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Creating effective learning environments and learning organizations through gaming simulation design

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Creating effective learning environments plays an important role in supporting organizational learning, changing individual and social interpretation patterns of reality, developing knowledge and competencies, and changing the sociotechnical systems of organizations. This article describes gaming simulation and the design of simulation games as a design-in-the-small approach that has always been a powerful method and is instrumental in modeling and changing social systems while aiming at their sustainable development. Gaming simulation as an interactive-learning environment propels the principles of problem-oriented learning into action and enhances a shift of existing organizational cultures and structures and in this way contributes to the design-in-the-large processes of organizations. The training program for systems competence through gaming simulation demonstrates that interactive design of simulation games supports change processes in the educational organizations.

KEYWORDS: *experiential learning; gaming simulation design; organizational change; organizational learning; problem-oriented learning; training course*

Today, people, groups, and organizations are increasingly confronted with problems and situations that show a high level of complexity. However, human abilities to deal with complex dynamic systems and processes while behaving in a sustainable way have not improved to the required extent. An essential advantage of the gaming-simulation approach lies in the integration of knowledge of various scientific disciplines and the attempt to make complex-living contexts understandable. To survive, people, groups, and organizations need to adapt continuously to the change of inner and outer conditions. Therefore, human beings and organizations as social systems must be able to learn. Learning on the individual level implies acquiring knowledge, skills, and competencies to cope successfully with different circumstances. Learners need to change their inner conditions. Through cognitive (re)construction of mental

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models, learners change their perception and interpretation patterns of reality. Simultaneously, individuals must deal with the environment in which they live and learn to understand the influence of transformed behavior and communication patterns on that environment. Learning at the level of organizations signifies the change of organizational cultures and structures, strategies, and work processes. Organizational learning affects the (re)construction of social representations of groups and the development of social systems' processes.

Simon (1969) pointed out that design means to conceive and to implement courses of action aimed at changing existing dysfunctional situations into preferred ones. This approach of design-in-the-large (DIL) is the foundation of all forms of consulting work, training, and education in the attempt to foster new ways of thinking and acting and to develop organizations.

As problems and issues are becoming increasingly complex, how can we improve our individual and collective competence in steering and self-steering our societies, organizations and institutions? . . . Gaming and simulation have proved to be a powerful combination of methods and ideas in dealing with complex and unique issues. . . . Gaming simulation provides a language for combining the social-human domain with the physical, technological and economic domains and provides a shared language for communication between the natural and social sciences. (Klabbers, 1989, p. 3)

To produce a more holistic understanding of systems and to generate ideas for change, simulation games and related design methodologies offer an effective approach (Kriz, 1998, 2001). Gaming simulation design as a design-in-the-small (DIS) approach enhances a shift of existing organizational cultures and structures and in this way contributes to the DIL process of social systems. This leads to a (more or less) preferred (re)construction of real situations through the constitution of new action patterns, norms, and roles and the change of the physical and social environment itself. This form of DIL can be described as self-organizing development of social systems via DIS through designing and using simulation games.

Gaming simulation as a method for modeling and changing existing situations

Simulation games represent dynamic models of real situations (a reconstruction of a situation or reality that is itself a social construction). Simulation games help to mimic processes, networks, and structures of specific existing systems. In addition to mirroring real-life systems, simulation games incorporate players who assume specific roles. The prototype gaming simulation combines role-play and simulation. Full-fledged simulation games include actors, rules, and resources (Klabbers, 1999). These simulate social dynamics (e.g., communication processes through the actors using rules) as well as the dynamics of the resources depicted in the reference system. In simulation games, the scope of communications and actions between the actors is broadened by linking them to technical and material processes that mirror the social

l system's resources. The main goal of simulation games is to simulate the actors' decision-making process and to demonstrate the consequences within social systems (e.g., within a company). Simulation games can be defined as the simulation of the effects of decisions made by actors assuming roles that are interrelated with a system of rules and with explicit references to resources that realistically symbolize the existing infrastructure and available resources.

Two notable varieties of simulation games—closed (rigid rule) and open (free form)—are generally used. In rigid rule simulation games, the players receive clear instructions based on well-defined rules. The problem is presented to the player(s) in a well-defined framework, and they are expected to solve it in a target-oriented manner as precisely as possible by making decisions in line with the instructions. In free-form games, the simulation model, rules, and flow of the gaming simulation are not given a priori. On the basis of an initial scenario, models of systems are (co)constructed by the players themselves (facilitated by experienced gaming simulation designers). Players become the experts in their own right.

