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An Integrative Model of Team Learning. Evidence from Corporate Strategy' Students

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Abstract: *The aim of our research is to evaluate simultaneously the working of groups that facilitate group learning and, finally, the accumulation of knowledge using the theoretical basis of team mental models.*

Introduction

The teams/groups[1] constitute a relevant ontological level in organizational learning. For some practices or activities in organizations, group's working is unavoidable and must be done in a way that helps to group learning and global performance (Walsh, 1995; Anand et al. 1998). Our objective in this paper is to evaluate group practices that theory predicts to be beneficial to improve group learning. The paper is presented as follows: First, we present the foundations of group learning, our model and hypothesis. Second, we describe the methodology –sample, variables, empirical model and econometric methods-. Next, we present our results and finally, we explain the main conclusions, implications and limitations of our research.

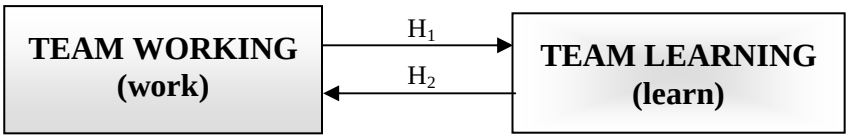
Theoretical framework

The learning group' analysis arouses an important interest among researchers. Group learning implies sharing individual interpretations to get a global comprehension (Bontis et al., 2002). The group is at the heart of knowledge generation because it eliminates the limitations of the individual level, facilitating the integration of individual knowledge and the generation of a stock of knowledge within the group increasing its effectiveness (Walsh, 1995; Anand et al. 1998). For some courses taken at the University –Corporate Strategy as an example– to work and learn in groups is specially important. We base our research in the literature on mental models (Mohammed and Dumville, 2001) among which we focus on transactive memory (Hollingshead, 2000), cognitive consensus (Brehmer, 1976; Walsh et al., 1988; Bettenhansen, 1991), group learning (Argote et al., 1995; Edmonson, 2002) and information sharing (Kraut et al., 2002). Following this line of thought, we consider the role recognized to groups in the learning literature and we construct our model of group learning as presented in Figure 1.

The first group of hypothesis (H_1) relate team working with team learning (De Venney-Tiernan et al., 1994; Hollingshead, 2000). Using the conceptual arguments of team mental models, we hypothesis: *the larger use of informational sharing systems produces higher team learning* –H_{1a}– (Kraut et al., 2002), *the larger use of transactive memory systems produces higher team learning* –H_{1b}– (De Venney-Tiernan et al., 1994), *the larger use of consensus in the decision process produces higher team learning* –H_{1c}– (Brehmer, 1976; Bettenhaunsen, 1991; Walsh et al., 1988), and *greater psychological safety in the decision process produces higher team learning* –H_{1d}– (Edmondson, 1999).

[1] We take into account the dichotomy between the term group and team. 'Group' is used to characterize individuals who realize ambiguous tasks in uncertain environments, they do not have specific roles and interact without explicit rules. 'Team' refers to individuals with very structured tasks, their roles are completely specified and their interactions too (Mohammed and Dumville, 2002). In this paper, we will use both terms alternatively but with the meaning of 'group'.

Figure 1. Team learning model



The second group of hypothesis (H_2) relate team learning with team working and refers to the feedback process that integrate group learning to improve team practices (Hedlund and Nonaka, 1993; Nonaka and Takeuchi, 1995). Then, we hypothesis: *team learning improves team working in terms of informational sharing (*H_{2a}*), transactive memory systems (*H_{2b}*), consensus (*H_{2c}*), and psychological safety (*H_{2d}*).*

Methodology

The methodology includes first, the research design of the experiments, the variables and the sample and then, the econometric techniques and the empirical model..

Research Design, Variables and Sample

We tried to achieve the purpose of our research by conducting an experiment with students within a course in which it is unavoidable to work in groups in order to learn (Edmonson, 1999; Espinosa et al., 2002). In particular, we developed the empirical part of the analysis and examined the hypotheses in the context of a realistic business simulation called the *Business Strategy Game 6.0.* (Thompson and Stappenbeck, 1999). Teams of four, five and six fifth-year business students of the 2004/2005 academic year of Business Administration in the University of Valladolid (Spain) who were enrolled in the Corporate Strategy course (in the last year of the business studies) competed with each other running athletic footwear companies over a five-week period. The students had to act as senior managers of a consumer product company and take decisions regarding the nature, production, distribution and financing of their products –athletic footwear–.

