L2C: Designing Simulation-based Learning Experiences for Collaboration Competencies Development

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Abstract

Effective collaboration dynamics are at the core of learning, knowledge exchange and innovation processes. Nevertheless, in today's global environment, a large number of collaboration initiatives fail to deliver the value expected, as complexity is increased by the diversity and the distributed nature of the people, groups, and knowledge sources and by the knowledge integration processes involved. Effective collaboration competencies are hence emerging as a key condition for productive and sustainable value creation at the individual, team, organizational and inter-organizational level. L2C - Learning to Collaborate - is an ongoing research project addressing the design of effective immersive simulation-based learning experiences supporting the development of collaboration competencies both at the individual and organizational level. The key characteristic of such advanced learning tools consists in the integration of psychological, motivational, cognitive, organizational, cultural and technological factors affecting the success or failure of collaboration into the modeling of a set of virtual characters with whom learners can interact dynamically within a challenging and realistic collaboration scenario. This paper provides an overview of the conceptual basis, key design principles and expected pedagogical impact of this new type of immersive simulation-based learning experience.

Introduction

Effective collaboration dynamics are fundamental to learning, knowledge exchange and development/innovation processes in a wide variety of educational, economical or societal contexts. In spite of the attention that the subject of collaboration has attracted over the last few years in fields like management (Hansen and Nohria, 2004), organizational dynamics (Mayer et al., 1995; Orlikowski, 1992) and education (Pea, 1994), no traditional or computer-enhanced approaches and learning solutions have emerged to-date which address efficiently and effectively the development of collaboration competencies from an inter-disciplinary perspective, including:

- individual psychological and motivational factors determining knowledge seeking and behavior sharing of people involved in collaboration
- group, organizational and inter-organizational factors conducive or detrimental to collaborative behavior
- cognitive and behavioral mechanisms to support effective knowledge exchange processes in order to seek and integrate knowledge from diverse sources taking into consideration their contextual embeddedness
- opportunities and pitfalls of technologies aimed at supporting distributed collaboration
- pragmatic aspects resulting from the analysis of best/worst cases and experiences of collaboration patterns in different contexts (such as merger-like situations, joint ventures and initiatives by global teams of business or social entrepreneurs, alliances between educational or public sector organizations, global professional communities, or international research consortia)

In fact, in today's global environment, a very large number of collaboration initiatives fail to deliver the value expected (Shenkar and Yan, 2002; Miles and Snow, 1992; Labianca et al., 1998), as collaboration complexity is significantly increased through the diversity and the distributed nature of the people, groups, and knowledge sources, through Information and Communication Technologies (ICT) and e-Collaboration platforms involved to support such distributed processes.

The Collaboration Challenge

If, under the best conditions, collaboration can be successful in "traditional" settings in which people and organizations are either co-located (such as in centralized R&D centers) or distributed but involved in "simple/highly structured" collaboration processes (such as software developers operating within open source communities [Angehrn and Loebbecke, 2004]), we are reaching today a "Collaboration Frontier" (see Figure 1).

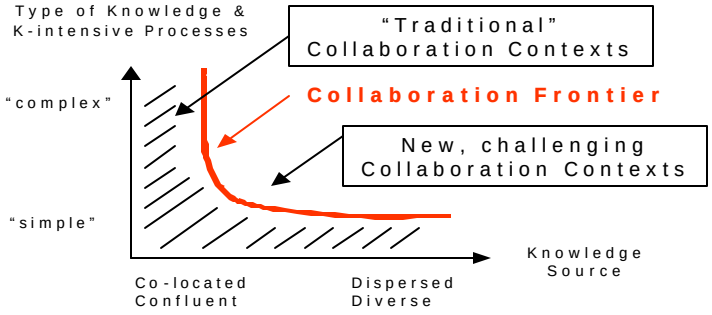

Figure 1. Collaboration and Knowledge Integration Frontier

Our ultimate objective, however, is to acquire the competencies to move beyond the current "Collaboration Frontier" into contexts in which highly distributed and diverse groups are able to successfully collaborate on complex types of knowledge exchange and knowledge creation processes. This emerging need is calling for innovative approaches to design and deploy effective learning experiences aimed at stimulating and facilitating the acquisition and continuous development of collaboration and collaboration management competencies.

It is with this objective in mind that the project "**L2C: Learning to Collaborate**" was launched as an EC co-sponsored R&D collaboration among several European academic institutions and industry partners.