When attempting to teach certain skills by means of gaming simulation, a reflection phase is necessary to evaluate the experiences gathered during the game session. During this process, the experiences of the participants are consolidated by means of reflection, evaluation, and open feedback, which are key social skills in carrying out cooperative actions. The reflection phase allows participants to apply the knowledge acquired during the gaming simulation to the real world (e.g., at work).

The term *debriefing* refers to a common consolidation of an experience in view of an evaluation of the psychic and social processes (cognition, emotion, communication, negotiation, etc.) that took place during the game; the aim is to draw realistic conclusions. Debriefing offers a consolidation of the experiences made and therefore a chance to acquire important knowledge that has theoretical as well as practical value. Both enable the transfer of the learning experience into real-life situations. During debriefing, common understanding and important differences between simulation game and reality can be addressed. This reduces the risk of confusing reality and simulation. From a constructivist perspective, it is necessary to question and discuss the model of the simulation game. Debriefing offers such an opportunity wherein participants can compare their view of reality with the simulated reality, find differences and commonalities, and achieve a transfer of the acquired knowledge for reality.

Linking design-in-the-large with design-in-the-small through gaming simulation

The gaming simulation approach and how it is integrated with DIL and DIS is illustrated in Figure 1.

Simulation games are widely used in professional training and organizational development. Figure 1 illustrates that the overall design and play of simulation games are closely linked to DIL. The implementation of a designed game as well as the design process itself aid DIL. A part of the existing situation of reality (Reality Level 1) is

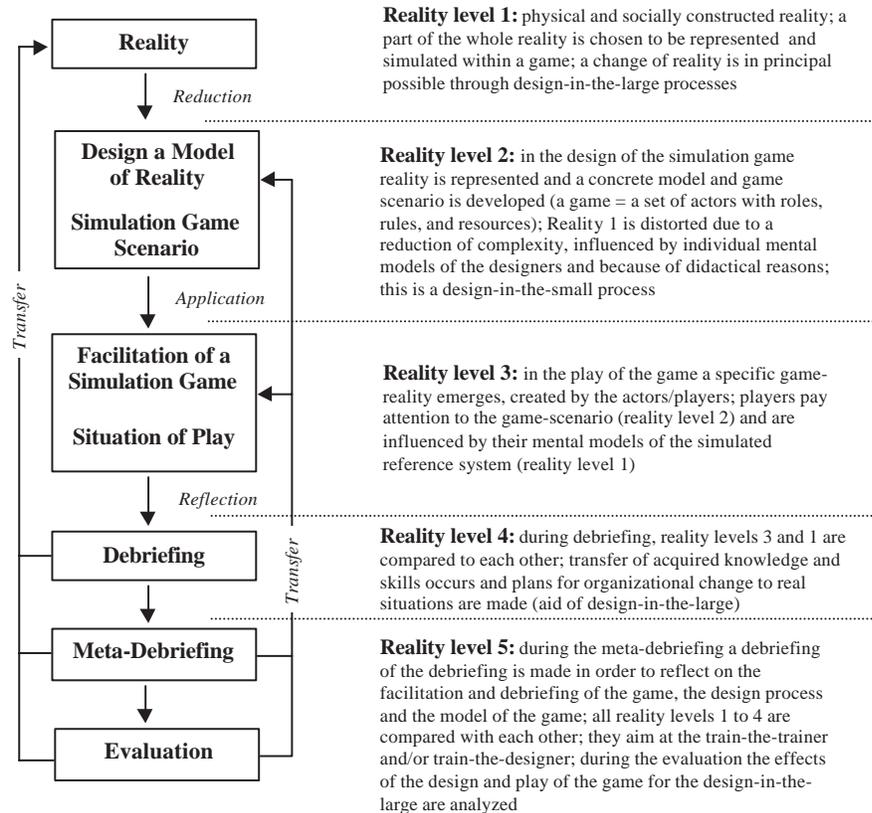


FIGURE 1: Linking DIS and DIL Through Gaming Simulation

selected as reference system for the designed simulation game. The final aim is to change organizational structures and processes within Reality Level 1. To carry out DIL, a game as a dynamic model of reality is created (Reality Level 2) and applied (Reality Level 3). By inviting stakeholders and opinion leaders to participate in the design process, it becomes natural to have them contribute both as agents and actors. Participating in design, play, and debriefing allows the players to take part in the DIS process while ultimately contributing to the next phase of the social system processes' DIL. Debriefing (Reality Level 4) is facilitated to enhance the learning process and to apply newly gained insights, knowledge, and skills within the DIS aimed at changing reality (DIL). The secondary phase of debriefing, referred to as meta-debriefing and evaluation (Reality Level 5), is required to further a reflection on the linkages between DIS and DIL and to measure profits of changes in reality.