Before the first decision and after each of the rest of the decisions, the students were asked to fulfill a questionnaire in which they have to give information about the team working. This information was used to evaluate the team practices (using the mental model literature). Other than this information, we used the results of the decisions made by each company in order to measure the level of learning of each group. In particular, we used the company's performance index facilitated by the simulator, this is an algorithm based on six performance measures: sales revenues, earnings per share, return on investment, market capitalization, the company's bond rating and the company's strategy rating.

The sample were 167 students with age from twenty two to twenty eight years old and half of which were women, we had 44 groups competing in eight industries.

Econometric Techniques and Empirical Model

The method used is that of simultaneous equations . In view of the nature of the relationships among variables –team working and team learning–, we consider that this is the method that better fits to our analysis. The method of simultaneous equations is suitable when endogenous variables appear in the different equations of the model, so that, if these equations are measured

separately, we could not account for the influence each one of them exercises on the others. For the overall model, we use as instrument variables: age (*AGE*), sex (*SEX*) and previous individual knowledge (*STOCK*) and also, the interaction between team working characteristics is also an important factor for group learning (Walsh et al., 1988; West, 1990Kraut et al., 2002). Equations accounting for the dyadic dependence on which the model is developed, are theoretically formulated as follows:

$$learn_{ti} = f\,(work_{(t-1)i},\ instrument_{(t-1)i}) \qquad \textit{(equation 1)}$$

$$work_{ti} = f\,(learn_{ti},\ instrument_{ti}) \qquad \textit{(equation 2)}$$

where, $t= 1$ to 5 and $i=1$ to 44.

Results

We present the result of the research in two stages, first, the results of the factor analysis conducted to create the team working dependent variables and second, the results of the simultaneous equation analysis.

Construction of Team Working Variables

The team working (work) are measured using the information from the questionnaires we passed to our students in each of the five periods. Based on previous research, we develop fifteen questions to measure the variables of the four theories we use to build our hypothesis. After the process of calculating the mean values for each question/variable in the 44 groups and the five periods, we transform those variables in four factors using the principal components methodology (Table 1).

We confirm the suitableness of performing factor analyses with the data obtained in the questionnaire. For each one of the team working characteristics we perform the Bartlett's test of sphericity –that allows us to reject the hypothesis that the correlation matrix is an identity matrix–, and the Kaiser-Meyer-Olkin measure of sampling adequacy, obtaining in all cases values superior to 0.5, which is considered the minimum acceptable value. The results of these measures allow us to conclude that the factorial analysis is pertinent for the information to be analyzed.

Table 1. Matrix of components of the factorial analysis (principal components)

COMPOSITION OF THE MATRIX OF COMPONENTS (CORRELATIONS)							
INFORMATION SHARING (ISH)		COGNITIVE CONSENSUS (CCN)		TRANSACTIVE MEMORY (TMM)		PSYCHOLOGICAL SAFETY (PSL)	
ISH 1 (Q.1)	0.673	CCN 1 (Q.5)	0.902	TMM 1 (Q.9)	0.713	PSL 1 (Q.13)	0.684
ISH 2 (Q.2)	0.792	CCN 2 (Q.6)	0.925	TMM 2 (Q.10)	0.763	PSL 2 (Q.14)	0.715
ISH 3 (Q.3)	0.529	CCN 3 (Q.7)	0.930	TMM 3 (Q.11)	0.620	PSL 3 (Q.15)	0.745
ISH 4 (Q.4)	0.248	CCN 4 (Q.8)	0.556	TMM 4 (Q.12)	0.797		

For the first of team working characteristics, 'information sharing' (ISH), we performed a factor analysis on the variables 1 to 4 in the questionnaire, corresponding to the questions related with this theory and with the capacity of the members of the team to share information in each period of the game.

By applying the latent root criterion, the factorial analysis shows the existence of one component that accounts for 56.062% of the variance from the original data. Since this factor presents great factorial loadings in all the variables –except for the last one–, and considering it

presents an eigenvalue of 2.242, it will be the value we will use as a suitable summary of the information with respect to the variable 'information sharing'.

The information for the second independent variable, 'cognitive consensus' (CCN), corresponds with questions 5 to 8, regarding the specific methods that groups use to make decisions. We obtained one factor with an eigenvalue of 2.841 and stands for 71.021% of the variance from original data. The third factor concerns the 'transactive memory' (TMM) and take into account the questions from 9 to 12 in the Annex. For this theory, we obtain an eigenvalue of 1.790, standing for 44.752% of the variance from original data. Finally, the 'psychological safety' (PSL) is measured using the questions from 13 to 15 (see annex). The theory of the group learning is resumed in a factor with an eigenvalue of 1.820, standing for 30.333% of the variance from original data.

