Simulation games, a learning tool

Ricardo Zamora Enciso

ABSTRACT[1]

Since Peter Senge wrote "The Fifth Dimension" in 1990 and helped spread word of the system concept, its application in social systems has grown and become increasingly clear and evident. In a world of growing complexity, under constant change and more highly interrelated as every day passes, a partial, simple or undisciplined approach to understanding and managing it would be impossible. As long ago as in 1961, MIT professor Jay W. Forrester introduced the concept of systems dynamics applied to modelling. Computer tools developed since then have facilitated the creation of these causal models

New training disciplines based on Gaming and Simulation are able to take advantage dramatically of the creation of explicative models (System Dynamics). These are based on systemic conceptions of social and economic reality (Systems Thinking), fully exploiting the power of new technologies to develop simulators (Business Simulators) capable of being used in higher education dynamics in universities as well as in other organizations, such as businesses. The result is a form of living learning which, combining cognition and emotion, allows the participant to understand and integrate dynamic and complex contexts.

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INTRODUCTION

Various factors are contributing to the increased complexity of the environment in which we live. In the first place, globalisation processes are leading to plans involving key elements that affect our operational capabilities, and which go beyond our immediate and easily controllable environment. Secondly, Information Technologies are improving accessibility and communication between the different economic agents, contributing to an increase in the speed of action and reaction.

These processes have an ever greater specific weight, favouring the interrelation and interconnection of economic factors and agents. The difficulty in predicting their behaviour and the depth of their impact generates enormous uncertainty in the business environments of all organizations.

Organizations that work in circumstances of fast, deep changes need to possess a high capacity for internal change. This requires skill and flexibility in being able to make continual internal adjustments to the organization, adapting it to the external conditions of the time (Brandenburger & Nalebuff, 1995).

As far as people are concerned, considered in isolation we have an insufficient capacity of understanding to be able to act in this global and complex world. We must count on teams that are sufficiently skilled, committed and self-organized to react quickly at a local level, within a global strategy. Strategic positioning in turbulent conditions requires, first and foremost, a team which is free of prejudice, with a positive attitude towards change based on commitment (Chan Kim & Maugborne, 1997)

With regard to the future, the ability to learn dynamically is becoming more and more important, at both individual and organizational levels, with a view to being able to apply the necessary changes which will facilitate adaptation to the environment. There is a need for instruments capable of reflecting highly interrelated, real, complex systems in a way that is easy to understand, and of enabling the rapid integration of information. This knowledge, integrated by self-organized groups, will permit fast, adaptive reactions.

New disciplines based on games and simulation are now capable of permitting this learning, through a living experience which facilitates the understanding and integration of complex systems. Furthermore, increasing use of computers in model representation allows the participant to concentrate on handling the concepts, relegating calculations and mechanical operations to the simulator.

In this article we shall see how experiential learning, made possible through gaming/simulation, encourages the necessary change of mental organization with regard to learning and the organization's evolution. This, together with the power of the simulators, converts gaming/simulation into a unique tool for the understanding of systemic, complex and dynamic realities.

AN INCREASINGLY COMPLEX ENVIRONMENT

We define *system* as a set of interrelated and interdependent elements. We define *systemic thinking* as the discipline that allows us to visualize these interrelationships. Systemic thinking offers a holistic perspective, because systems are qualitatively different to the sum of their parts (Kriz, 1998). The systems possess characteristics which their individual parts lack; systemic thinking attempts to understand these properties on the basis of the system parts and their interactions.

During the conference that he held at the University of Seville on 15 December 1998, Professor Jay W. Forrester defined *systems dynamics* very simply when he said, “For the last 30 years I’ve been developing a field known as systems dynamics. Systems dynamics combine theory, method and philosophy to analyse the behaviour of systems. Systems dynamics use concepts from the field of control feedback to organize information in a computer simulation model…, the resulting simulation reveals behaviour implications of the system represented by the model.”

