AN INTERDISCIPLINARY STUDY OF THE IMPACT OF PLAYING A MARKETING SIMULATION GAME ON STUDENT KNOWLEDGE OF MANAGEMENT ACCOUNTING/FINANCE PRINCIPLES

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ABSTRACT

An interdisciplinary study of student knowledge of accounting/finance principles in concert with their application in a marketing simulation game was undertaken in three sections of an Introduction to Marketing. The subjects were 454 second year marketing students who took an accounting/finance knowledge test composed of 14 multiple choice questions focused on understanding definitions and making calculations for selected concepts including unit contribution margin, inventory carrying costs, working capital, gross margins, return on sales, straightforward breakeven calculation, current ratio and mark-ups. A total of 368 students agreed to participate in the study from which 308 usable responses were collected, a 67.8% response rate. The study employed a simple pretest-posttest design resulting in a pretest average score of 42.4% (32.7% corrected for guessing) and a posttest average score of 55.5% (43.7% corrected for guessing) for the accounting/finance test. Paired t-test comparisons of pretest versus posttest scores for both uncorrected and corrected for guessing results were significantly different at the .000 level. The overall conclusion was that the marketing simulation experience led to an improvement in knowledge and application of accounting/finance principles. This study provides further evidence for the external validity of business simulation games.

Acknowledgements: The research undertaken in this paper was funded by a grant from the Certified Management Accountants of Ontario

INTRODUCTION

The ability of business simulation games to enable participants to apply and integrate their knowledge of business principles is often presented as one of the key virtues for business game use. Among other things, effective marketing decision making requires an understanding of fundamental accounting and finance principles. Consequently, the purpose of the study reported here was to investigate the impact of the use of a marketing simulation game on participant understanding of basic accounting/finance principles.

The study was undertaken through a grant from the Certified Management Accountants of Ontario (CMAO) who have developed an interdisciplinary certification approach for admission into their organization. The CMAO is interested in knowing how well accounting knowledge is acquired, retained and applied in cross disciplinary studies in business education programs. The interest in knowledge acquisition and retention by the CMAO is in concert with recommendations by the Accounting Education Change Commission which recommends that cases, role playing and simulations be employed as learning tools in addition

to readings and lectures (Sundem, Williams and Chironna, 1990).

LITERATURE REVIEW

Barab, et. al. (2002, p. 77) suggest that there is a moving away from the teacher centered or lecture environment to more "participatory learning environments that are technology rich," which allows participants to ground their understanding with their own experiences. Haywood, McMullen, and Wygal (2004) comment that educators are continually encouraged to include a variety of learning methods in classrooms, which include application methods and critical thinking rather than strictly memorization or passive learning. "Predicated on a social constructivist philosophy, the role of teacher switches from one of telling students correct answers to guiding student activity, as they direct their own learning process" (Barab, et. al, 2002, p.77).

It has been over 50 years since the first use of a business simulation game in a university class in 1957 (Watson 1981) and business games are considered a form of active learning. Since that time, the number of business games and their usage has grown enormously. "A 2004 e-mail survey of university business school professors in North America reported that 30.6% of 1,085 survey respondents were current business simulation users while another 17.1% of the respondents were former business game users" (Faria et. al., 2009).

"Learning in simulation games occurs on many levels. Players learn from the contextual information contained in the dynamics of the game, the process of playing the game through risk taking and weighing up the risks, benefits, costs, outcomes and rewards resulting from decision making" (Doyle and Brown, 2000, p. 331). Business simulation games offer a realistic representation of complex decision making (Keys and Wolfe, 1990) and stimulate cycles of probing, analysis, and re-probing, which is considered an effective learning method (Gee, 2004). During the decision making process, motivated participants engage in a self-regulating learning process and this enhances learning effectiveness (Chua, 2005; Hoffjan, 2005). In their review of 68 studies of simulation games from a variety of disciplines, Randel et al. (1992) found that in 32% of the studies simulations led to better student performance over traditional teaching methods, 56% showed no significant difference, and 5% favored traditional teaching methods (7% had questionable controls). In an accounting based game, Hoffjan (2005, p. 71) demonstrated "that playing the game improves students' level of knowledge" in selected decision making criteria. According to Anselmi and Frankel (2004, p. 164), business simulation games "encourage students to engage in higher-order learning as they personalize content, thus developing a deeper understanding of material."