Results of the Simultaneous Equation Analysis

Due to the quadruple nature of team working (four factors derived from previous analysis), we estimate four simultaneous equations analysis. For each of the four models, we proceed to estimate separately each of the two equations (equation 1 and equation 2), what allowed to verify the dependence between endogenous variables as well as their relationship with exogenous variables, besides confirming the endogeneity of the variables under analysis through the Hausman test. In each joint model, in all specified equations there are more exogenous excluded that endogenous variables included, for what the order condition is fulfilled. The range condition is also verified, for what we can perform a joint measurement of the system through the different methods applicable to simultaneous equations. More specifically, we proceed to performed the estimate through the least square method in two stages. This method uses a limited information approach that estimates each equation separately, accounting for all the variables in the model, the variables that are included in the equation and those that are excluded, though not the particular specification of the other equations. The results obtained after the two-stage least squares (2SLS) estimation of the eight equations confirm the results obtained through each simple regression model.

The results indicate the robustness of four models (Table 2). All team working characteristics affect team learning and *vice versa*, team learning influences changes in team working. In particular, groups that use the best practices to work –members share information frequently, write briefings and reports and feel psychologically safe– learn the most. The only team practice that seems to damage learning is the cognitive consensus among members (negatively related to learn).

Other than team working effects on learning and the simultaneous lagged influence of accumulated learning on performing team working, we observe a positive relationship between male working teams and better learning, also male working teams and better team working characteristics. Also younger groups are better learners and know better how to work in groups. Finally, we would want to know the interaction effects among team working practices and we introduce these variables as instruments. The results is that interactions among good team practices make groups to have higher learning and better global team working characteristics – exception for TMM_2 (model 1, eq.1), PSL_1 (model 2, eq.1 and model 4, eq.2) –. The results for stocks are not conclusive.

Table 2. Simultaneous models

Dependent variables	MODEL 1 (Eq. 1) ISH → learn		MODEL 2 (Eq. 1) CCN → learn		MODEL 3 (Eq. 1) TMM → learn		MODEL 4 (Eq. 1) PSL → learn	
C	-0.107	[-0.92]	-0.204	[-0.16]	-4.709	[-7.22]***	-8.782	[-7.56]***
Learn	-0.290	[-2.32]***	0.294	[2.03]*	0.307	[2.46]**	0.261	[1.94]*
Age	-0.122	[-3.33]***					0.141	[3.69]***
Sex			-0.118	[-2.87]**				
$Stock_1$			0.287	[2.67]**				
$Stock_2$	-0.166	[-3.22]***	0.157	[2.44]**	-0.299	[-1.75]*		
ISH_1					0.204	[2.79]**	0.089	[5.17]***
ISH_2					0.510	[6.50]***		
CCN_2							0.519	[2.64]*
CCN_3							0.173	[3.98]***
TMM_1	0.145	[1.75]						
TMM_2	-0.231	[-2.99]**						
TMM_5							0.350	[1.20]
PSL_1	0.612	[7.20]***	-0.151	[-1.53]				
PSL_2	0.424	[4.87]***	0.236	[2.45]**	0.414	[5.20]***		
N	173		176		172		171	
R^2	0.480		0.467		0.552		0.552	
Dependent variables	MODEL 1 (Eq. 2) ISH → learn		MODEL 2 (Eq. 2) CCN → learn		MODEL 3 (Eq. 2) TMM → learn		MODEL 4 (Eq. 2) PSL → learn	
C	4.182	[10.30]***	4.316	[7.17]***	3.926	[9.79]***	5.084	[14.9]***
ISH/CCN/TMM/PSL	0.073	[2.11]*	-0.151	[-4.06]***	0.080	[2.32]*	0.089	[2.41]*
Age	-0.385	[-3.57]***	-0.063	[-2.78]**				
Sex			-0.449	[-4.01]***	-0.310	[-3.00]**	-0.397	[-3.91]***
$Stock_1$	-0.130	[-2.38]*	-0.114	[-2.28]*	-0.119	[-2.39]*	-0.108	[-2.09]*
$Stock_2$	0.064	[2.18]*	0.091	[3.16]***	0.066	[2.39]*		
CCN_1	-0.120	[-2.51]*						
CCN_2					-0.131	[-2.76]**		
TMM_3			0.094	[2.31]*				
TMM_4			0.217	[4.35]***	0.068	[1.99]	0.065	[1.82]
PSL_1	0.156	[3.19]**			0.164	[3.52]***	-0.103	[-1.98]*
N	173		176		172		171	
R^2	0.202		0.259		0.244		0.177	

Implications for adult education

In some graduate courses, individual learning is conditioned to initial characteristics of the team. In those cases, group learning can be improved taking into account the conclusions of this research. In particular, a professor/mentor has to create mechanisms that facilitate sharing information among members of the group, to suggest a process of taking decisions step by step, to promote tolerance and diversity among the members of the group.