Three concepts are thus basic to understanding systems dynamics; the concept of the system itself, the model concept, and the computer simulation concept.

We define a complex system as one which requires a great deal of information to be able to be described. Complex systems present a form of behaviour which may, in many cases, be exactly the opposite of what might intuitively be expected. Forrester calls this behaviour “counter-intuitive”. The intuition that presides over systems analysis is the result of the analysis of simple systems, therefore the conclusions reached from the application to complex systems of this intuition may lead to results which are completely contrary to those that appear in reality (Rodríguez Valiente, 2000).

When we are faced with a complex environment, it may prove useful to consider a simple yet powerful diagram developed by Bob Armstrong. This diagram consists of four quadrants, using four constant concepts:

- Rational /Intuitive
- Calibrated /Non-calibrated (Quantitative /Qualitative)
- Few variables /Many variables
- One decider /Many deciders

Obviously, all social agents would like to work in Quadrant 1, though they would normally be situated in Quadrants II and III. The greater the degree of environmental complexity and the number of interrelationships, the closer we get to Quadrant IV, where it will no longer be possible to apply simple or lineal policies, or policies centred in the individual management of elements. Greater significance will be awarded to the concepts which govern the system, to “the weak signals” being interpreted as indicators and to the handling of the relationships themselves.

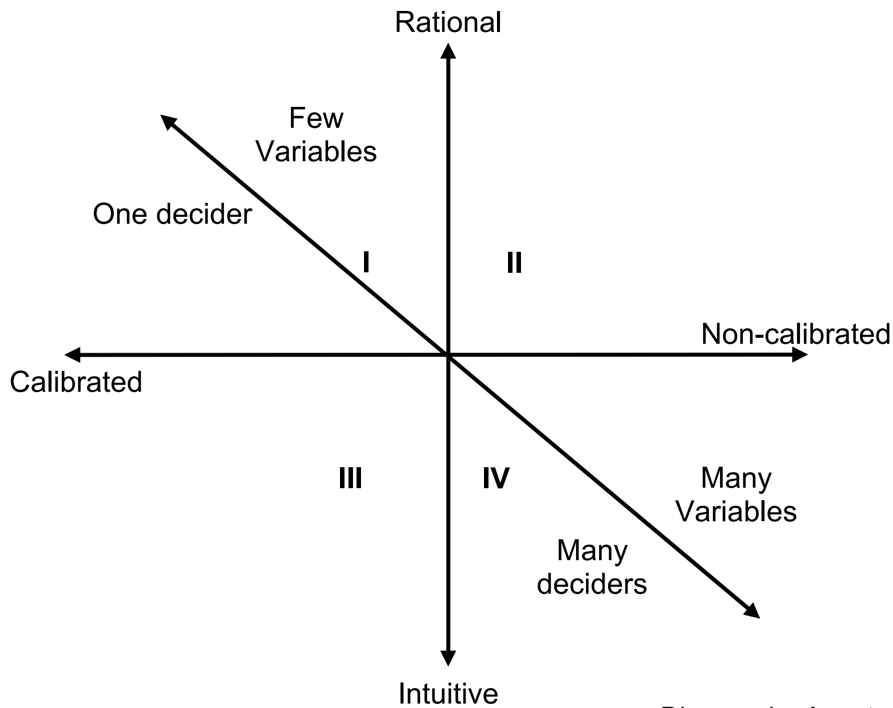
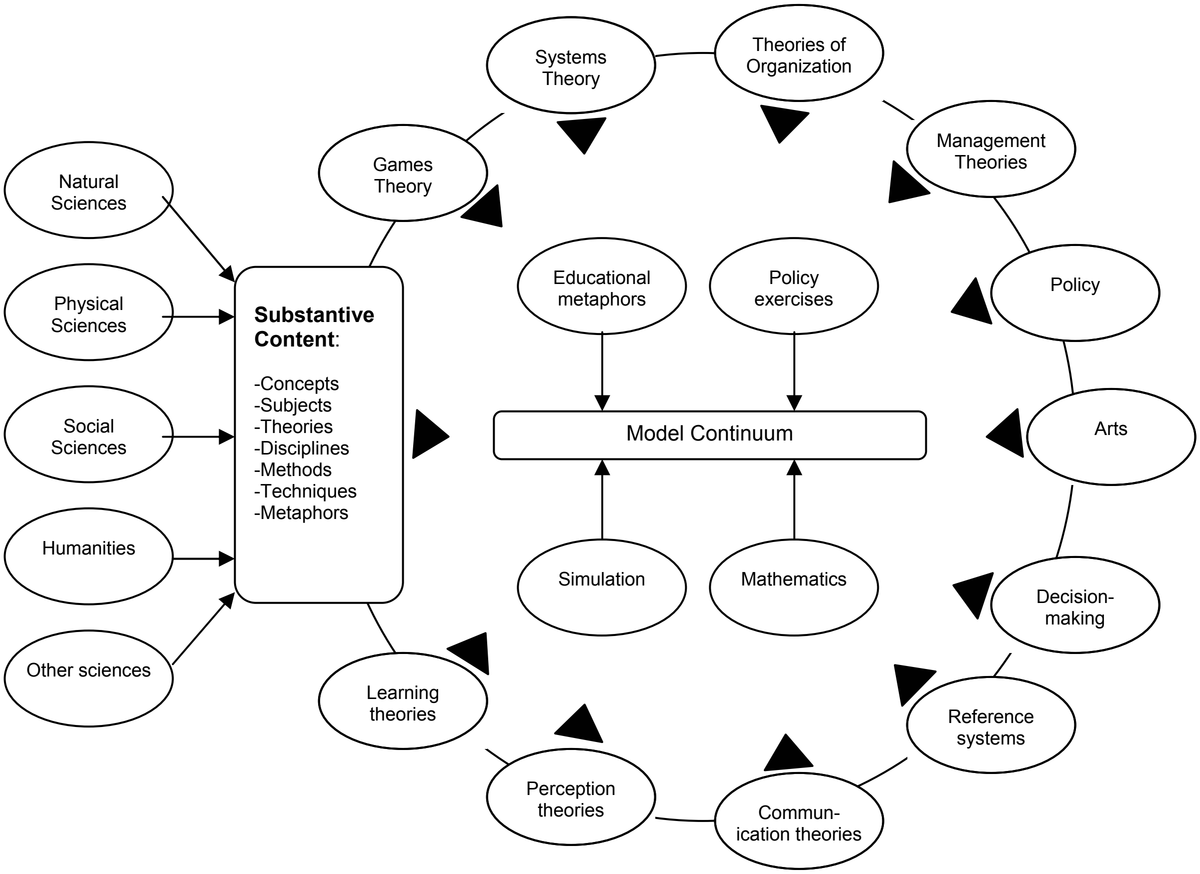


Diagram by Armstrong/Hobson

