PERFORMANCE LEVEL (MTL) X QUESTION TYPE (QT) INTERACTION EFFECT

Question Type	MTL Pairwise Contrast	Means Compared	Obtained t-value
Applied	High - Moderate	0.652 - (-0.579)	7.59*
	High - Low	0.652 - (-0.073)	4.47*
	Moderate - Low	-0.073 - (-0.579)	3.12*
Theory	High - Moderate	0.577 - (-0.527)	6.80*
	High - Low	0.577 - (-0.049)	3.86*
	Moderate - Low	-0.049 - (-0.527)	2.95*
Quantitative	Moderate - High	0.182 - (0.152)	0.19
	Moderate - Low	0.182 - (-0.323)	3.11*
	High - Low	0.152 - (-0.323)	2.93*

Notes: df = 549, critical t-value = 2.35, FWI = .05, and $MS_{e\ cells}$ = 0.83 was the error term for the set of pairwise contrasts for each Question-Type analysis. All means are Z-scores.

"*"indicates pairwise contrast is significant.

TABLE 3
MULTIPLE COMPARISONS (VIA TUKEY WSD TECHNIQUE) OF FINAL EXAM SCORES OF THE GAME STATUS (GS) X QUESTION TYPE (QT) INTERACTION EFFECT

Question Type	GS Pairwise Contrast	Means Compared	Obtained t-value
Applied	Played - Did Not Play	0.112 - (+0.064)	1.28
Theory	Did Not Play - Played	0.032 - (-0.055)	0.63
Quantitative	Played - Did Not Play	0.206 - (-0.113)	2.32*

Notes: df = 549, critical t-value = 1.96, and FWI = .05. $MS_{e\ cells}$ = 0.83 was used as the error term. All means are Z-scores.

"*"indicates pairwise contrast is significant.

DISCUSSION

The purpose of the present study was to determine if playing a marketing simulation game in a principles of marketing course improves a student's acquisition of marketing knowledge as measured by the student's final exam performance. The results of this study show that performance on the final exam overall, and on the applied and theory questions in particular, did not vary as a function of game status. However, with respect to the quantitative questions on the final exam, those who played the game performed better than those who did not play the game.

There are two possible explanations for the lack of difference between the game status groups on the applied and theoretical questions. One is that the nature of the simulation game played was such that there was no need for the student to significantly draw on the applied and theoretical material covered in the course. All that was required of the participants was for them to make decisions that were primarily of a quantitative nature (e.g., price, sales force size, shipment quantities, and level of advertising).

Further, no strategy or post-game performance reports were required. The preparation of such reports would have made it necessary for the students to refer to the appropriate applied and theoretical course material. Reports of this nature might have enhanced the final exam performance on these question types.

Another possible explanation for the lack of difference between the game status groups on the applied and theory questions is that only a limited number of decisions were required. The participants in the game only had to make four weekly decisions. Had more decisions been required, the results might have been different. A longer game could have given the students a greater opportunity to draw on the applied and theoretical course material. The limit on the number of decisions was necessary, however, as game participation could not begin, due to the study design, until after the mid-term exam.

The finding that those who played the game performed better on the quantitative questions than those who did not play the game also can be explained in either of two ways. One explanation is that participation in the game allowed the students to become more skilled in the quantitative techniques covered in the course. By playing the game, the students had the opportunity to practice and apply techniques such as sales forecasting, return on investment, markups, average cost pricing, and breakeven analysis. Those who did not play the game did not have this opportunity. As a result, those who played the game performed better on the quantitative questions than those who did not play the game. Based on the raw exam scores for the quantitative questions, participation in the game resulted in a grade of 54.6 percent versus 48.2 percent for the non-players, a 13.3 percent improvement.

While the above explanation for the difference in performance is reasonable, it is also possible that those who chose to play the game had better quantitative skills than those who chose not to play. The plausibility of this explanation is limited, however, because it leads to the conclusion that those who chose to play had better quantitative skills but only comparable skills in the applied and theoretical areas. (An analysis of variance based on the mid-term grades found no difference between the game-status groups overall or on the applied and theoretical questions.) Since there is no reason to believe that only those who had better quantitative skills were likely to participate in the game, the validity of this explanation is open to question. Nonetheless, further research is definitely required to clarify this issue.

CONCLUSION

The evidence from past research as to whether business simulation games are a more effective teaching tool than other instructional approaches is inconclusive. This state of affairs may be due to the limitations associated with the experimental designs, the sample sizes, and the measurement approaches used in the various studies. The results of the present study show that simulation games are an effective means by which to improve quantitative skills but not an effective means by which to improve the acquisition of applied or theoretical knowledge.

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