The reported types of learning brought about by the use of business games includes goal setting and information processing; organizational behavior and personal interaction skills; sales forecasting; entrepreneurial skills; basic economic concepts; inventory management; mathematical modeling; personnel skills such as hiring, training, leading and motivating; creative skills; communication skills; data analysis; formal planning and report preparation; and much more. Faria (2001) provides a history and detailed list of references covering the research on skills training and learning brought about through the use of business simulation games.

The literature review revealed very few studies that examined the acquisition of accounting knowledge. Specht and Sandlin (1991) report that knowledge of accounting principles were retained better among students who had learned using experiential exercises. There are other reports indicating an improvement in learning of accounting principles with active learning and simulation approaches but the rigor of these studies is open to question (Lightbody, 1997; and Giguere 2006).

PURPOSE AND HYPOTHESES

The purpose of the present study is to determine whether the experience of participating in a marketing simulation game will have an effect on the level of accounting/finance knowledge of the game participants. Based on past research findings, and some amount of logic, the following six hypotheses will be tested:

H1: As a result of the simulation game play experience, the accounting/finance principles knowledge level of all game participants as measured on a pretest will increase significantly when measured on a posttest.

H2: As measured on the pretest, students with greater accounting/finance knowledge will outperform students with less accounting/finance knowledge at the conclusion of the simulation game.

H3: As measured on the posttest, better performing students will demonstrate more knowledge of accounting/finance principles than poorer performing students.

H4: Well performing students will have a more positive attitude towards the simulation competition than less well performing students.

H5: Students with higher self-reported GPA's will outperform students with lower self-reported GPA's on both the pretest and posttest accounting/finance testing.

H6: Students with higher self-reported GPA's will outperform students with lower self-reported GPA's in the simulation game.

H1 through H3 are presented to accomplish the purpose of this study. H4, H5 and H6 are offered as manipulation checks to establish some external validity for the results of H1 through H3. Past research findings (Wellington and Faria, 1994) have indicated that ending simulation performance and ending participant attitudes towards the simulation experience are related in that well performing students tend to feel more positive about the experience than less well performing students. Although mixed, some past research results have reported a relationship between GPA and simulation performance (Faria and Wellington, 2005).

METHODOLOGY

Accounting/finance knowledge acquisition and retention was measured using a pretest-posttest design. The subjects for the study were drawn from an Introduction to Marketing class in which Merlin: A Marketing Simulation (Anderson, Scott, Thomas and Beveridge 2005) was used as part of the course material. The subjects for the research were 454 second year marketing students who, as part of their education sequence, would normally have been exposed to the accounting principles examined prior to taking the marketing course. The students were enrolled in one of three different sections of an Introduction to Marketing course taught by the same instructor using the same textbook, syllabus and evaluation scheme. The Merlin participants played as single member companies divided into industries of seven companies each and participated in a seven period competition.

Merlin presents financial results through income statements, balance sheets and cash flow statements. With the advice of a managerial accounting professor and textbook author, a test of accounting/finance principles which were in direct accordance with the information and presentation of the Merlin financial statements was developed. The test was composed of fourteen multiple choice questions (MCQs) which tested the students' understanding of definitions or asked them to make calculations for selected accounting/financial concepts including unit contribution margin, inventory carrying costs, working capital, gross margin, return on sales, simple breakeven determination, current ratio and mark-ups.

The pretest version of the accounting/finance knowledge questionnaire was administered prior to the students being enrolled or briefed on the simulation. The accounting/finance questions presented provided students with five choices. There was a correct answer along with two distracter choices and students could also select one of two other choices – that they remembered being exposed to the concept but couldn't remember what it was, or that they had never been exposed to the concept. The pretest questionnaire was presented as an assessment tool and grades were for completion only although students were informed that

