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Transforming Knowledge into Action through Gaming and Simulation

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Software-Based Simulation: A Case Study of a Business School

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Teaching in management schools is often supported by other methods such as assignments, industry visits, project work, case study analyses, role plays and simulations (including simulation games). The use of such methods has been justified because of the vast scope and complexity of the program syllabus. Students in a management school learn to allocate resources efficiently, make effective decisions, plan for the future, and work with other people within and outside their teams and organizations.

Although the value of simulation games is publicly acknowledged, some experts have shown skepticism about their impact and commented on their inherent weaknesses. For example, Crookall & Arai (1995) argued that games with long time horizons may suffer from system inertia and uncertainties. For example, participants in games for policy making did not get sufficient time for experimenting with changing relationships. They tended to be emotionally detached, as they were immune to the risks that accompanied policy making in real life. Referring to three simulation games, Ivancevich (2002) stated that hard evidence whether they accomplished the desired outcomes (of making a manager a better performer on the job) was scarce.

The objective of the study was to capture and analyze the users' views about the effectiveness of simulations as such findings would best reflect the value of the simulation technique. A software-based management simulation game was conducted in a management school to ascertain their effects as experienced by the student participants. The correlates of learning from simulations were extracted from their participants' self-reports.

1. Literature review

Ments (1999) described stimulation as a technique that provided the participating student with a highly simplified reproduction of part of a real or imaginary world. The simulation game included the structured system of a competitive play. Simulations helped students to learn to make decisions and communicate and negotiate with others. Ivancevich (2002) described the management game as the operating characteristics of a company, industry or enterprise. In a computerized management game, the interplay of team decisions was computed in accordance with a model, which generated results in the form of measures such as profits or market share. Games emphasized the development of problem-solving skills, helped to integrate several interacting decisions, allowed experimentation with decisions, provided feedback on decisions, amongst other, and simulate reality.

2. Method

The sample

The target organization was a business school in New Delhi having two parallel sections of a 2-year post-graduate program in business management. Sixty-six students (females=11, males=55) in section A and 70 students (females=14, males=56) in section B participated in the sessions. The students were in the age group of 22-25 years and had graduate degrees in accounting, psychology, physics, chemistry, mathematics, engineering and business management. As they were in the second month of their course, they were yet to complete the first semester, which had basic management subjects such as management principles, accounting and finance, human resources, marketing and business economics. Very few students had work experience.

The procedures

The 2-day simulation game was conducted separately for each section. Early on the first day, the simulation facilitator gave the students a 2-hour briefing on management concepts and practices, simulation rules and objectives, and documents and reports. The faculty of the school deliberately allotted the students of each section to nine teams of approximately equal numbers of students. This ensured that the team composition was heterogeneous in terms of their educational profile. Each team was equivalent to each other in terms of perceived leadership skills, attitudes towards aggression and willingness and eagerness for learning, and gender.

The simulation was conducted within a fictitious industry scenario, where all the teams were deemed to be producer firms of automobiles for personal use. Students were given documents that described the industry in terms of inputs, technology, product range, markets, economic conditions, state regulations and competition. At the beginning of the simulation, each team was given financial and other reports that showed that each firm had an identical position. The briefing analyzed these reports threadbare so that the students were placed on a level playing field in terms of their intellectual competence and readiness for the session.

Each student was told about his role within every team. Members were asked to choose their roles according to their preferences; no roles were imposed. As each team was in total charge of the management of their firm, the students were designated as chief managers in charge of production, marketing, new product launch, finance (cash budgeting), finance (analysis), competition analysis, and human resources (performance management). The team leader was their chief executive officer. His principal function was to urge discussions of divergent views amongst his team members, and to facilitate the formation of consensual management proposals.

The session simulated a business for 15 months in five quarters of three months each, during which period, each team received performance reports for study and further action at the end of every quarter. Industry 'newsletters' at the beginning of every quarter discussed economic issues, displayed advertisements, and reported business events: these prompted the students to modify their decisions for that quarter. At the end of every quarter, each team would give the facilitator their management action plan listing proposals for decisions for that quarter. Each plan was supported with the cash budget that demanded the computation of all expected cash flows and the projected income statement for that quarter. Each quarter lasted for about 2 hours each, but the earliest quarters were longer than the latter quarters to enable the students to improve their understanding.