Another implication of our research is related to the fact that helping groups to use good team working from the beginning implies an early learning that will have consequences for subsequent learning. Finally, we think that the initial knowledge of individual members is important but not determinant for group learning if the group use the adequate group practices. Then, insufficient knowledge of the group's members at the beginning will not impede the group to learn in the future.

References

Anand, V., Manz, C.C. and Glick, W.H. (1998): "An Organizational Memory Approach to Information Management". *Academy of Management Review*, 23(4), 796-809.

Argote L, Insko CA, Yovetich N, and Romero AA. (1995): "Group learning curves: The effects of turnover and task complexity on group performance". J*ournal of Applied Social Psychology*, 25, 512-529.

Bettenhausen KL. (1991): "Five years of groups research: what we have learned and what needs to be addressed". *Journal of Management*, 17, 345-381.

Bontis, N., Crossan, M. y Hulland, J. (2002): "Managing an Organizational Learning System by Aligning Stocks and Flows". *Journal of Management Studies*, 39(4), 437-470.

Brehmer B. (1976): "Social judgment theory and the analysis of interpersonal conflict". Psychological Bulletin, 83, 985-1003.

De Venney-Tiernan, M., Goldband, A., Rackham, L., and Reilly, N. (1994): "Creating collaborative relationships in a co-operative inquiry group". In P. Reason (Ed.), *Participation in Human Inquiry* (pp. 120-137). Thousand Oaks, CA: Sage.

Edmonson, A. (1999): "Psychological safety and learning behaviour in work teams". *Administrative Science Quarterly*, 44, 350-383.

Edmonson, A. (2002). "The local and variegated nature of learning in organizations: a group level perspective". *Organization Science*, 13(2), 128-146.

Espinosa, J.; R.E. Kraut, S.A. Slaughter , J.F. Lerch, J.D. Herbsleb and A. Mockus (2002). "The Effect of Shared Mental Models and Knowledge Distribution on Asynchronous Team Coordination and Performance: Empirical Evidence from Management Teams", *International Conference for Information Systems*, Barcelona, Spain.

Hedlund, G. y Nonaka, I. (1993): "Models of knowledge management in the West and Japan", n.5, pp. 117-144. In Lorange, P., Chakravarthy, J.R., y Van de Ven, A.(eds.): *Implementing strategic processes: Change, learning and co-operation*, Basil Blackwell, Oxford.

Hollingshead, A. B. (2000): "Perceptions of expertise and transactive memory in work relationships". *Group Processes and Intergroup Relations*, 3 (3), 257-267.

Kraut, R. E., Fussell, S. R., Lerch, F. J., and Espinosa, A. (2002): *Coordination in teams: Evidence from a simulated management game*. Unpublished manuscript.

Mohammed, S., and Dumville, B. C. (2001): "Team mental models in a team knowledge framework: Expanding theory and measurement across disciplinary boundaries". *Journal of Organizational Behavior*. Special Issue: Shared cognition, 22 (Special Issue), 89-106.

Nonaka, I. and Takeuchi, H. (1995): *The knowledge Creating company*. Oxford University Press. New York.

Thompson and Stappenbeck (1999): *The Business Strategic Game. 6th edition*, Ed. Irwin McGraw Hill.

Walsh, J. P., Henderson, C. M., and Deighton, J. (1988): "Negotiated belief structure and decision performance: An empirical investigation". *Organizational Behaviour and Human Decision Processes*, 42, 194-216.

Walsh, J.P. (1995): "Managerial and Organizational Cognition: Notes from a Trip Down Memory Lane". *Organizational Science*, 6(3), 280-321.

West, M. A. (1990): "The social psychology of innovation in groups". In M. A. West, J. L. Farr, et al. (Eds.), *Innovation and creativity at work: Psychological and organizational strategies* (pp. 309-333). Chichester, England UK: John Wiley and Sons.