Organizational change as design-in-the-large

Greif and Kurtz (1996) showed how the process of change can be managed in an effective way. They described *organizational development* as DIL with characteristic sequential phases and feedback loops: diagnosis, defining goals, development of change strategies, concrete planning, action, and evaluation. In all phases of organizational development, gaming simulation can specifically be used as a catalyst for reasonable managerial change (Ruohomäki, 2002). Figure 2 shows the interaction between organizational change phases as DIL process and gaming simulation as a supporting DIS approach.

Gaming simulation methods support the phase of diagnosis to determine the actual condition, for example, as part of assessment centers and potential analysis. Gaming simulation helps in the understanding of existing organizational structures and work processes. For example, members and stakeholders of the organization can design simulation games together with gaming simulation experts to illustrate the processes and structures of the real organization (present state simulation game). When playing and debriefing such a simulation game, existing advantages and disadvantages of these structures can be illustrated, thereby fostering discourse on ideas for potential change strategies. The knowledge acquired and the conclusions drawn can be used to define goals and concrete planning of change measures.

With gaming simulation, consequences of alternative scenarios in a changed organizational structure can be tested, scored, and discussed. In an organization, desired changes can be illustrated in vision/future state simulation games (see Ruohomäki, this issue). Gaming simulation can be used as an intervention tool for human resource management and organizational development in the training of specific department-related knowledge and required skills. Finally, intended learning experiences and consequences of organizational changes can be evaluated with the help of simulation games.

Gaming simulation and organizational change

The use of gaming simulation in a company, for example, can serve as a tool to create a better understanding of the prevailing organizational culture, structure, and processes to assess the risks, chances, and necessities of organizational change. Gaming simulation is a method used to support people and organizations in dealing with the sustainable (re)construction of their reality. Gaming simulation imitates organizational processes and changes them in an experiential and playful way. This aids organizations in their search for creative problem solution in real-life situations.

Through gaming simulation, a number of different scenarios can be designed and played. The participants can experience the influence of playing different roles. Through a series of experiences in dealing with various social situations, roles, perceptions, and characteristics of the reference system, alternative modes of (re)acting can be developed. During debriefing, alternative behavior patterns are shared among the

