Mutual Gains From Team Learning: A Guided Design SDM Classroom Exercise

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Motivation

Alumni and employer surveys often reveal that employers of undergraduate students value problem-solving skills and the ability to work in teams more highly than other core quantitative training received in our agricultural, applied, and resource economics departments. Litzenberg and Schneider reported that interpersonal work skills such as self-motivation, a positive work attitude, high ethical standards and the ability to work as a team player clearly dominate hiring decisions, at least in industry. Recent hires in both private and public sectors report to their departments that they soon find themselves in their new careers solving organizational problems or responding to competitive challenges in teams, task forces, and committees on nearly a daily basis. Both employers and employees perceive that productive citizenship and the creation of social capital in teams represent important organizational priorities and values (Bolino, Turnley and Bloodgood). The recognition of the importance of learning with fellow employees has spawned the emerging literature on action and team learning in corporations (Dotlich and Noel; Redding; McGill and Beaty).

Contrasting didactic approaches in managerial economics classrooms, particularly those settings that supply both economic theory and management training, provide students with two sets of problem solving/decision-making tools. Standard microeconomic theory provides a valuable analytical framework for the study of decisions under constraints where postulates and assumptions are combined to predict behavior or choices (Silberberg 1978). Firm-level models to solve economic problems generally require specific knowledge concerning objective functions, technology, prices and their functional (generally mathematical or statistical) interactions and relationships. These data generally are given to students in the classroom and these problems are solved by the individual learner.

In contrast, management, the process of allocating resources to reach a goal, is defined variably in the business literature as either a set of functions (George and Jones), tasks (Drucker), or as a process (Kepner and Tregoe). All three management frameworks capture the essence of a behavioral process of human interaction to reach organizational goals through data acquisition, analysis and decision implementation. Human interaction within the firm, largely ignored in managerial economics except for the interdependent utility literature, is the central component in the decision making process in this literature. Management theorists recognize that this give and take of decision-making within organizations may or may not produce optimal economic outcomes because time and informational constraints place cognitive boundaries around the decision maker's choice set (Simon; Cyert and March). More emphasis is given in this management literature to explanation and description rather than to prediction.

The process framework of management emphasizes a step-by-step procedure (e.g. goal definition, problem statement, information gathering, analysis, synthesis, decision, implementation, evaluation) of decision-making. This process is often labeled serial decision-making (SDM) because of the recommended sequential steps in organizational deliberations. Table 1 presents three versions of SDM in decision-making. All three sets of guidelines recommend problem or objective definition, evaluation and analysis of alternatives, and implementation/evaluation for reaching desired goals. Failure to follow the prescribed sequence of decision steps may produce no decision or a sub-optimal one, a solution to the wrong problem, or general decision-making inefficiency characterized by a misallocation of time and money.

Stevens notes that the best intentioned efforts to reach a solution to a problem via SDM are blocked or constrained by several common human conditions: perceptual biases, emotional attachments, knowledge and information limitations, communication challenges, external

Table 1: Selected Examples of Serial Decision Making (SDM)

Kepner and Tregoe	Altier	Lyles
(Decision Analysis)	(Decision Analysis)	(Decision Making)
Establish Objectives	Define the Decision Statement	Define Objectives
Rank the Objectives	Establish Objectives	Generate Alternatives
Develop Alternative Actions	Value Objectives	Develop Action Plan
Evaluate Alternatives Against Established Objectives	Generate Alternatives	Troubleshoot
Tentatively Choose the Best Alternative	Compare and Choose	Communicate
Explore Tentative Decision for Future Possible Adverse Consequences		Implement
Control Effects of the Final Decision by Taking Actions to Prevent Possible Adverse Consequences and by Making Sure Actions Decided on are Carried Out		

distractions and cultural predispositions. When individuals work in a group or team to make decisions, the process according to Leavitt and Bahrami, can be a “monster or a miracle”. The “monster” obstacles to group SDM are intragroup competition or conformity, lack of leadership, and time constraints while “miracles” can happen due to greater expertise, in-check biases, greater willingness to take risks, sense of community, and better decisions.

The organizational benefits of SDM have been documented over the years as a result of management testimonies, case studies, and organizational research (Wales and Stager). However, little empirical evidence exists that measures the actual gains (if any) of SDM in teams. Just how significant are the gains to teams and individual team members from SDM processes? What factors in the process produce these gains to the organization? This paper will report an attempt to measure and test three SDM hypotheses with team learning implications:

1. SDM produces superior decisions relative to non-sequential decision-making.
2. Teams using SDM make superior decisions to those decisions reached by individuals working on their own.
3. Individual expertise positively contributes to the team-generated solution.