The "L2C: Learning to Collaborate" Perspective

The ongoing work on the L2C Project is progressively aiming at the design of immersive simulation-based learning experiences supporting the development of collaboration competencies both at the individual and organizational level. The key characteristic of the project consists in the adoption of validated simulation design principles (*SmallWorld Simulations* or SWS [Angehrn, 2006]) underlying the development of learning experiences which are currently extensively used to develop the competencies of managers, engineers and decision-makers in top business schools (such as MIT, Stanford, etc.) in managing change and innovation in different types of organizational contexts [see e.g. Angehrn, 2005 and 2004a].

A concrete example of a learning experience which can be classified as a *SmallWorld Simulation* is the so-called 'EIS Simulation" (Manzoni and Angehrn 1997; Angehrn 2004/5) which has been widely adopted over the last few years to substitute or complement traditional ways of teaching change management competencies to engineering and management students, as well as to experienced executives. In this type of simulation, learners (operating typically in small teams) are projected into a realistic scenario in which they have to play the role of "change agents" sent into a company with the mission of introducing a major innovation (a new Information and Reporting System). Over a period of six simulated months their task is to get to know and convince more than 20 simulated characters (representing the top management of the simulated organization) to adopt the innovation by using different communication and intervention tactics to address their different forms of resistance to change, by understanding and leveraging the formal and informal/hidden social networks among the simulated characters, and by taking into consideration the specific culture of the targeted organization in which the innovation has to be introduced.

The EIS Simulation provides a concrete example, the effectiveness of which has been validated by thousands of user experiences in academic and corporate contexts, of how the know-how of a specific complex domain (in this case: change and innovation management in organizations) can be embedded in a dynamic, computer-based simulation to provide a rich, intensive, and realistic game-like learning experience considered superior to more traditional ways of teaching such a complex subject (Manzoni and Angehrn 1997).

Applied to the challenge of developing collaboration competencies, as described in the previous section, the design approach adopted for L2C Simulations consists mainly in integrating psychological, motivational, cognitive, organizational, cultural and technological factors affecting the success or failure of collaboration into the modeling of a set of virtual characters with whom learners can interact dynamically within a challenging and realistic collaboration scenario similar to the one outlined above.

Designing Simulation-based Learning Experiences for Collaboration Competencies Development: Underlying Models

The first step in designing SmallWorld Simulations addressing the development of collaboration competencies consists in the identification of relevant models emerging from either academic studies or empirical observations.

The design of the EIS Simulation is for instance based on a number of models related to innovation dynamics, individual patterns of resistance to change, and cultural factors, which have been embedded in the simulation engine in order to model the behavior of the simulated characters in a believable way and to reflect realistically the dynamics of a specific change scenario (see [Angehrn, 2004b] for more details, or [Angehrn et al. 2005] for a description of the models and dynamics underlying *EduChallenge*, a special version of the EIS Simulation in which users/learners are challenged with a change project taking place in a university environment, interacting with simulated characters representing deans, faculty members and university administration staff).

Analogously, the design of L2C Simulations is based on a number of models related to the theory and practice of collaboration, as well as on a number of pedagogical/learning factors which guarantee its pedagogical effectiveness: Stimulating and facilitating the acquisition and continuous development of collaboration competencies in managers and professionals operating in the educational, business or social areas.

Within the L2C Project, 6 domains have been identified from which to select conceptual and behavioral models (theories), relevant collaboration patterns (practice) and relevant knowledge gained through the deployment of traditional or advanced learning approaches which target the development of collaboration competencies (learning). These models, patterns and knowledge will be integrated and embedded in the simulation-based learning experiences.