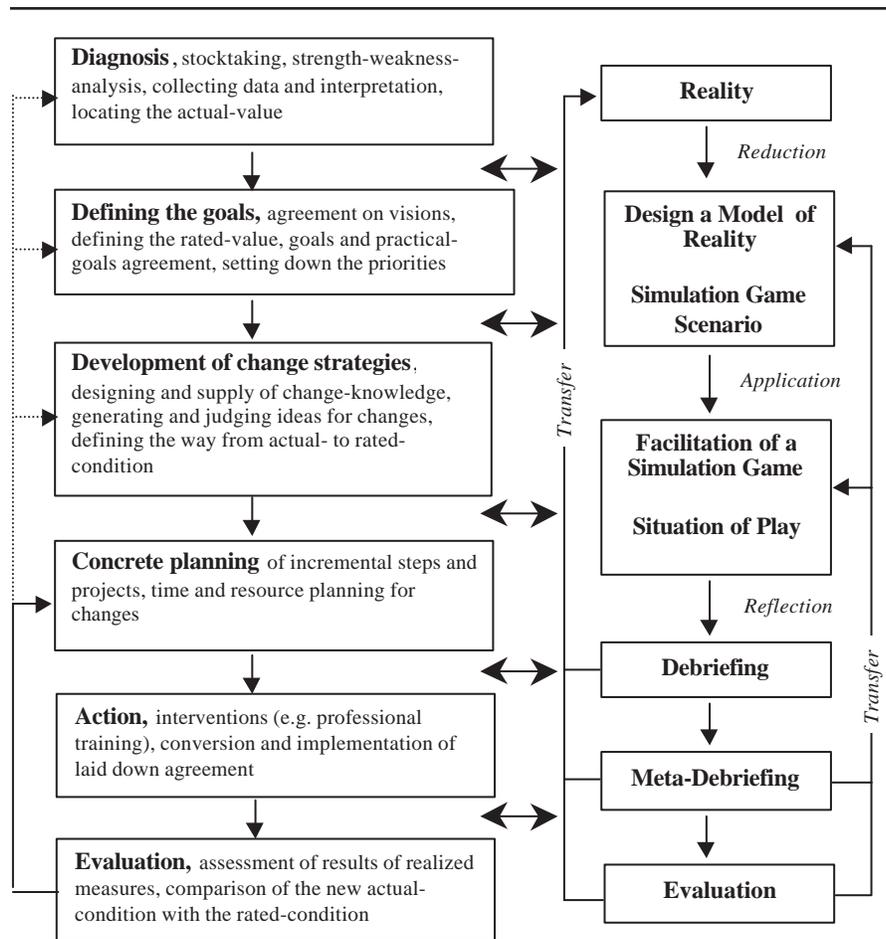


FIGURE 2: Interaction Between Organizational Change, DIL, and DIS

participants, followed by discourse on ideas for implementing change. The construction of organizational models and the design of corresponding simulation games by members of the organization themselves (with coaching assistance by experts) tend to be more effective than simply participating in rigid rule-simulation games (even if they are properly designed by simulation and gaming experts) (Kriz & Landler, in press).

The translation of experiences gained from the design of a simulation game (DIS) and from the playing of the self-designed games to the real-life system will lead to a deeper understanding of that system's structure. This understanding may lead to intervening in the system to improve its functioning (DIL). The design of simulations and

games by stakeholders can be defined as a type of free-form game. Participants have the opportunity to settle their own learning goals, construct models of reality, and define game rules. The design process as a self-organizing learning environment helps reveal the communication modes of the group as well as the individual mental models and systems representations of the participating designers. Common values, goals, rules, social representations of reality, and strategies for complex systems management can be mutually shaped.

“Games are social systems. They include actors, rules and resources, which are the basic building blocks of social systems. They are also models of existing . . . social systems” (Klabbers, 1999, p. 22). Therefore, the design of gaming simulation offers a perfect learning environment for the training of social skills, the (re)construction and sustainable development of social systems, and dealing with the complexities of modern corporate life. Another advantage in using employees as codesigners of simulation games, with their own organization as a reference system, is that participating staff members will be more motivated to transfer their experience from this DIS activity into changing the real situation. In this way, people will be more committed to their own ideas and visions of change. Therefore, the probability of an effective DIL process will increase.

Organizational learning

Shared visions, exchanges of individual mental models in the group, skills for teamwork and team learning, personal mastery, and systems thinking are the factors Senge (1990) described as central disciplines of learning organizations. To create learning organizations and to change dysfunctional and undesired situations, various approaches of organizational psychology refer to the following different areas to initiate change processes (König & Volmer, 1997):

- a. Changes related to persons: A change that begins with the characteristics of a person, for example, excluding the person from specific social processes or giving him or her the option to take part in specific social processes. In reality this could mean that a person is relocated in a company or is selected as a new member of a project team.
- b. Changes of subjective interpretations of single persons: The attempt to create a variety of perspectives with corresponding methods (specific training sessions, conversations and feedback, etc.) and to change the mental models of the persons involved. These mental models relate to problem situations, the perception of people included.
- c. Changes in rules for behavior in social systems: The act of shaping and changing norms becomes the subject of discussion in both formal and informal settings. These changes cannot be limited to one group of actors, they must also relate to the rules that apply to the broader social system. For example, increased self-government of a department within a company may be at issue.
- d. Changes in the structure of interaction: Different archetypes in communication and action must be developed. Adequate interaction archetypes can be fostered with the use of training tools. Dysfunctional archetypes hamper the ability of social systems to develop. Adequate communication patterns are the prerequisite for successful teamwork

and team learning. Patterns of interaction and communication unite with mental models of participants' social processes and established norms of the social system.

- e. Changes concerning direction and speed of development: These changes stand (among other things) for the development of common goals and visions and a perspective for the scheduled change of processes (e.g., which tasks should be fulfilled and how could workflow be organized and designed in a better way).
- f. Changes concerning system resources: Changing the general social setup and remodeling the physical arrangement of the system (e.g., purchasing new furniture for the office, changing the equipment, structural engineering measures, etc.). For example, changes in physical resources and infrastructure can increase physical health and psychological well-being at the workplace, ultimately increasing motivation and productivity. These material resources, such as office computers, are also prerequisites for basic job performance.