In addition, the paper attempts to predict, via a multiple regression model, the percent improvement in team-based versus individual decisions associated with SDM using explanatory factors such as team knowledge, size, diversity, the presence of an expert on the team, and the relative individual team member knowledge. A final appeal will be made to continue to bridge the didactic gap between conventional economic and management problem solving in our classes by taking advantage of the potential mutual gains associated with team learning.

The Exercise

A guided-design SDM exercise was conducted in a senior- and graduate-level managerial finance course from 1985-2002. Guided design is a learning strategy that directs students, working in small teams, to resolve open-ended problems (Wales and Stager). The learners, who are actively solving the assigned problem, are guided through a decision-making problem by the facilitator. This process is normally supported by periodic feedback (written or verbal) that gives students a "slow-motion" experience as they develop their team's solution to the problem. The recent partial "reincarnation" of guided design is action learning where learning takes place in a structured classroom setting, using "learning by doing" case studies, under the guidance of a facilitator.

Two hundred and eighty students participated in the SDM exercise representing 62 teams. Individually, students are asked to arrive at a solution to an assigned common problem independent of their classmates. The problem is the classic Robinson Crusoe or shipwreck scenario where the stranded individual or group must make a decision concerning the use of remaining resources to ensure physical survival. Students are given a set of written facts describing the shipwreck scenario and asked to rank, on their own, the salvaged items from the ship in order of importance for their survival. It is assumed in the exercise that a search party will begin to search for the lost boat in three or four days.

The facilitator organizes randomly selected teams of four or five students for the next class period. At the next class meeting each team is guided through a SDM process to solve the assigned problem again. Teams work in different rooms so as not to distract other teams in their deliberations. The guided design nature of the experiment subtly directs the teams through the SDM framework making sure they have defined the problem correctly, evaluated alternatives, and agreed on a "solution". The give and take in the teams lasts for 30 minutes. The teams are then asked to produce a team ranking of the survival items available from the shipwreck, based on their shared understanding of the problem (15 minutes). Team solutions are compared to individual pre-SDM decisions and to the baseline solution of a subject matter expert—the hypothetical Coast Guard captain who rescues the stranded teams. Absolute deviations from the expert opinion are calculated for both the individual and the team scores (5 minutes). At the end of the class period the facilitator shares insights on the benefits and risks of team learning and the value of SDM.

Results

Six of the sixty-two teams experienced the "monster" of team learning. One three-person team failed to reach a solution in the time provided, experiencing complete collaborative breakdown in their deliberations. Another three-person team stubbornly voted to build a boat with the remaining materials and row away from the island in hope of rescue. Four teams failed to improve on the mean of their individual scores. Their observed failure to achieve mutual gains was due largely to a lack of team intelligence—the knowledge of how to work in teams even under guided design procedures (Robbins and Finley). However, in 90% of the teams, the "miracle" of team or group SDM was evident. Table 2 notes that substantial improvements (>20%) in decision-making were achieved by 72% of the "non-monster" teams.

Teams applying SDM do not always outperform individual decision-making, however. When the "monster" teams are set aside, thirty individuals in the student population of 256 students outperformed their team-generated SDM solution. Individual scores for 12% of the students remained lower (better) than the score from their group's deliberations. In some cases these expert individuals had previous survival training. As a result, 10% of the teams did not experience any benefits from the team SDM and 12% of the remaining individuals would have been better off without the team decision-making.

Table 2: Magnitude of Improvement Associated with Group SDM*

Level of Positive Improvement Relative To pre-SDM Group Mean (Percentage Change)	Number (%) of Groups
1-10%	9 (16)
11-20%	7 (12)
21-30%	21 (38)
> 30%	19 (34)

* The six "monster" teams are not included in these calculations.

Mutual gains, however, still were experienced by a majority of these teams and team members. Fifty-eight percent of the teams reached a team score that was equal to or lower than any individual team member's score—significant evidence of mutual gains.

As the team members enter their workrooms they observe or notice four characteristics about their team. The first is team size. Groups range from three to six members due to class attendance on that day. Secondly, after a few minutes of discussion the amount, or lack thereof, and diversity of knowledge across the individual team members is revealed. During the team deliberation the existence of a student expert will be obvious, someone who understands the problem from a technical point of view and has well-reasoned arguments for his or her rankings. Finally, the individual student will soon realize where he or she stands in survival knowledge and decision-making skills relative to the other team members.