UNDERSTANDING THE COMPLEX ENVIRONMENT

The concept of gaming/simulations embodies knowledge garnered from various scientific disciplines and attempts to make these complex realities understandable. Games and simulation help us understand complex dynamic contexts and, thus, are ideal in learning to acquire systemic skills. The gaming/simulation permits the breaking of rigid, rigorously hierarchical social forms of organization, by forming groups who are responsible for themselves; it permits the development of flexibility, dialogue and creativity, emphasizing personal initiative, encouraging group self-organization and models of communication based on systems competence. (Kriz & Rizzi, 1998)



Paradigm from "The Gaming Discipline…" (Duke, R., 1998)

Throughout history, many have been the studies which have demonstrated the suitability of the discipline of gaming/simulators in the understanding of systems. In his Doctorate thesis research, Willy Kriz analysed 125 people, using a series of trials destined to reveal their knowledge, personality, interests, styles of interaction and so on. A few months earlier, some of these people had participated in a program imparting training in systems competence, which was based on simulation and games. The difference between the two groups consisted in that this latter group confronted risk and doubtful situations better, encouraged a more sustainable use of resources, created more communications structures and more efficient work groups. They were more interested in the development of their own group and of co-operation relationships between its members, proposing discussion, a definition of roles and a more detailed distribution of the workload and, finally, they came up with solutions to improve the process as a whole.

