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CORRELATIONS BETWEEN ACADEMIC ACHIEVEMENT, APTITUDE, AND BUSINESS GAME PERFORMANCE

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As business games were initially used as business school integrative devices and management development aids, it was natural that the first "rigorous" and quantitative evaluations of them would be in the form of correlational studies between a player's previous academic achievements and the results obtained by teams of players in a particular simulation. To have any credibility, and to make at least a cursory effort at satisfying the educator's demand for internal validity, it was hypothesized that high academic achievers would outperform those players who had proved to be low academic achievers. Certainly if a simulation "is a slice of reality" and a business education prepares an individual for a real-world life of productive activity, the integrative, capstone experience provided by a complex business game should endorse, authenticate, and vindicate all that the student/player had been exposed to in an academic career [1,6]. Unfortunately, for both the opponents and proponents of business gaming, the results of those correlational studies have led to mixed results and impressions.

Dill [2] reported the first study of the type reviewed here. No correlation was found between a team's average ATGSB score and its cumulative profit even though the ATGSB correlated between .4 and .5 with overall graduate school grades. In another study conducted at the graduate level, Potter [81 obtained slight correlations (.07 to -.07) between ATGSBs and a firm's rate-of-return on investment (ROI), and a -.4 correlation between a student's grade point average (GPA) and the firm's ROI. One year later McKenney and Dill [7] presented results obtained by combining a number of academic predictors. Teams of students were created that were above-average, average, and below-average in academic ability based upon ATGSBs, undergraduate CPAs, and first-term graduate school grades. It was found that the above-average firms earned the highest profits while the below-average firms earned the lowest; there were no correlations with sales volume as a criterion of game performance.

On the output side of the effectiveness equation, Vance and Gray [14] created a game performance index consisting of a firm's market share, profits, ROI, dividend performance, and optimal inventory levels and cash balances. Using this multi-variate criterion, no correlations were found between SATs, or all-college or all-quantitative GPAs; correlations of .285 (n4O8, $p < .03$) and .369 ($n = 166$, $p < .03$) were found between Business College GPAs and the performance index in two separate university samples. Gray [4] later used the same

business game, Vance's [13] Management Decision Simulation, and the same performance criteria with modified weightings. Respective correlations of .351 and .365 ($n = 73$, $p < .05$) were found between the performance index and all-college, and Business College GPAs.

Based on the literature just surveyed, a recent statement by Rowland and Gardner [10, p. 270] might be altered slightly to read "the results from these studies suggest that participants' intellectual abilities, as measured by achievement and aptitude tests and grades, are not generally [or consistently] related to measures of team performance, such as profits, sales, or return on investment." The source of these discrepant findings could be traced to a number of factors-- graduate versus undergraduate populations, particular course applications and pedagogical uses, game complexities and functional biases, different measures of performance criteria, and various grade values and incentives offered for game performance. As obfuscating as these factors are to the relationship between prior academic achievement and current game-playing effectiveness, an even more important problem exists.

The past research has consistently taken individually-obtained academic achievement and related that achievement to game performance outcomes that were obtained through teamwork and team play and not through individual skills and abilities. This practice has inadvertently introduced an individual's group maintenance and interpersonal skills into the research design. Although group maintenance and inter-personal skills are essential for both managerial success and tests of the external validity of business games, their accidental introduction in the past research has served to blur the question of academic performance and game-playing success. Accordingly this study examined the relationship between certain standard measures of academic aptitude and achievement and the performance results obtained by students in sole control of their firms in a complex business game. Single-member operations would place accountability for corporate results on the shoulders of only one person while simultaneously putting into relief the academic achievement relationships previously studied.

METHODOLOGY

An initial group of 90 students in two senior-level Business Policy sections were assigned to single-member firms within a number of eight-firm industries.[1] Relative company success within each industry was based on a weighted index consisting of the following: cumulative earnings (CEARN) 55%, ROI 20%, and rate-of-return on owner's equity (ROE) 25%. Thusly, the index gave primary emphasis on profit performance with

[1] Sample sizes change from table to table and case to case due to missing data.

secondary and supportive emphasis given to financial efficiency. The business game used in this study, Jensen and Cherrington, [5], had been found in previous studies [15,16] to be both comprehensive and cognitively unbiased.