Table 1
Paired Comparison T-Test for H1

Comparison of Pretest-Posttest Changes T-Test	N	Pre-test Mean	Post-test Mean	t-score	Sig.
H1a: Total Test	308	42.4%	55.5%	-11.615	.000**
H1b: Total Test Adjusted for Guessing (AFG)	308	32.7%	43.7%	-8.792	.000**
H1c: Working Capital Calculation (AFG)	319	46.1%	54.2%	-2.021	.044*
H1d: Gross Margin Calculation (AFG)	319	18.6%	25.9%	-1.680	.094
H1e: Return on Sales Calculation (AFG)	319	20.0%	33.2%	-3.086	.002*
H1f: Contribution Margin Definition (AFG)	319	46.0%	69.2%	-5.983	.000**
H1g: Breakeven Calculation (AFG)	319	14.0%	22.5%	-2.118	.035*
H1h: Cash flow vs Net Income Concept (AFG)	319	61.7%	81.4%	-5.683	.000**
H1j: Inventory Carrying Cost Concept (AFG)	319	27.1%	45.0%	-3.979	.000**
H1k: Cash flow interpretation (AFG)	319	08.2%	-2.6%++	2.756	.006*
H1l: Breakeven point definition (AFG)	319	39.9%	59.5%	-4.758	.000**
H1m: Inventory Carrying Cost Calculation (AFG)	319	53.3%	67.2%	-3.308	.001*
H1n: Mark-up Calculation (AFG)	319	-9.3%	-14.1%++	1.497	.135
H1o: Current Ratio Calculation (AFG)	319	51.0%	67.9%	-4.419	.000**
H1p: Overall Assessment of Financials (AFG)	319	39.7%	47.8%	-1.694	.091
H1q: Inventory report interpretation (AFG)	319	25.4%	55.2%	-7.434	.000**

Notes: ++ Correction for guessing gave a negative score

* Significant ** Highly significant

their competency would be reported but not graded. For the posttest questionnaire, students were given the same set of accounting/finance principles questions but on this questionnaire they only had four choices, the correct answer and two distracters plus a choice of "I honestly don't know this principle." They were told that the scoring on the second questionnaire was being evaluated for completion as was the case for the first questionnaire but this time the competency measure would earn them a bonus point.

In addition to the accounting/finance knowledge testing, the pretest-and posttest questionnaires also asked respondents to indicate their attitudes towards the simulation experience. The participants' attitudes toward the simulation competition were measured using a five item Strongly Agree to Strongly Disagree scale developed by the authors. Students were told that the nature of their responses to the attitude questions would not affect their grading in the course. The internal consistency alpha reliability of the pretest attitude scale was .715 while the posttest attitude scale had a value of .828. Finally, the posttest asked respondents to indicate their GPA levels and the course work they had completed previously.

A total of 454 students attended the classes during the study period and all of them were required to take part in both the prestest-posttest knowledge survey as part of their normal course work. However, having their data included as part of the research study reported here was wholly voluntary. Consequently, of the 454 students who were enrolled in the course, 368 (81.0%) agreed to participate in the study from which 308 usable responses were collected, a 67.8% response rate.

In the Merlin competition, performance is measured using a ranking based on an index of company sales, earnings, return on sales, and forecast accuracy. These indexes were weighted 5%, 85%, 5% and 5%, respectively, resulting in each participant/company being ranked from first place to last place within their industries (e.g., from first to seventh position).

H1 was tested using a paired t-test procedure to compare the accounting/finance knowledge competency score for the whole group at the beginning of the simulation and at the end of the simulation competition. H2 and H3 were tested with ANOVA analysis of game ending rank performance group versus the accounting/finance knowledge scores on the pretest and posttest. H4 was tested using an ANOVA analysis of game ending rank performance group versus the pretest and posttest attitude scale scores. Finally, H5 and H6 were tested using an ANOVA analysis of self-reported GPA group versus pretest and posttest accounting/finance knowledge scores.

It must be acknowledged that the performance data were ordinal and involved the dependent variables of game rank order performance versus the independent variables of pretest adjusted for guessing accounting/finance principles knowledge test performance and posttest adjusted for guessing accounting/finance principles knowledge test performance. As such, it can be argued that it would be most appropriate to use a non-parametric procedure such as the Kruskal-Wallis One-Way Analysis of Variance by Ranks test for the rank order data. However, when samples are large as is the case with this study (308 students and at least 30 individuals in each ranking group), "parametric tests are robust to deviations from Gaussian distributions. . . . Unless the population distribution is really weird, you are probably safe choosing a parametric test when there are at least two dozen data points in each group" (Motulsky 1995). Consequently, the parametric ANOVA procedure was used to compare pretest and posttest accounting/finance knowledge and attitude toward the competition versus Merlin rank order performance as a factor variable