GAMING / SIMULATION

Simulation is popularly defined as a partial representation of reality which selects crucial characteristics of a real situation and makes a replica of them, within an environment or place which is basically free of risk. (Saunders & Powell, 1998)

Here, we define gaming/simulations as an activity that works, fully or partially, on the basis of the players' decisions. The simulation is an operational model which involves abstraction, and the representation of a much larger system.

Thus, we distinguish between simulation as an exercise in representation and gaming/simulation as a human, relational activity which uses said simulation as an instrument. This subtle difference is of special relevance inasmuch as the gaming/simulations create a new, shared, mental model.

Three essential components may be identified when describing gaming/simulations:

1) a basic operating model
2) human activity
3) a scale representation of reality. In contrast to pure games, which have no representation, and to pure simulation, which has no human activity in the operating model.

Fruit of this human activity is the exchange and modification of individuals' mental models, with respect to which Professors Tomoaki Tsuchiya and Shigehisa Tsuchiya ask:

How can games or simulation change the mental models that guide us, and create a shared mental model which goes beyond the different values, interests and vision of the world of its participants? The reasons are the following:

Voluntary Learning

When forced to learn, we learn little, as we usually resist accepting anything new in the governing mental models. The fun elements of simulation and games encourage us to participate in an experiential learning environment in a simulated world, and to learn voluntarily.

Creation of Turmoil

As Festinger points out (1957), the first step in the process of changing attitudes, beliefs and suppositions is to allow participants to doubt the validity of the mental models that guide them. The conflict and turmoil created by gaming/simulation raises the doubts in their minds and lessens their resistance to change.

The Big Picture

The schematic approach allows participants to share a holistic view of the matter. This counteracts the narrow perspectives derived from specialization and provides a model for retaining details. Once the whole is understood, the participants' individual mental models grow. Consequently, compatibility between their mental models increases and the creation of shared mental models becomes possible.

Compression

Compression of time and space makes experiential learning possible and accelerates the learning process. Gaming/simulation enables participants to experience the outcomes of their decisions and actions within a short space of time. In the real world we have only little opportunity to learn from our experience, mainly because the results of our decisions and actions often lie beyond our learning horizons. In addition, accelerated learning processes provide a more solid acquisition of knowledge. Individuals are often unaware that there is a problem and that it can only be solved by altering the mental models that control us. Once we discover this miss-match however, our mental models are affected and altered, though the change may be imperceptibly small. Gaming/simulation allow the participants to experience numerous cycles and thus to accumulate these small changes until they become visible, resulting in a stronger, double-loop, learning process.

Risk-free Environment

Gaming/simulation lets the participants experiment with new policies, strategies and learning skills, without risk. Actions that in the real world are irreversible or have no turning back can be carried out countless times. Thus the risk-free environment provided by the gaming/simulation broadens the range of experiences that make sense to the participants.

Shared Experience

Participants' individual mental models converge through shared experience and as a result of this, commensurability is increased, something essential for the creation of a shared mental model.

Rich Interpretation of History

Our understanding of past experience, or "history", through gaming/simulation allows us to learn from small episodes in the real world. These small pieces of experience are used to construct a theory of history from which a variety of additional scenarios are generated which, though not carried through, are nonetheless possible. The rich interpretation of history facilitates experiential learning.

Cause Maps

Uncertainty and ambiguity in the real world pose obstacles to our experiential learning, because they make it difficult to find meanings or invent explanations. The cause maps, developed through participation in their design and use in a gaming/simulation situation help participants to interpret and make sense of their lives.