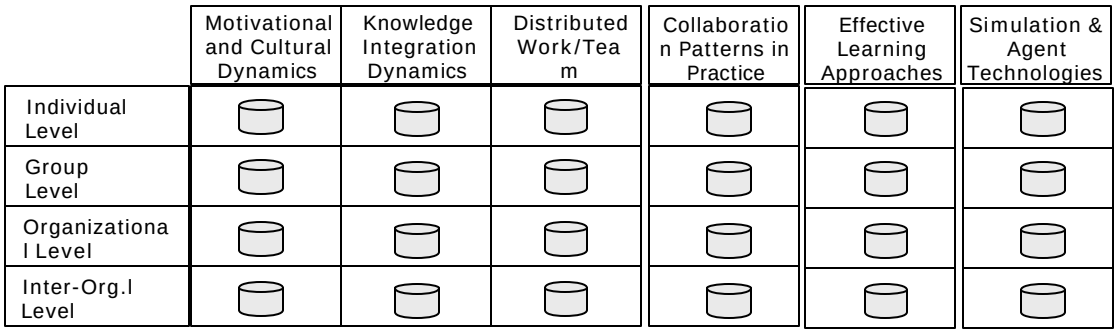

Figure 2. L2C Underlying Knowledge Domains

Collaboration-related Motivational and Cultural Dynamics

A first significant barrier to effective collaboration can be associated with the 'willingness' or 'motivation' gap. This includes cognitive and psychosocial factors preventing individuals from perceiving the value of collaborative behavior and knowledge sharing, and rather perceiving it as a threat (Ashforth & Mael, 1989; Brewer, 1993). Similar barriers operate at the level of groups and organizations (non-collaborative group and organizational cultures) as well as in inter-organizational contexts, in which competitive pressures often lead to non-collaborative behavior (Fulk & al., 1992, Locke and Schweige, 1979). Dominant mental models and habits need to be taken into consideration. Such models reflecting relevant individual psychological factors, attitudes and behavioral patterns, as well as the relevant dynamics unfolding in teamwork, groups, organizational or inter-organizational collaboration contexts provide the basis for modeling the diverse characters and behaviors embedded in the simulation-based learning experiences.

Collaboration-related Knowledge Integration Dynamics

A second significant barrier to effective collaboration can be associated with the 'competency' gap. Even when fully motivated (intrinsically or by environmental factors (Collins and Amabile, 1999)) to collaborate, individuals, teams, or organizations might not have the competencies to effectively integrate different knowledge sources (Cohen and Levinthal, 1990), as this requires an often under-estimated ability to bridge different "thought worlds" ("semantic spaces", "coding schemes" etc., Tushman, 1977; Tushman & Katz, 1980; Dougherty, 1992) as well as a significant de-contextualization and re-contextualization effort (De Vries, *et al.*, 1998). This is particularly relevant when the knowledge sources (people, knowledge assets, processes, technologies, etc.) have a strong tacit component (Hansen, 1999) and are very diverse in terms of background and culture. Additional studies stemming from the knowledge management and knowledge integration areas (Hargadon 2003; Fliaster, 2004; Grant, 1996; Hippel 1994; Johnson, 2001; Wenger, *et al.*, 2002) are providing the basis for selecting and integrating the most relevant models to enable the resulting simulation-based learning experiences to reflect the complexity of knowledge integration dynamics and ways of addressing this complexity productively, beyond developing increased awareness and

stimulating the interest to extend one's competencies in this domain (individual and/or organizational collaboration readiness).

On the individual level, in addition to motivation, there are two critical areas of knowledge integration/fusion competence – the cognitive and the social component (Fliaster, 2004). The cognitive competence means the ability to seek knowledge assets in diverse contexts and to transfer, adapt, combine and develop them further. Additionally, empirical research suggests that transferring new knowledge and maintaining a diverse social network are related activities and have a reciprocal effect on each other (Reagans & McEvily, 2003). In these terms, social competence means in particular the ability of individuals to establish and maintain collaborative interpersonal relations (Wunderer & Dick, 2002; Kihlstrom & Cantor, 2000). Both social and cognitive competencies contribute to the perceived trustworthiness of actors, thus playing a decisive role for knowledge-sharing and other forms of collaboration which are relevant for innovation and learning (Mayer et al., 1995; Levin & Cross, 2004).

Furthermore, the social network theory has shown that new and useful knowledge can be gathered through trusted "weak ties" (Levin & Cross, 2004) and brokerage across structural holes (Burt, 2004). Social networks that span structural holes are associated with creativity and innovation, high compensation and profits (Burt, 2001). An integrative analysis of motivational, social, cognitive as well as structural dimensions of effective knowledge integration processes in collaborative social networks is another critical area from which models to be embedded in L2C Simulations can be drawn from.

Collaboration-related Workgroup/Team Dynamics

Effective workgroup dynamics is a third essential component of collaboration (Poole & al. 1993; Hogg & Abrams, 1993). This is particularly the case when people are geographically distributed and need to support their collaboration through a variety of media and technologies as studied in the area of Computer-supported Collaborative Work (CSCW) (Benbasat & Lim, 1993) and Virtual Communities (Finholt & Sproull, 1990). Adopting traditional team dynamics management processes for such distributed workgroups has clear limits in terms of sustaining critical factors such as attention (Davenport and Beck, 2001) or trust (Davis, 1989; Jarvenpaa & Leidner 1998). The insights from the relevant literature stemming from online team dynamics, virtual communities success factors and experiences with different types of collaboration technologies and mechanisms (such as social translucence (Erickson et al. 1999), reputation and presence technologies (Hollingshead & al., 1993)) also need to be integrated in the simulation-based learning experiences to provide a richer understanding of the impact of ICT on collaboration dynamics.