To track their performance, each team kept quarterly records of prices, financial ratios and other indicators of their team and of the industry, on a continuous basis. After the end of the fifth quarter, and before the end of the second day, each team was given a set of questions for the self-appraisal of their performance across the session. Although the entire team would be involved in this appraisal, each chief executive officer (or nominee) would make a presentation before the entire group of participants. This would involve an evaluation of their decisions and results, an exchange of many experiences, elicit admissions of ignorance and failure to understand, and about techniques learnt and applied.

The facilitator de-briefed the students on a variety of issues. Initially, he responded to the difficult issues reported in the students' self-appraisal. He thereafter discussed the need to scan the environment, and explained the complexity of markets and the volatility of competitive actions. He emphasized the need to focus on business data and goals, argued for constructive dissent leading to consensual decisions, and discussed the value of continuous enquiry as a basis for further learning.

Instrument

A set of 20 statements on a five-point Likert scale was used to elicit the students' assessment of their learning. Each started with the expression "This simulation session has helped me to…", which the students would evaluate in order of their importance and utility to them within the range of 1 to 5 (1 = *least important* to 5 = *most important)*. This instrument compared favorably to scales used earlier in similar simulations for career managers (Dumblekar, 2003 and 2004), and incorporated the expected learning objectives of management students. The composition of the scale was strongly influenced by the comments and other feedback received by the facilitator in earlier sessions. Using the split-half correlation method, the reliability of the test was found to be 0.9981, and the revised validity of the test using the internal consistency method was calculated to be 0.9990.

To avoid emotional contamination of the students' responses due to their reactions to their last quarter results, the instrument was administered to them after the teams had submitted their action plans for the fifth and last quarter of the session. After the instruments were collected from them, the team leaders made self-appraisal presentations, and this was followed by the facilitator's de-briefing. The performances of the 5th quarter were declared at the end of the session.

Data analysis

The data from the 20 statements was then reduced using exploratory factor analysis on the bases of principal component analysis and varimax rotation methods with Kaiser Normalization. Measures of central tendency and dispersion such as mean and standard deviation, correlation and t tests were generated and analyzed using the Microsoft Excel and SPSS software.

Results and discussion

Results

Table 1 presents the results of the factor analysis of the data in 20 statements. Five learning factors were extracted after 7 iterations. The factors with Eigen values greater than 1 accounted for 57% of the total variance. The statements had an average loading of 0.62 and their values ranged between the minimum of 0.41 and the maximum of 0.78.

The mean responses for the 20 statements of females were compared against those of the males. The t test for paired samples did not show any significant difference (n=20 each, females=25, males=111), but the correlation (r) was a significantly strong 0.89 ($p<0.01$).

Table 2 presents the descriptive statistics and intercorrelations amongst the statements and factors extracted from the factor analysis. Most correlations were positive and statistically significant. However, nine correlations were negative, out of which only one (*discover the purpose of the cash budget x explore and test classroom fundamentals*) was statistically significant (r=-.22, $p<0.01$). To explore the effect of gender differences, similar results were extracted for males and females, separately.

Results of factor analysis				
	Abridged statements	**Loading**	**Factors**	**% of Variance**
V1	Acquire new skills (e.g. pricing and planning).	0,71	Acquire competitive skills to meet the long-term goals of the organisation	15,10
V16	Acquire a far-sighted view of the organisation.	0,66		
V4	Learn how to influence sales.	0,66		
V19	Understand how to contribute to the overall objective of the team.	0,63		
V11	Realise the need for matching resources and decisions to goals.	0,59		
V15	Recognise and respond to signs of competition.	0,51		
V9	Perceive that data must be measured, understood and interpreted before use.	0,78	Understand that strategic decisions emerge out of a study of the changing business environment	11,75
V8	Accept the need for measuring the effect of alternative choices for business decisions.	0,76		
V13	Create and change strategy in tune with new information and events.	0,47		
V7	Realise that our environment is always changing and is never constant.	0,42		
V6	Interpret business issues and prospects.	0,41		
V3	Discover the purpose of the cash budget.	0,77	Interpret the data within financial reports	11,41
V10	Understand the structure of the income statement.	0,73		
V14	Understand the components of the balance sheet.	0,57		
V5	Realise that working with others is more effective than working alone.	0,67	Appreciate how consensual action within the team facilitates the achievement of goals	10,04
V17	Measure and control organizational resources for achieving our goals.	0,62		
V18	See that decisions come from conflict, compromises and consent.	0,62		
V12	Find ways to resolve conflict with other members in the team.	0,55		
V20	Clarify management concepts and practices heard in the classroom, and read in textbooks, magazines and newspapers.	0,79	Explore and test classroom fundamentals	8,70
V2	Realise that the market determines the financial success of a business firm.	0,51		
			Cumulative %	57,00