In addition, to ANOVA analysis, an examination of change associated with the simulation experience was undertaken using t-test comparisons of the following: pretest

Table 2

A Pretest and Posttest Post Comparison of Accounting/Finance Principles Knowledge by Rank Performance in a Marketing Simulation Game

Merlin Rank	N	Pretest AFG Score	Posttest AFG Score	t-score	Sig.
1	51	41.35	49.60	3.096	.003*
2	53	35.80	46.79	3.511	.001*
3	50	30.81	48.96	5.905	.000*
4	47	28.48	42.27	3.627	.001*
5	37	32.42	43.17	3.437	.002*
6	38	27.73	34.28	2.019	.051
7	32	28.89	34.96	1.471	.151
Anova	F- Score	2.56	F Score	2.90	
	Sig.	.002*	Sig.	.009*	

* Significant ** Highly significant

versus posttest change in accounting/finance knowledge across game ending rank performance groups; pretest versus posttest change in attitude towards the simulation across game ending rank performance groups; and pretest versus posttest change in accounting/finance knowledge across self-reported GPA groups.

FINDINGS

The overall findings with respect to H1 which was tested using a paired t-test, are reported in Table 1. To test H1, the average total test percentage raw score on the 14 item accounting/finance test on the pre-test questionnaire was compared to the average total test percentage raw score on the post-test questionnaire to determine if there was a change. In addition, a corrected for guessing score on the 14 item accounting/finance pretest and posttest was also calculated to measure the "true" level of accounting/finance knowledge of the students. As shown in Table 1, the average level of accounting/finance knowledge for both the total test raw scores and adjusted for guessing total test scores increased on the posttest versus the pretest and the difference was highly significant. These results provide overwhelming support for the acceptance of H1.

The knowledge level of the students on individual test items is also reported in Table 1. In general, the level of pretest-posttest knowledge improved significantly for the majority of the test items. Interestingly, three of the fourteen knowledge items showed no knowledge improvement and, in fact, the experience seemed to actually lower the knowledge of the students on one of the items. The ability of students to interpret cash flows was at a very low level on the pretest and when adjusted for guessing, the performance was actually negative on the posttest and the change was significant. Further, the ability of students to calculate a gross margin was not enhanced significantly by the game experience. Finally, students were not proficient at all at being able to compute a mark-up and were still not proficient at this task at the conclusion of the simulation.

The results related to H2 and H3 are reported in Table 2. These results support the acceptance of both of these hypotheses. For both the pretest and posttest results, the students who performed better in the simulation demonstrated more knowledge of accounting/finance principles and the differences between the simulation rank performance groups were significant.

The findings for H4 on the impact of simulation results on attitudes towards simulation play are reported in Table 3. The results indicate that H4 should be accepted. The posttest attitude of students towards the simulation was related to their ending performance as evidenced by the ANOVA results. Further, their pretest attitude towards the simulation mostly changed in response to their performance as evidenced by the t-score results. The exception was that top performing students increased in terms of becoming more favorable towards the simulation game but these in-

Table 3
A Pretest and Posttest Post Comparison of Attitude Change by Performance Rank in a Marketing Simulation Game

Merlin Rank	N	Pretest Attitude	Posttest Attitude	t-score	Sig.
1	51	3.66	3.84	-1.955	.056
2	53	3.67	3.80	-1.401	.167
3	49	3.55	3.29	2.405	.020*
4	47	3.34	2.91	3.480	.001*
5	37	3.50	2.90	4.562	.000**
6	38	3.38	2.28	9.137	.000**
7	32	3.38	2.91	4.311	.000**
Anova		F- Score 2.00 Sig. .065	F Score 27.51 Sig. .000**		

* Significant ** Highly significant

Attitude measurement scales were 1-5 point, with lower numbers meaning more positive attitude

creases were not significant. Conversely, students who performed below first and second place became more negative towards the simulation experience at the conclusion of the game. Interestingly, the pretest attitudes of better performers were generally more positive than poorer performers but the pretest ANOVA results demonstrate only a marginal level of significance at the .065 level.