Collaboration Management Competencies: Best/Worst Practice Cases and Patterns

A number of articles and books have appeared presenting theories built on practical experiences with the management of different types of collaboration contexts among different organizations (Huxham and Vangen, 2005; Katzenbach and Smith, 1993). Combining these insights with new data resulting from questionnaires and structured interviews conducted with the non-academic partners involved in the L2C Project is a critical step for identifying representative collaboration experiences (both successful and unsuccessful ones) and analyzing the management factors which lead to their success or failure. This includes a classification of cases documenting Collaboration

Patterns and related Collaboration Traps embedded in the realistic scenarios on which the simulation-based learning experiences are built.

Learning solutions addressing Advanced Collaboration Dynamics

Although there is effectively a large amount of literature on the relevance of team competencies, not many learning solutions exist today to address the domain of collaboration competencies (Euler, 2004). Nevertheless, a number of valid insights can be gained from current practices and experiences with current pedagogical approaches (both traditional and advanced, in terms of conceptual and technological sophistication) aimed at developing at least one of the competencies related to effective collaboration, providing learning experiences for instance in the areas of Knowledge Management (Scardamalia & Bereiter, 1994), Social Competencies and Social Networks (Williams, 2002), Group Dynamics, or e-Collaboration (Gibson & Cohen, 2003; Mayrhofer & Back, 2003).

Advanced Simulation & Agent Technologies

A number of relevant frameworks, research projects, technologies and standards are emerging in the domain of simulations enabling users/learners to interact dynamically with believable cognitive agents and characters, i.e. socio-cognitive agents embedded in dynamic simulations and displaying the behavior of individuals (Sarjoughian and Singh, 2004, Baillie de Byl, 2004, Funge and Terzopoulos, 1999). Within the L2C project we aim to build on and extend the design of generic gaming architectures and tools (simulation engines and development environments), the underlying modeling component (simulation kernels and modular knowledge integration modules) as well as the user interface component (advanced user interfaces for socio-cognitive agents) to achieve the degree of flexibility and believability necessary for the design of SmallWorld Simulations [Angehrn 2006].

Implementing Simulation-based Learning Experiences for Collaboration Competencies Development: Design Elements

The second design-oriented step consists in selecting and integrating the models, dynamics and the insights gained in the first step into an interactive simulation providing the basis for the targeted L2C Learning Experiences (see Figure 3).

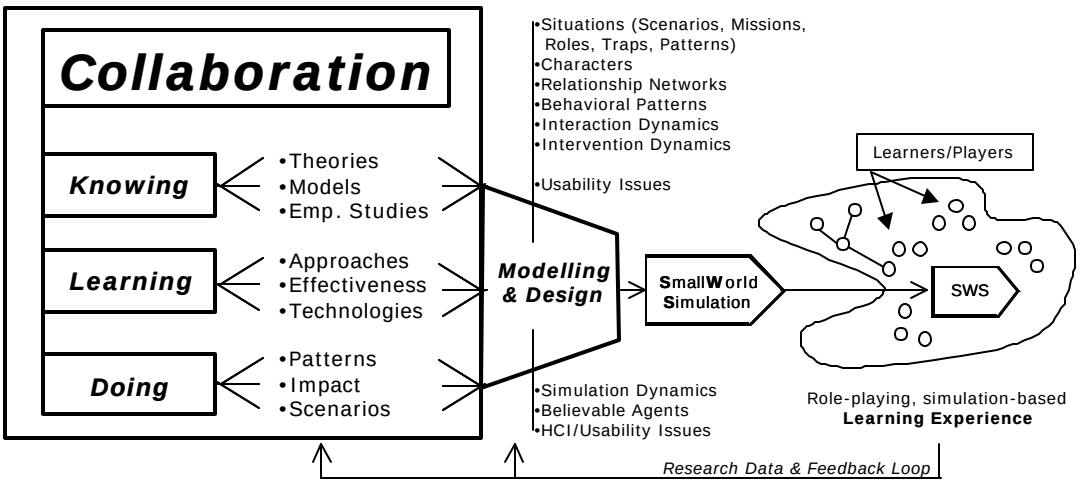

Figure 3. L2C Simulations Design Process (adapted from [Angehrn 2006])

As mentioned in the first part of this paper, the specificity of the targeted simulations is to integrate models of: (i) **individual behavior** (to allow learners to come into touch with different types of individuals displaying different types of attitudes), (ii) **group interactions** and **relationship network dynamics** (e.g. influence networks affecting the diffusion of attitudes in a group), (iii) **organizational contexts** and **dynamics** (e.g. specific cultures reflecting a given industry, a family business or an SME context), and (iv) **intervention dynamics** (e.g. what happens when the learners try to intervene in the simulated context using different approaches and tactics).