Table 1 displays the results of a chi-square test to determine if the simulation favored one academic discipline over another. It could be reasoned that a business game, which requires the quantification of all decision outcomes regardless of the effective elements embedded in the decisions, would favor the more quantitatively-oriented disciplines such as Accounting or a Production or Operations Systems concentration within the Management major. It was concluded that the simulation was functionally unbiased and was a proper vehicle to investigate the problem addressed in this study as the performance ranks obtained by students possessing different academic majors were no different than what could have been obtained by chance.

TABLE 1

Quartile-Ranked Firm Performance by Performance Standard and Academic Major

Academic Major	Quartile-Ranked Performance											
	1			2			3			4		
	Σ$	ROE	ROI	Σ$	ROE	ROI	Σ$	ROE	ROI	Σ$	ROE	ROI
Accounting	12	8	9	8	11	10	8	12	9	7	6	6
Economics/Finance	1	2	2	1	0	1	2	1	1	4	3	3
Management	1	2	1	1	2	2	2	1	2	3	3	3
Marketing	2	3	3	5	2	2	3	3	2	4	6	6

All χ^2 by Σ$, ROE, ROI, p=n.s.
Overall χ^2 = 14.268, df=9, p=n.s.

Students played the game for eight fiscal quarters (eight decision rounds) where their company's ranked performance determined 55% of the course's final grade. Academic aptitude and achievement was indicated by records available in the form of: 1. the American College Testing Program's (ACT) English (EACT), Mathematics (MACT), Social Science (SACT), and Composite (CACT) test scores; 2. all-University GPAs (UGPA); 3. all-business College GPAs (CGPA); 4. all-Quantitative GPAs (QGPA); and 5. academic major GPAs (MGPA).

RESULTS AND DISCUSSION

Table 2 displays the Spearman rank correlations found between the eight independent and four alternative dependent variables examined. A positive relationship was found in all

TABLE 2

Spearman Rank Correlations between Independent and Dependent Variables

Independent Variables	Dependent Variables			
	CEARN	ROE	ROI	COMP
MGPA	.401[b]	.385[b]	.392[d]	.357[d]
UGPA	.503[a]	.396[b]	.373[b]	.447[b]
QGPA	.415[b]	.415[b]	.414[b]	.413[b]
CGPA	.428[b]	.452[b]	.390[b]	.398[b]
EACT	.198	.197	.252	.222
MACT	.234	.267	.151	.196
SACT	.351[c]	.232	.144	.277[d]
CACT	.280[d]	.338[d]	.325[d]	.302[d]

Significance levels:

[a] $p < .001$
[b] $p < .01$
[c] $p < .02$
[d] $p < .05$

cases where higher grades and aptitude scores were associated with higher firm performance. It additionally appeared that coursework grades were more strongly associated with firm performance than aptitude scores as all 16 grade and performance relationships were significant while only 6 of 16 ACT relationships were significant. Of the four performance indicators, cumulative earnings showed the highest correlation while the QGPA demonstrated the greatest stability over all performance criteria. The overall composite performance index (COMP) obtained a lower correlation than CEARN due to the weighted ROE and ROI values which possessed generally lower individual correlations.

A further analysis of the independent variables indicated that there were fairly high intercorrelations within each set but that the between set intercorrelations were much lower. As shown in Table 3, within CPA intercorrelations ranged from .570 to .837, ACT intercorrelations ranged from .306 to .731, and GPA/ACT intercorrelations ran from .049 to .570. The composite ACT appears to have value as a predictor of student achievement, however, as it ranged from .313 to .570 over the four collegiate standards examined.

TABLE 3

Correlations between Independent Variables

	MGPA	UGPA	QGPA	CGPA	EACT	MACT	SACT	CACT
MGPA	1.000	.782[a]	.570[a]	.751[a]	.357[c]	.049	.268	.313[d]
UGPA		1.000	.742[a]	.837[a]	.527[a]	.112	.338[c]	.422[b]
QGPA			1.000	.805[a]	.460[b]	.344[c]	.371[c]	.570[a]
CGPA				1.000	.449[b]	.252	.351[c]	.467[b]
EACT					1.000	.306[b]	.447[b]	.716[a]
MACT						1.000	.336[c]	.679[a]
SACT							1.000	.731[a]
CACT								1.000

Significance levels:

$^{a}p < .001$
$^{b}p < .01$
$^{c}p < .02$
$^{d}p < .05$

Although all academic majors fared equally in the simulation, it would be valuable to know if there were perceptual or behavioral differences by academic majors as these differences might affect class enrollments, withdrawal rates, and attributed learning stimuli. A K-S test on the class distributions shown in Table 4 found that the section attracted students whose majors were no different than those of the most recent graduating class and that particular majors did not withdraw from the course with greater frequency.