The findings related to H5 and H6 are reported in Table 4. These findings support the acceptance of both of these hypotheses. Students with higher self-reported GPA's had better rank performance results on the simulation game and also achieved higher scores on both the pretest and posttest accounting/finance knowledge tests. The ANOVA results are significant in all of these cases. In addition, a t-test comparison was undertaken to see if there was any significant knowledge gain as a result of the simulation game experience. This would be expected if H1 is true. It was found that irrespective of self-reported GPA, there was a knowledge improvement between the pretest and posttest for all groups and this change was significant.

DISCUSSION AND CONCLUSIONS

The research reported here sought to examine whether students improved their knowledge of accounting/finance principles as a result of the experience of playing a marketing simulation game. In addition, the study considered whether students who had more knowledge of accounting/finance principles would outperform students who had less knowledge on the simulation game. Finally, the study examined whether participant attitudes towards the simulation experience would change as a result of the simulation experience and whether prior knowledge, as evidenced by GPA would impact simulation game performance.

The findings indicate that there is strong evidence that the general level of knowledge of accounting/finance principles for the whole class improved as a result of the simulation experience. Further, students who demonstrated more knowledge of accounting/finance principles on both a pretest and posttest measure tended to outperform students who had less knowledge of accounting/finance principles. As gratifying as these changes were, the fact is that at the beginning of the simulation experience, and the course, the base level of knowledge of accounting/finance principles of the entire class was only 43.7% which was reduced to 32.7% when adjusted for guessing. This is shockingly low. At the conclusion of the simulation, the student's base level of accounting/finance knowledge had improved significantly to 55.5% or 42.4% when adjusted for guessing. Although the investigators were happy to show that the simulation experience had significantly improved the knowledge of the students, it is not satisfying to know that even for the students who reported having GPA's at A grade level, the absolute level of accounting/finance knowledge was still below what would be considered a minimally acceptable average of 60%!

As might be expected, there was a shift in attitudes amongst students towards the simulation experience as a result of their simulation performance. Poorer performing students had less positive attitudes towards the simulation than better performing students. Interestingly, although the attitude scores of top performing students increased between the pretest and posttest measures, these changes were not significant. Conversely, students who experienced average or poor performance became less positive in their atti-

Table 4
Anova of Mean Game Rank Performance: Anova and T-test of Mean Pretest, and Mean Posttest Post Accounting/Finance Principles Knowledge by GPA

GPA	N	Mean Rank	Pretest AFG Score	Posttest AFG Score	t-score	Sig.
A Range	41	2.93	40.97	55.33	-4.461	.000**
B Range	136	3.60	35.19	47.38	-6.322	.000**
C Range	110	3.95	28.66	36.11	-3.464	.001*
D Range	9	5.11	14.64	27.67	-2.605	.003*
Anova		F-Score: 4.59	F-Score 6.56	F-Score: 11.37		
		Sig. .004*	Sig. .000**	Sig .000**		

* Significant ** Highly significant

tude towards the simulation and the changes were significant.

These findings indicate that the experience of playing a marketing simulation game both drew upon and enhanced the knowledge and application of fundamental accounting/ finance principles. As such, the present study findings provide evidence that simulation games are an effective learning approach to encourage students to integrate and apply business knowledge and principles. This finding provides further evidence to support the external validity of simulation games.

As hypothesized, there was a relationship between self -reported GPA and both pretest-posttest accounting/finance test performance and simulation game performance. Previous studies of simulation performance and overall academic performance have reported mixed results with respect to the relationship between academic ability as measured by GPA or examination performance and simulation game performance. This study looked specifically at knowledge of accounting and finance principles as they might be applied to a specific simulation game and did find a relationship. The authors can only speculate as to why this is the case. Perhaps the employment of an "academic" accounting/finance test at the outset of the simulation may have sensitized students to the necessity of applying this knowledge. The students who were academically stronger may have been able to remember more of these principles at the outset of the simulation and also improved their knowledge of these principles through to the completion of the simulation. As such, their comprehension of the simulation game may have developed faster and may explain why they performed better.

In conclusion, this study provides further evidence that the experience of simulation game play is beneficial in that it assists students in integrating their learning and improving their conceptual knowledge of business principles.

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