Key design guidelines also include a realistic scenario, a challenging collaboration-related management mission, a set of believable characters, a range of managerial actions and a realistic role for the players (operating typically in teams to strengthen the collaborative learning dimension of the simulation-based learning experience, [Manzoni & Angehrn 1997]).

In addition to **design guidelines**, the L2C Project is producing **implementation guidelines** which support the selection and design of appropriate modeling approaches and technologies for simulation kernels (engines and integration of specific dynamics) and user interface components. Such guidelines aim to provide games and edutainment designers with a structured approach for developing and deploying effective learning experiences based on realistic scenarios in which learners are placed in the situation of being in charge of "managing" complex collaboration processes, and where they come into touch dynamically with all the factors (at the individual, group, organizational, as well as the cognitive and behavioral level) determining the success of failure of collaboration dynamics.

Design and implementation guidelines are being complemented by **pedagogical guidelines** describing the ideal educational settings and processes in which L2C Simulations can be deployed in universities or organizations. This is particularly important, as (1) L2C Simulations have the primary objective to stimulate and facilitate learning, and (2) the "learning-by-playing" approach employed is not the currently dominant model for adult learning. The key role of games in triggering learning, knowledge structuring and cognitive change in children has been extensively analyzed in the work of Piaget and Vygotsky (Wadsworth, 1979; Moll, 1990). In adult education, and particularly management development, computer simulation games have been employed successfully over several decades, and studied extensively in terms of their impact on variables such as the development of various competencies and skills, motivation, willingness to experiment, development of appropriate mental models, and critical thinking (Wild, 1996; Malone, 1981; deJong, 1991). However, the successful deployment of "games" in organizational learning contexts remains a challenge in most cultures and organizations.

The key hypothesis we aim to test through the resulting L2C simulations is the extent to which ICT-based systems can be used to: (1) model cognitive and behavioral processes related to collaboration dynamics, (2) embed such processes in interactive game-like learning experiences, and (3) help individuals and organizations to diagnose and learn how to address cognitive and behavioral barriers (at both the individual and organizational level) to effective collaboration and knowledge sharing.

Conclusion

In the modern hyper-competitive business environment, learning and innovation are increasingly seen as the most powerful sources of competitive advantage. Current theoretical and empirical research

has also demonstrated that the most successful firms span multiple, otherwise disconnected industries and markets and develop new technologies, products, and processes by recombining existing knowledge assets in new, creative ways [Hargadon, 2003]. Effective collaboration competencies are hence emerging as a key condition for productive and sustainable value creation at the individual, team, organizational and inter-organizational level.

L2C Simulations, the design of which has been discussed in this paper, address the area of collaboration from a multi-disciplinary perspective, integrating insights and models from social sciences, knowledge management, collaboration-oriented ICT, and experiential, computer-enhanced learning.

Research-wise, our objective is to demonstrate how individual cognitive and behavioral processes and relevant organizational dynamics can be modeled using simulation technology in a way that is realistic enough to trigger experiential learning about the factors determining the success or failure of collaboration in organizational and inter-organizational contexts. This line of research will hence contribute to extend our understanding of how to best design and deploy learning-oriented simulations of social interaction contexts (Aldrich, 2005; Angehrn et al., 1995; Angehrn and Nabeth 1997; Angehrn 2005 and 2004a; Gilbert 1993; Gilbert and Chattoe, 2001; Magerko and Laird, 2003; Salen and Zimmermann 2003; Sarjoughian and Singh 2004;Yilmaz and Oren 2003).

The ultimate objective is to provide: (i) the community of educators with a new technology-enhanced approach to the effective development of relevant collaboration competencies, and (ii) the community of instructional designers, learning technologies experts and researchers with tools, components and a conceptual and design framework enabling them to design and deploy their own collaboration scenarios, simulations, and learning experiences.

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