(Tsuchiya, S & Tsuchiya, T 1999)

WIDENING MENTAL SCHEMATICS TO LEARN

Polanyi (1996) classified human knowledge into two categories: tacit and explicit. Tacit knowledge is that which is difficult to express with any type of language. Explicit knowledge refers to knowledge that may be expressed through words, drawings or any other mechanism of articulation. While tacit knowledge may be possessed as it is, explicit knowledge has to rely on being understood and applied tacitly. In any case, all knowledge is either tacit in itself, or is based on knowledge that is tacit. And this can only be indirectly expressed and transferred by means of metaphor. Just as Michael Polanyi emphasises, we often express ourselves and transfer our knowledge only indirectly, by means of metaphorical explanations.

The original source of organizational knowledge lies in the tacit knowledge of its individual members. However, organizational knowledge is not simply an accumulation of individual knowledge. Individual members' knowledge needs to be shared and legitimated before it becomes organizational knowledge. (Tsuchiya, 1993)

The only way to reform interpretive environments is by creating new knowledge, free of the restrictions of existing knowledge, then carrying out new actions and decisions based on that new knowledge, and interpreting the results (Tsuchiya, 1996).

By means of games and simulation, members of organizations can generate metaphors using words, data, graphs and images. These metaphors make it possible to create knowledge which is free of the restrictions imposed by existing interpretive models. This new knowledge changes the members' decisions and actions and, through interpretation of the results of the new actions and decisions, they develop new interpretive environments.

These new interpretive environments possess the advantage of having been generated by the participants themselves, through a natural, fluid process, so they are automatically integrated and legitimated as valid. Gaming/simulation permits the legitimisation of knowledge by providing it with the necessary processes, legitimacy often depending more on the adequacy of the processes than on the results (March & Oldsen, 1976). At the same time gaming/simulation allows for the creation of new cause maps. A cause map is a summary of the suppositions that people make about a certain structure (Weick, 1979). With the cause map, the new interpretive environment acquires rationality and foundation, thereby consolidating its validation.

Modification of mental models has special relevance for learning, as it permits what is known as Level 2, or double loop learning, in contrast to the technical learning of Level 1, or single loop. In the latter, what we do varies on the basis of analysis of the results of our previous actions. We modify our ways, working the content within our schematic, reinforcing the governing mental model. In Level 2 however, it is the very way of thinking, the way we actually do things, which is changed.

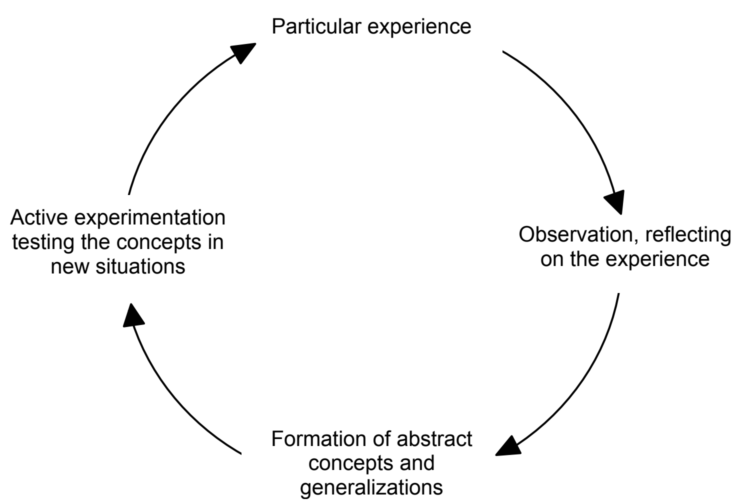
In order for the organization to be capable of evolving and learning, it becomes necessary to incorporate these new mental models that will enable it to experiment and go beyond its existing limits.