The following multiple regression equation was employed to capture and explain the variables that go beyond the guided design SDM approach:

$$G_{ij} = \beta_0 + \beta_1 N_j + \beta_2 TK_j + \beta_3 D_j + \beta_4 E_j + \beta_5 S_{ij} + \varepsilon_i$$

where G_{ij} is the percent gain in the i^{th} individual's score in the j^{th} team, I_{ij}, compared to the mean team score for the post-SDM solution, $(I_{ij} – PM_j)/I_{ij}$; N_i is the instrumental variable differentiating teams of four or fewer members (N=0) and teams of five or more (N=1); lack of team knowledge (LTKj) is mean team pre-SDM score; D_j is the diversity in the team measured by the coefficient of variation associated with team member pre-SDM scores; E_j denotes the existence of an expert (E=1) on the team with an I_{ij} score of 36 or lower representing a score 1.5 standard deviations below the overall mean score for all students; and LIK_{ij} measures the relative lack of pre-SDM knowledge for the team member as compared to the group's knowledge, I_{ij}/LTK_j..

It is hypothesized that team size (N) is an important explanatory variable with relatively smaller teams processing information more efficiently and effectively than larger groups—so the direction of influence is hypothesized to be negative. A contrary position would be that more team members have the opportunity to share a wider variety of ideas and produce a superior decision to those reached by smaller teams. The functional relationship between score improvement and the lack of team knowledge (LTK) is hypothesized as a positive influence. The less knowledgeable the overall team is about survival the more likely the gains from team learning and SDM will be positive. Higher measures of within team variability (D) are expected to produce greater improvements in individual team member performance. People with very diverse perspectives on a problem can mutually gain from discussing their ideas and reaching a consensus decision, at least in theory. Positive group dynamics are critical in reaching a team decision in an effective manner, however. The presence of an expert (E) on the team is hypothesized to have a positive influence on the individual team member's level of improvement. The decision analysis literature argues that expertise in the subject matter or in the decision making process can lead to better decisions. And finally, we should expect that the less a person knows about the subject of survival (a high LIK value), the more the individual will gain from team learning.

Table 3 summarizes the regression results for the classroom exercise. The specified model explains 54% of the variation in the dependent variable G, the percent improvement in the individual score due to team SDM. Team size (N) is significant at the 10% level and demonstrates a negative relationship with S. Smaller teams produce a larger gain for the individual team member. The lack of team knowledge measured by LTK has a strong positive impact on individual gains. It appears that team members on below average teams were able to gain the most from the guided design SDM exercise.

Team diversity and the existence of an expert team member produce marginally significant results. In the case of diversity, greater relative variability in a team produces greater gains for the individual team member. This is the hypothesized relationship. However, in the case of an expert participating on the team the relative gains to individual team members was less than with "expert less" teams. E is highly correlated with LTK ($\rho = -0.57$) and D ($\rho = 0.67$).

Table 3: Regression Results for the Guided Design SDM Exercise

Variable	Estimated Coefficient (Standard Error)
Constant (β_0)	-1.0677*** (0.1228)
Team Size (N)	-0.0349* (0.0206)
Lack of Team Knowledge (LTK)	0.0075*** (0.0020)
Team Diversity (D)	0.2646* (0.1743)
Expert (E)	-0.0131 (0.0307)
Lack of Individual Team Member Knowledge (LIK)	0.8582*** (0.0499)
Observations	274
R^2	.54
F	64.12

***,**,* statistically significant at the 1%, 5% and 10% confidence level, respectively.

Removing E from the estimation, however, fails to change the estimated coefficients significantly although the estimated F value increased from 64.12 to 80.35. The data and these results indicate that experts are associated with lower LTKs, higher Ds, and draw the other members of their team towards their understanding of the decision problem and the solution method. Remarkably, some expert-less teams performed as well or better than teams with one or more experts in the guided design SDM exercise.

Finally, the relative lack of team member knowledge (LIK) has a positive impact on G as hypothesized. Team members coming into the survival exercise with little knowledge of survival or SDM experience significant gains in their understanding by the end of the exercise. Team learning favors the non-expert individuals with relatively limited understanding of the problem.

So What?

Working and learning in teams in and outside the academic classroom is fraught with "monster" implications for the economics and management instructor. Free riding, uneven preparation, sporadic attendance, plagiarism, and the opportunity cost of material replaced by the in-class group exercise are only a few of the hurdles the instructor must overcome to facilitate successful team projects. Yet the "miracle" potential of team activities, not only to enhance learning but also to prepare students for their careers, may dominate the downside risks of student interaction in groups.