To put such change processes of DIL into practice, it is important to begin the learning processes at the individual level while creating a useful environment for learning on the level of the overall social system. Senge, Kleiner, Roberts, Ross, and Smith (1997) described fundamental factors and interdependencies of individual and organizational learning. They referred to individuals as being the "place of change," meaning that all members of the organization and the unique psychological processes that accompany them are the leverages for learning and change within an organization. Goals of learning processes in organizations should be supported by the realization of internal personal development measures and continuing education. They should not only procure new knowledge, competencies, and acting strategies in the context of existing norms (*single-loop learning*) but also foster a deeper understanding of any changed convictions, judgments, and rules, as in a *double-loop learning* system (Argyris & Schön, 1996). Senge (1990) distinguished between three phases of an individual learning cycle:

- a. New skills and abilities: Individual strengths and potentials among members of an organization should be fostered to promote creative thinking and acting. The creation of techniques for individual knowledge management and the ability to visualize one's own knowledge by using mind maps are perfect examples of behaviors fostered in a healthy organization. Such visualizations enable all team members to solve problems more efficiently while deepening a common understanding of the organization.
- b. New awareness and new sensibility: With the development of new skills, persons also gain new cognition and insights that often lead to new attitudes. For instance, the members of a project team can become more sensitive to the interpersonal processes in the team while also developing a new awareness that may help in creating a smooth workflow.
- c. New attitudes and opinions: During the learning process, new perspectives are taken on, thereby changing old attitudes and opinions. New ways of thinking and new perspectives of behavior are established. If a large number of organization members change their personal opinions in, for example, their desire for cooperative teamwork as opposed to the egoistic way of working as "lone fighters"—this will ultimately act as a catalyst toward a cultural change within the whole organization.

Stimulation of such individual learning processes can be difficult to achieve due to the fact that many people are not willing to drop their old ways of thinking and

behaving in favor of new patterns that they feel insecure about. The organization must secure an effective learning environment in addition to the efforts of individual organization members. Furthermore, it is necessary to carry out continuous organizational development, leading to an organizational culture whereby members of an organization are able to show desired habits. An organization that always promotes the buzzword *teamwork* and sends its employees to costly training seminars for team development makes a serious mistake if the dominant leadership style in action is not changed simultaneously. To make teamwork possible, the organization has to move away from authoritarian power structures and implement participative leadership. Senge (1990) referred to an organization as a “place of doing,” and he defined the following three phases of organizational learning cycle:

- a. New guiding ideas: New goals and ideas tend to appear in the early stages of periods of innovation and change. The approach an organization takes summarizes the main goals and values within the organization and among those working there. Leading ideas and visions dealing with the future of an organization are essential to expedite goal-oriented changes, for example, the realization of a team culture.
- b. New concepts and methods: To implement visions, new methods, and concepts, procedures have to be developed and set into action. New methods for organizational development and innovative concepts for personal development that are linked with guidelines must also be included. These methods are needed to build up adequate individual and social competencies. Gaming simulation design can be used as a valuable tool toward implementing such changes.
- c. New organizational structures: The structures and strategies of the organization must be rearranged to achieve desired changes. Methods, concepts, and training are useless unless adequate structures in the configuration of the organization are provided to foster new social competencies. Teamwork is only efficient when the entire team is involved in the decision-making processes, working together toward agreement.

These notions are shown in Figure 3.

With the use of gaming simulation, a general competence in dealing with change processes and learning cycles, mentioned earlier, can be developed and tested. This is fruitful when, for example, designing sociotechnical systems. Simulation games can also be used for supporting the acquisition of knowledge and competencies in a domain-specific context for the training of specific skills needed to manage specific systems. Gaming simulation and especially the design of simulation with debriefing and meta-debriefing can be used as methods of training to foster individual learning processes. Simultaneously, the design of simulation games affects learning at the organizational level. New sensibilities and awareness; new team skills, competencies, and cognitive capacities; and new action rules, attitudes, and values that are formed in the design process of simulation games (DIS) give direction and are implemented to produce new organizational approaches, structures, and corporate cultures (DIL). The results of the DIL (e.g., a changed organizational climate that allows far more self-organizing teamwork) have a proactive effect on the chances that the facilitation of the game design will be an effective tool in implementing change management (e.g., in team-based organizations, it will normally be easier to use gaming simulation for such purposes than in functional organizations).