If an organization should starve or suffocate some types of mental structures, these will probably undergo some form of modification, or remain in the shade. In a company, the longest-serving supervisors and employees show newcomers what to do and what not to do, and how to proceed. This is called "socialization". New employees may, in some cases, be indoctrinated with company philosophy, any deviation from which could result in their not being promoted, or not assigned an interesting job, which is known as “marginalization”. Or they could be ignored and excluded, which is “ostracism”. (Maruyama, 1998)

EXPERIENTIAL LEARNING

The concept of learning may be defined as an adaptive change to inputs from the environment (Witteman, 1997: 6). In the Theory of Education it is cognitive learning that receives most attention. Cognitive learning means the interpretation and processing of information. It's about making sense of things, which means choosing, interpreting and situating information. It is a process by which individuals develop cognitive maps of their environment. It makes sense of the environment by recognising the events which do not fit in with the individual's own experience, then absorbing and codifying them, taking the reference framework as the basis from which to work. Making sense of something is a self-referential activity, which implies that the selection of what makes sense or not is based on the actor's own framework of choice (Cisca Joldersma, 2000).

Experiential learning is based on the assumption that knowledge is created through the transformation brought about by experience. The particular experience is translated into an abstract conceptualisation which is actively tested through new experiences. Kolb's cycle of experiential learning ((Kolb, 1984) perfects the work of other authors following the same line, such as Lewin (1951), Dewey (1938) and Piaget (1978). It is centred on the idea that experiential learning exists as a special form of learning, distinguished by the central role that experience plays in the learning process.



Kolb's Cycle of experiential learning

Organizational learning

Individuals are the origin of all organizational learning. It is the thoughts and actions of the actors that influence learning at the level of the organization. Individual actors all have their own theory-in-use, which is implicit in the results of the actors' behaviour patterns. On interacting, the actors exchange their theories-in-use, creating the organizational theory-in-use. Shared behaviour cycles are created, involving negotiation and agreement on the significance different situations may have for the organization (Weick, 1979).

CONCLUSION

Systems Theory may explain reality, and Systems Dynamics represent it conceptually and instrumentally through models and simulators. It is the game and the simulation, however, that are responsible for involving the individual and facilitating understanding and learning through the change of mental models, thereby permitting real-life learning.

REFERENCES

Branderburger, A.M. & Nalebuff, B.J. (1995). *The right game: Use game theory to shape strategy*. Harvard Business Review, 73, 4.

Burgess, T (1998), *A case study in the diffusion of an educational process innovation: Computerised business gaming* in Simulation & Gaming Yearbook: Simulations and Games for Emergency and Crisis Management, 6 pp.110

Chan Kim, W. & Mauborgne, R. (1997). *Fair Process: Managing in the knowledge economy*. Harvard Business Review, 75, 4

Cisca Joldersma, (2000), *Policy learning through simulation/gaming*, in Simulation & Gaming Yearbook: Simulations and Games for Transition and Change, 6 pp.79-80

Crookall, D, Martin, A, Saunders, D and Coote, A (1986) *"Human and computer involvement in simulation"; in Social Science* in Microcomputer Review, 4, 2, 149-164

Dewey, J (1938) *Experience and education*, Kappa Delta, New York

Duke, R. (1998) *The Gaming Discipline as perceived by the Policy and Organization Sciences*. Gaming/Simulation: for policy development and Organizational Change. Tilburg University Press, pp.21-27

Festinger, L (1957) *A theory of cognitive dissonance*, Stanford University Press Stanford

Greenblat, CS (1989) *Extending the range of experience, in Communication and Simulation: From two fields to one theme*, ed. Crookall and D Saunders, pp 269-283, Multilingual Matters, Clevendon, UK

Kolb, D (1984) *Experiential Learning: Experience as the source of learning and development*, Prentice Hall, New Jersey

Kriz, W (1998), *Training of systems Competence with Gaming/Simulation* in Gaming/Simulation: for policy development and Organizational Change. Tilburg University Press, ch. 39

Kriz, W. & Rizzi, P. (1998) *Simulación y juego para el desarrollo de los Recursos Humanos*. Los Juegos de Simulación: Una Herramienta para la Formación. 25, 131-137

Lewin, K (1951) Field Theory in Social Sciences, Harper & Row, New York

March, J.G.& Olsen, J.P. (1976). *Ambiguity and choice in Organizations*. Bergen: Universitetsforlaget.