Individual active learning outside the classroom via homework assignments is standard offering in economics classes. But group-based mutual gains learning may or may not occur in these assignments. Within the classroom, however, research has demonstrated that active individual and group processes enhance learning on the margin more than the equivalent time spent on more traditional forms of presentations (See Wilson, Fairchild, Willett and Erven for a summary of this literature). The research reported in this teaching note provides evidence that students with little experience in SDM learn from their interaction with other team members in a guided design process.

Guided design team projects can be an effective and efficient tool for not only teaching managerial decision-making but for teaching economic principles as well. The reality of the give and take of economic decision-making in organizations can be created by the instructor and produce mutual learning gains. Some economic educators have gone so far as to associate doing economics to detective work (Breit and Elzinga), while others promote role-playing (Alden) and case studies (Carlson and Schodt; Velenchik) as individual and team-based tools for learning economic theory and policy analysis. The substantive foundation for utilizing team learning has been laid by the increasing number of short problem-solving case studies in managerial economics textbooks (e.g. Mansfield, et. al.; Maital). Our ongoing challenge is to utilize these available resources regularly and appropriately to prepare our undergraduate students for productive citizenship within organizations.

References

Alden, D. "Experience with Scripted Role Play in Environmental Economics." *Journal of Economic Education* 30(Spring 1999):127-132.

Altier, W.J. *The Thinking Manager's Toolbox*. New York: Oxford University Press, 1999.

Bolino, M.C., W.H. Turnley and J.M. Bloodgood. "Citizenship Behavior and the Creation of Social Capital in Organizations." *Academy of Management Review* 27:4(2002): 505-522.

Breit, W. and K.G. Elzinga. "Economics as Detective Fiction." *Journal of Economic Education* 33(Fall 2002):367-376.

Carlson, J.A. and D.W. Schodt. "Beyond the Lecture: Case Teaching and the Learning of Economic Theory." *Journal of Economic Education* 26(Winter 1995):17-28.

Cyert, R.M. and J.G. March. *A Behavioral Theory of the Firm*. Second Edition, Cambridge, Massachusetts: Blackwell Publishers, 1992.

Dotlich, D.L. and J.L. Noel. *Action Learning*. San Francisco: Jossey-Bass Publishers, 1998.

Drucker, P.F. *Management: Tasks-Responsibilities-Practices*. New York: Harper & Row Publishers, 1974.

George, J.M. and G.R. Jones. *Understanding and Organizing Organizational Behavior*. New York: Addison-Wesley Pub., 1996.

Kepner, C.H. and B. B. Tregoe. *The Rational Manager*. New York: McGraw-Hill, Inc., 1965.

Leavitt, H.J. and H. Bahrami. *Managerial Psychology: Managing Behavior in Organizations*. 5th ed., Chicago: University of Chicago Press, 1988.

Litzenberg, K.K. and V.E. Schneider. "Competencies and Qualities of Agricultural Economics Graduates Sought by Agribusiness Employers." *American Journal of Agricultural Economics*. 69(December 1987):1031-1036.

Lyles, R.I. *Practical Management Problem Solving and Decision Making*. New York: Van Norstrand Reinhold Co., 1982.

Maital, S. *Executive Economics: Ten Essential Tools for Managers*. New York: The Free Press, 1994.

Mansfield, E., W.B. Allen, N.A. Doherty and K. Weigelt. *Managerial Economics: Theory, Applications, and Cases*. Fifth Edition, New York: W.W. Norton, 2002.

McGill, I. And L. Beaty. *Action Learning*. 2nd Edition, London: Kogan Page Limited, 2001.

Redding, J.C. *The Radical Team Handbook: Harnessing the Power of Team Learning for Breakthrough Results*. San Francisco: Jossey-Bass, 2000.

Robbins, H. and M. Finley. *The New Why Teams Don't Work*. San Francisco: Berrett-Koehler Publishers, 2000.

Silberberg, E. *The Structure of Economics*. New York: McGraw-Hill, Inc., 1978.

Simon, H.A. "A Behavioral Model of Rational Choice" *Quarterly Journal of Economics* 69(1956):99-118.

Stevens, M. *Practical Problem Solving for Managers*. London: Kogan Page, 1988.

Velenchik, A.D. "The Case Method as a Strategy for Teaching Policy Analysis to Undergraduates." *Journal of Economic Education* 26(Winter 1995):29-38.

Wales, C.E. and R.A. Stager. *Guided Design*. Morgantown, West Virginia: West Virginia University Center for Guided Design, 1977.

Wilson, P., G.F. Fairchild, L.S. Willett and B. Erven. "Engaging Learners in Economic and Management Education: A Challenge to Our Profession." Teaching and Learning Paper TLP 99-2, Food and Resource Economics Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, December, 1999.