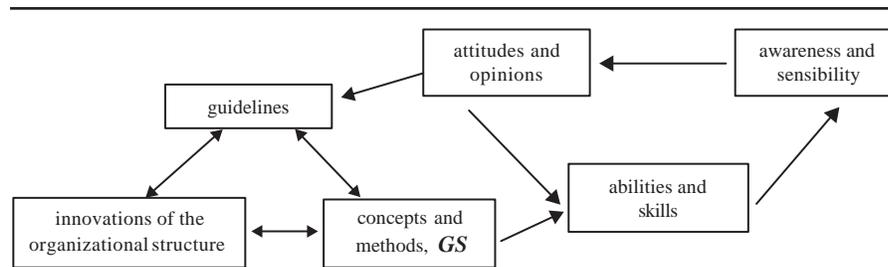


FIGURE 3: Organizational Learning Cycle and Linkage to the Individual Learning Cycle

Dealing with the gap between knowledge and action

Students usually have substantial theoretical knowledge available to them when earning their university degree. Nevertheless, as Renkl, Mandl, and Gruber (1996) pointed out, the majority of students are not able to cope successfully with everyday tasks in the practice of their specific field or profession. They are not competent enough to put their knowledge into practice. Research in educational psychology shows that knowledge acquired in schools, universities, and vocational education programs often cannot be used by the students to solve real and complex problems (this refers to the German system—but it seems that these findings are more or less valid for other countries as well). Knowledge about the subjects taught remains inactive. The predominant learning culture, which produces so-called inert knowledge, can be characterized as abstract, artificially systematized, and scarcely application oriented. This knowledge does not correspond to the complexity and the interconnection of the various fields of knowledge and application of our daily reality (Mandl & Gerstenmaier, 2000). The unnatural reduction of complexity in school and university not only affects the cognition, it also has a negative effect on the motivation to learn (Pekrun, 1993). Moreover, our education system is frequently aimed at the examination and promotion of individual skills. Social-action skills such as interdisciplinary understanding, appreciation/cultivation of diverse perspectives, and the ability to work in a team are scarcely developed or not developed at all.

Psychologists make a distinction between different forms of learning. Their most comprehensive interpretation of learning stresses that experiential learning is an essential feature of learning. The importance of application-based and transfer-promoting exercises as essential elements of the learning processes is often ignored. According to Johnson and Johnson (1994), experiential learning creates a learning environment in which people either make concrete experiences in real life or in a virtual environment, such as by playing a game. Following the experience, there should be a phase of observation and reflection whereby participants discuss their experiences and different perspectives become better understandable. During a third step, the experience is compared and connected to existing theories, and abstract concepts

are formed in the cognitive process (e.g., participants evaluate the significance of the experiences and create generalizations; they define patterns of effective and ineffective communication). Newly created concepts (e.g., mental models and social representations) support the development of better strategies for sustainable behavior in real life. These strategies are tested and lead once again to new concrete experiences. For example, participants try to use “better” communication patterns to achieve more effective teamwork in the next game or at the workplace. Thus, the transfer to the workplace affects the dynamics of the simulated reference system and improves social processes as well as changes the sociotechnical arrangements to refine the capacities of the employees.

Learning is considered a self-organizing process in which person-internal factors alternate with person-external factors, so-called situational conditions. In this case, the concept of situation means both material and social environmental variables. The interaction between people and the cultural frame in which a person’s thoughts and actions are embedded plays an important role. Learning always takes place in concrete situations. The design of adequate learning environments to change culturally defined interpretation patterns of reality is one of the most important areas where DIL can take place.

Bridging the gap: Transforming knowledge into action through gaming simulation

When changing dysfunctional education systems into preferred ones, that is, moving from passive reproduction of inert knowledge to active production of applicable knowledge, gaming simulation has much to offer. To acquire usable knowledge and competencies and to foster social skills (e.g., teamwork skills), it is necessary to design appropriate interactive-learning environments. In this context, it becomes increasingly important to enhance self-organization and self-steering in learning by focusing on problem-oriented learning. Kriz and Nöbauer (2002) stressed that learners should be stimulated to take on joint responsibility and to be proactive in shaping their own learning processes.

The approach of problem-oriented learning requires the following:

- a. complex and authentic contexts, encouragement toward experience-oriented learning;
- b. multiple contexts, variety of perspectives and methods;
- c. social contexts, team learning, and teamwork; and
- d. instructional contexts, appropriate support from the teacher or trainer via debriefing by paying attention to experiences such as problem-solving strategies, cooperation, conflict, resolution, and so on.