TABLE 4

Distribution of Academic Majors

Academic Major	Fall Graduating Class (n=113)	Business Policy Section	
		Pre-Course (n=90)	Post-Course (n=64)
Accounting	51.33%	51.11%	57.81%
Economics/Finance	6.19	7.78	7.81
Management	23.89	17.78	10.94
Marketing	15.93	16.67	20.31
Quant. Methods	2.65	0.00	0.00
Undeclared	0.00	6.67	3.13
Significance*		n.s. n.s.	n.s.

*Kolmogorov-Smirnov one-tail test, df=2

As part of an overall study of student motivation in a game-oriented course, Schriesheim [11] or Schriesheim and Yaney [12] used withdrawals as one of several behavioral indicators of the motivating power of business games. It was found that the gaming students when compared to a control case course, evidenced equal absenteeism, visits to the instructor, and study of optional readings, but greater withdrawal rates. On this basis it was concluded that business games might possess negative motivational value. As a re-examination of this finding, the UGPAs of the withdrawn students were compared to those of the students who remained in the course. The respective means were 3.283 and 3.650 (A5.000) significantly different at less than the .05 level. It appears that a simulation may be de-motivating for the marginally-performing student who (1) may sense an inability to meet the comprehensive academic and time demands of the game, or (2) cannot further endanger an already-low overall grade point average by engaging in the simulation.[2]

Perceived learning stimuli by academic major were also examined by having the instructor enumerate the various learning sources built into the business policy course which housed the simulation. Table 5 lists the 7 nominal learning sources defined by the instructor. Based on the student-assigned ranks, not all sources were perceived to be of equal value. Although no perceptual differences existed by academic major, the entire group ranked "playing the business game" of greatest learning value. The instructor's lecture and discussion sessions were of next importance while the assigned readings, laboratory sessions, and the game's computer program all ranked third. The learning-source ranks reported here roughly conform to those reported by Raia [9] and Dill and Doppelt [3]. The two games employed in Rais's study were ranked first as learning sources while the readings used in the control group ranked last. Dill and Doppelt found that the simulation's model ranked last when compared to group game-play and external directors, auditors, and labor negotiators as sources of graduate-student learning.

CONCLUSION

Evidence has been produced that a student's performance in a business game conforms to past academic achievement. This is also true to a lesser degree for certain ACT test scores. It has also been found that all academic majors responded equally to the simulation as a learning device. Withdrawal rates, enrollment profiles, performance results, and perceived learning values were the same for all students regardless to their own discipline's presumed biases and predilections.

The unbiased environment created by the simulation plus the relatively high transfer of past academic achievement to

[2] No significant differences were found between the ACT scores of the retained and non-retained students.

TABLE 5

Stated Learning Sources by Rank Order Preference

Rank Order		Stated Learning Sources	Mean Rank (n=59)	Significance Level*
Nominal	Statistical			
1	1	Playing the business game	2.09	
2	2	Lectures and discussions of assigned readings	2.66	.05
3	3	Readings	3.83	.001
4	3	Game laboratory sessions	4.32	n.s.
5	3	Business game's computer program	4.54	n.s.
6	4	Classmates in discussion and laboratory sessions	5.14	.05
7	4	Private study for examinations	5.34	n.s.

*Mann-Whitney U test, 2-tail test

the game's current challenges appears to support gaming's continued use in their now-traditional role as curriculum integration devices and capstone experiences at the organizational policy level. An unrealized potential exists, however, for a business game's use in collegiate assessment and placement decisions. Game performance, as measured by cumulative earnings, obtained a multiple R of .649. Simulation-play early in a graduate ~ career, combined with other grade-related personality measures such as intelligence, independence, and authoritarianism [4], might serve as realistic, concurrent, and behavioral advanced-enrollment or program-acceptance criteria.

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