Table 1

Table 2

Descriptive statistics and intercorrelations amongst statements and factors extracted from factor analysis

	Abridged statements	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
V1	Acquire new skills (e.g. pricing and planning).	1																			
V2	Realise that the market determines the financial success of a business firm.	.36**	1																		
V3	Discover the purpose of the cash budget.	.15	.01	1																	
V4	Learn how to influence sales.	.46**	.28**	.34	1																
V5	Realise that working with others is more effective than working alone.	.18*	0.13	.12	.19*	1															
V6	Interpret business issues and prospects.	.18*	.30**	.26**	.32**	.23*	1														
V7	Realise that our environment is always changing and is never constant.	.26**	.26**	.16	.24*	.16	.32**	1													
V8	Accept the need for measuring the effect of alternative choices for business decisions.	.19*	.38**	.15	.25**	.22*	.26**	.25**	1												
V9	Perceive that data must be measured, understood and interpreted before use.	.22*	.37**	.16	.15	.15	.39**	.26**	.46**	1											
V10	Understand the structure of the income statement.	.25**	.20*	.44**	.33**	.14	.34**	.21*	.14	.26**	1										
V11	Realise the need for matching resources and decisions to goals.	.37**	.31**	.19*	.40**	.32**	.37**	.39**	.35**	.31**	.35**	1									
V12	Find ways to resolve conflict with other members in the team.	.17	.37**	.21*	.19*	.27**	.33**	.19*	.35**	.22*	.37**	.20*	1								
V13	Create and change strategy in tune with new information and events.	.30**	.27**	.20*	.34**	.21*	.36**	.26**	.36**	.38**	.29**	.32**	.31**	1							
V14	Understand the components of the balance sheet.	.23*	.27**	.29**	.17*	.23*	.13	.27**	.13	.21*	.39**	.24**	.22**	.27**	1						
V15	Recognise and respond to signs of competition.	.27**	.24**	.36**	.44**	.25**	.38**	.37**	.25**	.26**	.45**	.47**	.32**	.45**	.36**	1					
V16	Acquire a far-sighted view of the organisation.	.40**	.22*	.19*	.41**	.29**	.24*	.19*	.26**	.17	.32**	.52**	.23**	.26**	.20*	.57**	1				
V17	Measure and control organizational resources for achieving our goals.	.31**	.28**	.19*	.31**	.35**	.32**	.30**	.22**	.24**	.29**	.40**	.34**	.25**	.19*	.35**	.38**	1			
V18	See that decisions come from conflict, compromises and consent.	.19*	.30**	.10	.20*	.26**	.28**	.18*	.19*	.16	.23**	.33**	.43**	.22**	.12	.22**	.32**	.37**	1		
V19	Understand how to contribute to the overall objective of the team.	.44**	.44**	.26**	.42**	.27**	.42**	.34**	.20*	.19*	.34**	.39**	.23**	.27**	.25**	.50**	.45**	.33**	.26**	1	
V20	Clarify management concepts and practices heard in the classroom, and read in textbooks, magazines and newspapers.	.24**	.33**	.03	.23**	.14	.34**	.17*	.15	.24**	.24**	.26**	.24**	.38**	.26**	.36**	.31**	.17*	.42**	.37**	1
F1	Acquire competitive skills to meet the long-term goals of the organisation	.71**	.28**	.14	.66**	.20*	.19*	.36**	.12	.06	.19*	.59**	-0,12	.22**	.14	.51**	.66**	.35**	.08	.63**	.24**
F2	Understand that strategic decisions emerge out of a study of the changing business environment	.16	.49**	.07	.14	.11	.41**	.42**	.76**	.78**	.09	.30**	.28**	.47**	.15	.16	-.01	.18*	.03	.12	.09
F3	Interpret the data within financial reports	.02	-0,05	.77**	.27**	.06	.32**	.17*	-.01	.16	.73**	.12	.32**	.32**	.57**	.51**	.15	.12	.04	.22**	.15
F4	Appreciate how consensual action within the team facilitates the achievement of goals	.00	.07	.11	.08	.67**	.24**	.10	.25**	.03	.16	.35**	.55**	0,05	-.01	.19*	.36**	.62**	.62**	.12	.04
F5	Explore and test classroom fundamentals	.17*	.51**	-.22**	.02	-.07	.24**	-.00	-.02	.11	.17*	.01	.36**	.28**	.22**	.15	.12	.03	.54**	.31**	.79**
	Mean (N=136)	4,21	3,94	4,03	3,82	4,24	3,60	4,25	3,90	4,37	4,03	4,04	3,40	4,21	4,07	3,89	3,72	4,01	3,48	4,13	3,90
	Standard deviation (N=136)	0,99	0,96	0,93	1,01	1,06	1,11	0,94	0,99	0,86	1,00	0,98	1,23	0,88	0,99	1,09	1,11	0,98	1,23	0,99	1,10
	Mean (females, N=25)	3,96	3,92	4,04	3,68	4,44	3,56	4,08	3,96	4,4	3,84	4,08	3,28	4,36	4,04	3,84	3,6	3,8	3,44	4,12	3,92
	Standard deviation (females, N=25)	0,98	0,86	0,84	1,11	1,00	1,23	0,81	0,89	0,76	0,94	0,91	1,06	0,86	0,89	1,14	0,96	1,04	1,04	0,78	1,12
	Mean (males, N=111)	4,26	3,95	4,03	3,85	4,19	3,61	4,29	3,88	4,36	4,07	4,03	3,43	4,18	4,07	3,90	3,75	4,05	3,49	4,14	3,89
	Standard deviation (males, N=111)	0,99	0,98	0,96	0,99	1,07	1,09	0,97	1,02	0,88	1,02	1,00	1,26	0,89	1,02	1,09	1,15	0,96	1,27	1,04	1,10
	** p<0.01																				
	* p<0.05																				