Because gaming simulation propels these principles into action, it is an extremely useful learning methodology. Gaming simulation is an interactive-learning environment that makes it possible to cope with authentic situations that closely mimic reality.

At the same time, gaming simulation represents a form of cooperative learning through teamwork. When working on strategies to solve problems in groups, one can expect to make mistakes. Learning from such mistakes is often the essence of learning. These expected mistakes have no permanent consequences as one can start all over again in the simulated reality. Therefore, simulation games are mistake-friendly learning environments; they allow learning through trial and error (i.e., the planning, implementation, and optimization of useful strategies). Trial and error and the benefit of immediate feedback about the consequences of participants' decisions are key elements in the success of learning processes. One single simulation game allows multiple contexts of use, and newly gained abstract knowledge can be used to enter unfamiliar domains. This learning under multiple perspectives creates flexibility when crossing domain-specific knowledge.

Design-in-the-small of a training course

In the process of experiential learning, the playing of simulation games, their design, and debriefing are all important aspects of the learning cycle. We have taken into account all considerations mentioned earlier while setting up a 560-hour gaming-simulation-based training course on systems competence (the program takes 1½ years). During the course, participants not only play simulation games and experience different forms of debriefing, they also learn how to facilitate and debrief simulation games (train the trainer). In addition, they design simulation games as well as debrief design sessions (train the designer), see Table 1.

The main contents and objectives of the program are fostering of systems thinking (especially skills for analysis and sustainable development of complex system dynamics), fostering of teamwork skills (especially training of competencies for better problem solving, decision making, communication, and exchange of mental models in groups), and learning about methods of gaming simulation.

During Seminar 1, students participate in different simulation games to gain basic skills in systems competence and to learn about methods of gaming simulation (e.g., policy exercises, role play, pure games and experiential learning activities, simulation games and played simulations, and computer simulations). In this seminar, trainers lecture on theory (lecture and discussion), present various techniques (e.g., tools for building models and systems analysis, brainstorming techniques, decision-making techniques, debriefing methods, etc.), and run illustrative simulation games.

During Seminar 2, the participants gather information and knowledge and prepare methods, techniques, and simulation games in small project teams (with coaching by the trainers). The participants are the ones that lead the activities of the second seminar: facilitate and debrief simulation games and train methods and techniques (similar to Seminar 1). In addition, optional workshops are offered: a special course in outdoor training methods (e.g., with low- and high-ropes course elements and special combinations of outdoor team exercises and simulation games), a seminar about computer simulation and use of system-modeling software, and a workshop on large-group

TABLE 1: Structure and Contents of Training Course in Gaming Simulation at the University of Munich

<i>Activities in the Whole Group of Participants</i>	<i>Individual Tasks (I) and Teamwork in Project Teams (T)</i>	<i>Training Hours</i>
Seminar 1: General introduction		2
Seminar 1: Basic course		50
	I: Writing learning diary	7 or more
	I: Design a modification/variation of a simulation game that was presented in Seminar 1	6 or more
	I: Paper about theoretical contents	15
Sum step 1		80 minimum
Seminar 2: General introduction		2
	T: Prepare the facilitation of exercises, presentations, and simulation games	40 or more
Seminar 2: Train the trainer, conduct games with debriefing		60
	I: Writing learning diary	7 or more
	I: Design a modification/variation of a simulation game that was presented in Seminar 2	6 or more
	I: Paper about theoretical contents	15 or more
Sum step 2		130 minimum
Seminar 2a (option)—outdoor training		20
Seminar 2b (option)—large-group simulation game	T: Prepare and conduct a game for 100 participants or more	40
Seminar 2c (option)—computer simulation and modeling software		40
Sum step 2 additional options		100
Seminar 3: General introduction		8
	T: Design a simulation game and prepare the facilitation of self-designed prototype game	80 or more
Seminar 3: Train the designer, conduct of designed games with debriefing		60
	I: Writing learning diary	7 or more
	T: Writing game manuals (facilitator and participants' manual)	15 or more
Sum step 3		170 minimum
Seminar 3a (option)—projects	T: Work as cotrainer and/or codesigner in real gaming and simulation projects (in small teams) for customers (later it is possible to write thesis in gaming and simulation)	40 or more (thesis some hundred hours)
Seminar 3b (option)—attending guest lectures of three to four gaming and simulation experts		10 or more
Sum step 3 additional options		50 minimum
Seminar 4: Excellence in gaming simulation (Venice International University)		30
Total sum without additional options		410 minimum
Total sum with all options		560 minimum

simulation games. Special problems and effects of large-group games are not only discussed in theory, participants of the workshop also prepare and facilitate a large-group game with more than 100 participants.