Maruyama, M (1998), *Esquemas Mentales: Gestión en un medio multicultural*. España. Dolmen.

Rodriguez, P (2000), *Metodología Dinámica para el Análisis de Sistemas Sociales y Económicos*. www.cacit.com

Piaget, J (1978), *What is psychology*, American Psychologist, July, pp 648-52

Polanyi, M (1996) *The tacit Dimension*, Routledge and Kegan Paul, London

Saunders, D & Powell, T. (1998) *Developing a European media simulation trough new information and Communication technologies: the TENSAL project* in Simulation & Gaming Yearbook: Simulations and Games for Emergency and Crisis Management, 6 pp.75-80

Senge, P M (1990) *The Fifth Discipline*, Doubleday, New York, NY

Thatcher & Robinson, J (1985) *An introduction to Simulations and Games in Education*, Solent Simulations, Havant

Tsuchiya, S & Tsuchiya, T (1999) *The unique contribution of Gaming/simulation: towards establishment of the discipline*. The International Simulation & Gaming Research Book: Simulations and Games for Strategy and Policy Planning, 7, pp 46-57

Tsuchiya, S (1993). *Improving Knowledge Creation Ability through Organizational Learning*. IIIA, Proceedings of International Symposium on the Management of Industrial and Corporate Knowledge 93, 87-95.

Tsuchiya, S (1998) *Reengineering management, International Transactions in Operational Research*, 5 (4), pp 271-281.

Tsuchiya, S. (1994). *A Study of Organizational Knowledge*. IIIA. Proceedings of International Symposium on the Management of Industrial and Corporate Knowledge 94, 105-111.

Tsuchiya, S. (1996). *Simulation/gaming as a facilitator of Communication. A new role in the ambiguous business world*. Simulation and Gaming: An International Journal, 26, 1, 93-100.

Weick, K. E (1979) *The Social Psychology of Organising*, 2nd, Addison-Wesley, Reading, MA

Witteman, H P J (1997) *Styles of Learning and Regulation in an Interactive Learning Group System*, Nijgh & Van Ditmar

ABOUT THE AUTHOR

Ricardo Zamora Enciso holds a degree in Business Sciences and a Master in Company Management, awarded by ESADE (Escuela Superior de Administración y Dirección de Empresas) in Barcelona.

As General Director and the founding member of Training Games S.L. (www.traininggames.com) he is a training consultant and expert in the application of methodologies of training using games. He is an advisor to, and collaborator with institutions such as the Polytechnic University of Catalonia (UPC) and the ESADE (Escuela Superior de Administración y Dirección de Empresas).

He is the creator of games such as *Teaching Cards, Fork, The 5 Phases of the Sale,* and *Linker*, and simulators including *Salesmanship, Carterbanc,* and *Synergy* and has worked with and applied these games in companies such as Nestlé, Danone, Nabisco, Warner Welcome, HP, Alzo Nobel, BICC, General Cable, Unilever and Solvay, among others. He has also worked in the public sector, with institutions such as the Spanish Ministry of Work, the Generalitat of Catalonia and the Ajuntament (City Council) of Barcelona.

Through Training Games, he maintains and promotes an Internet portal aimed at becoming the Internet meeting point for all creators and users of games. Boasting a database of more than 350 games consultable on a world-wide level at www.games2learn.net this constitutes the most significant initiative in learning games for adults on business topics ever established.

He is a member of ISAGA (International Simulation and Gaming Association), NASAGA (North American Simulation and Gaming Association), ABSEL (Association for Business Simulation and Experiential Learning) and SAGSET (Society for the Advancement of Games and Simulations in Education and Training). He is also a member of the System Dynamics Society.