Discussion

The factor analysis results showed that the simulation enabled the young students to get an exposure to and had acquired competitive skills, had learnt to make strategic decisions and had interpreted financial data. They also learnt to work together and had the opportunity to revisit their classroom experiences in their interactive sessions. These learning elements comprised important segments of a post-graduate management program.

The factor analysis revealed six statements with loadings higher than 0.70, each, with their respective factors (Table 1). It was most satisfying to discover that the greatest impact of simulation was to enable the students to relive and augment their classroom lessons (V20, 0.79). The simulation succeeded in making its students think, cognitively, for they developed a regard for use of data for making decisions (V9, 0.78), and for the use of measures to assess alternatives for making decisions (V8, 0.76). They appreciated the values of cash budgeting - both as an instrument and as a process of planning - which was a recurring exercise in every quarter (V3, 0.77) along with the necessity of generating the projected income statement to estimate their tax flows (V10, 0.73). The cash budget is certain to have sharpened their forecasting ability in many far-sighted directions. Finally, students acquired a variety of new skills to manage their firm as top managers (V1, 0.71), which along with five other statements, contributed to the factor, *acquire competitive skills to meet the long-term goals of the organization* with the heaviest variance (15.10%). This suggested that the biggest advantage for the simulation was that its students would acquire new skills, rapidly.

The negative correlation in Table 2 suggests that the students may not have covered their syllabus on subjects that related to cash budgeting when the simulation was conducted. At this stage, classroom teaching on cash budgeting and its application in top management planning was inadequate. Although the size of the negative correlation is not as large as the other positive correlations, its negative sign sends strong signals that the cash budgeting process in the simulation undertaken by the students may not have fitted in with their classroom 'knowledge' acquired in their ongoing first semester. The process may have substituted some of their earlier classroom views with understanding from the contexts set up in the simulation. This contrarian discovery is perhaps more important to the students than the re-confirmation of their classroom understanding.

A detailed analysis of Table 2 shows that females had higher means for seven statements (collective mean = 4.17), while males are superior in the remaining thirteen statements (collective mean = 3.91). These comparative findings threw up fascinating and debatable conclusions. Females were more eager to work with others (V5, 4.44), with data and with measured decisions (V9, 4.40 and V8, 3.96). They were more adaptive to changes (V13, 4.36) and were more goal driven (V11, 4.08 and V3, 4.04). They showed more interest in relating their simulation experience to their classroom studies (V20, 3.92).