During Seminar 3, the participants have again the opportunity to form teams in which they are to design simulation games. There again the trainers play a supervisory role. Self-created prototype games are presented, conducted, and tested. The trainers facilitate a continued metadebriefing within the whole design process. Again, additional optional activities are offered at this stage of the training program: guest lectures with experts and participation in real projects (students can work as cotrainers and/or codesigners of gaming simulation applications). Students can also choose to write their theses on a topic related to gaming simulation (e.g., evaluation of self-designed games, empirical studies about the effects of training programs, etc.).

Seminar 4 focuses on gaming simulation for intercultural communication (with participants and lecturers from different countries) and on "excellence in gaming simulation." There again simulation games are designed in teams, although in a very short period of time. Topics of the designed games are intercultural communication and additional specific themes linked with current design projects of the lecturers.

Students are required to write seminar papers covering the theory presented during the program. They are expected to keep learning journals (diaries) about their individual learning processes. These papers and learning journals are then discussed together with other course participants. The design of games and simulations (DIS) is used as a training method to improve students' acquisition of knowledge and skills and to aid in the formation of shared mental models within groups. Among the group of participating students, the design of simulation games creates a virtual reality that leads to a change in their social representations of reality. It is a (re)construction of their perceived reality. Empirical evaluation studies of this training course based on measurements both before and after show significant improvements in knowledge and competencies and a clear effect of knowledge transfer via training as compared with control groups without such training. Studies highlight the combination of education in systems thinking and team skills training through gaming simulation, which leads to a more sustainable systems management. As a result, the students' systems competence especially increases during the phase of designing their own games (Kriz & Brandstätter, 2003).

Effect of design-in-the-small on design-in-the-large

The participating students are educated in the training course to become designers themselves. In this way, participants as designers of gaming simulation (DIS) should also become change agents to develop and implement appropriate learning environments in educational organizations (DIL).

The process of game design as a part of the curriculum at the University of Munich enhanced the preferred change of the institution itself. The learning process and the learning culture at the university is affecting change in the direction of a new and

preferred culture that provides students with more opportunities for self-organized learning, team learning, and experiential learning. Students are beginning to use gaming simulation in other courses for building up special knowledge and skills. As a result, lecturers and professors are becoming interested in the program and have started using gaming simulations for their students' coursework. Some professors even participated in the training course to design gaming simulation for their own courses.

Not only has the university's complex social system been affected, the overall school system has changed as well. In general, participants of the training courses are students of the educational sciences (future educators) and they design games that they intend to use later on in their own classrooms. Some of these education students and recent graduates have gone on to design games with their own pupils. More than 20 teams designed games in the past 5 years, with a large spectrum of different gaming simulation methods, different contents, and varied learning objectives. These newly designed games include mathematics education among other classroom subjects; games for fostering teamwork skills, creating a positive climate and good relationships in the classroom, and intercultural communication in the schools; and frame games for learning how to learn (Kriz & Reichert, 2001). The learning aims of these games range from the development of personal and social skills to domain-specific and methodical competencies. Recent education graduates have also started to use gaming simulation in processes of organizational development of school administrations. Some teachers (former students and participants in the training course) have become members in the Swiss Austrian German Simulation and Gaming Association (established in 2001) and are building up the school section within the association. This branch has set the explicit target to foster the use of the gaming simulation approach in schools. Increasingly, more appropriate learning environments are constructed in the educational system, with a great potential to create effective learning processes and to advance educational social systems.

Summarizing remarks

The design of adequate learning environments plays an important role in supporting organizational learning, changing mental models, fostering alternative interpretation patterns of reality, developing new communication and action patterns, and reconstructing the sociotechnical aspects of organizations. The approach of gaming simulation and the design of simulation games have always been effective methods for modeling and changing existing situations into preferred ones. The design of simulations and games as a DIS approach can be linked with the DIL process to promote organizational change. Gaming simulation as an interactive-learning environment propels the principles of problem-oriented learning into action (set up by research in educational psychology). Thus, knowledge and skills do not remain inactive; instead, they become transferable and applicable. The example of a realized training program for systems competence with gaming simulation and the presentation of some of its

effects shows how much the design of simulation games is able to support change processes. Existing dysfunctional educational and organizational situations are changed and/or improved into preferred ones (DIL) through the design and use of simulation games (DIS).

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