In contrast, the males were more alert to change (V7, 4.29) and were better at seeing the future (V16, 3.85). The males were more receptive to picking up new skills (V1, 4.26), giving them an edge over the females in contributing to team goals (V19, 4.14) and controlling team resources for achieving organizational objectives (V17, 4.05). Their understanding of the financial performance reports was superior (V10, 4.07 and V14, 4.07). They were better able to perceive how market forces and business dynamics dictate sales and affect company performance (V2, 3.95; V4, 3.85 and V6, 3.61). Finally, the males were more open to confront others, seek consensus and decisions through discussions (V18, 3.49 and V12, 3.43).

However, the students' overall ability to learn from the simulation was not affected by gender. Two deductions immediately arise from this finding. Firstly, it confirmed the appropriateness of constructing the teams with due care for the gender distribution and the strict conformance to roles. Secondly, the simulation structure, conditions and documents created equal opportunity for both sexes.

The factor analysis findings of this study compare favorably with two other studies in management simulations. Dumblekar (2003) had covered a diverse sample of 138 managers in four Indian public sector enterprises in six simulation sessions that were conducted for two days each. The objective of these sessions was to enlighten the managers about operational and strategic skills and practices. The managers had learnt to:

- Generate competitive strategies to achieve organizational goals
- Discuss and understand the market dynamics that generate sales
- Develop and adopt a business leadership vision based on data and team support
- Acquire decision skill sets to recognize threats and solve problems

Direct resources for business performance

Dumblekar (2004) covered a small sample of 33 senior managers of an Indian public sector company in a one-day strategic thinking training program. The objective of this program was to make the managers aware of strategic issues and responses. The mean age of the participants in the respondent sample was 49.88 years (minimum=40 years, maximum=57 years). The mean length of their managerial experience was 15.24 years (minimum=5 years, maximum=27 years). The managers reported that they had learnt to:

- Use consensual decisions to reach strategic goals.
- Acquire financial, marketing and strategic skills.
- Make adaptive decisions to respond to competition and changing conditions.
- Understand that decisions involving the resources and success of the firm must be considered by everyone in the team.
- Interpret business data for making decisions.

3. Conclusions

The study demonstrated that a 2-day software-based simulation complemented and (sometimes) preceded the classroom lessons of management students in their first semester. The factor analysis isolated five major gains from simulations. In general, the simulation made them think and work at their decision making, and helped them understand financial reports. They were forced to look into the future, plan and budget for changing conditions. Each student played different roles within the team, and acquired skills due to the role play and interaction within the team. The study identified and discussed narrower areas where females learnt better than males, and *vice versa*. The simulation conformed to the general syllabus of the management program, and its student participants reported satisfaction with its benefits.

Implications for future research and applications

Further research in simulation studies will profit from the use of larger samples, which may help discover narrower issues of interest to learning in management. Any attempt at relating the age, academic qualifications, and nature and length of work experience to the extent of students' learning will be a valuable contribution to simulation studies.

Although gender differences were analyzed in this study, the sample size was lopsided weighed in favor of the males. Research studies to uncover the distinctive thinking orientation and decision behavior of females and males, separately would be useful for their identification and placement in situations demanding a specific set of skills. It would be interesting to ascertain whether the two sexes would consistently continue to behave differently in similar as well as in different conditions.

Are homogeneous teams (expert teams?) more effective than heterogeneous teams? For example, it could be argued that teams with members only with disciplines such as accounting and finance do better than teams with members from a mix of disciplines. Simulations where homogeneous teams were pitted against heterogeneous teams may offer valuable insights into team composition and dynamics, and role behavior.

Although the simulation is a versatile technique, it is not a panacea for management students of all ages, all courses and all programs. Comparative studies of the effectiveness of different methods would enable educators to choose the simulation to suit the needs of the situation, one of which would be student curriculum. For example, it would be useful to know whether the simulation is better than the case study, or *vice versa*, and if so, under what conditions.

Tyson & York (2000) described the elements of a successful learning program as participant motivation, performance feedback, individual process-centered, experientially rewarding and driven by the senses. The simulation was an effective technique because it had all the elements of the successful

learning program. It built management skills for diverse conditions, and rapidly raised the understanding of students. If its utility was reported to be high by its users, it should be conducted regularly at other semesters of the management program.

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