

Viewpoints on learning and education with simulation games

Virpi Ruohomäki

Helsinki University of Technology, Laboratory of Industrial Psychology,
Otakaari 4 A, 02150 Espoo, Finland,

Abstract

This paper deals with some psychological and educational viewpoints on learning with simulation games. First, I will give a short description of simulation games as they relate to learning and education. Second, the focus will be on the model of the experiential learning through simulation games. The aim is to give an overview of what happens in a simulation gaming process and to understand the learning cycle from the perspective of the participants of the game. Third, a short literature review on the educational effects of simulation games will be presented. Finally, I will summarize some viewpoints on behalf of using simulation games and make suggestions for further studies.

Keyword Codes: I.6.8; I.6.1; I.6.3

Keywords: Types of Simulation; Simulation Theory; Applications

1. SIMULATION GAMES AS THEY RELATE TO LEARNING AND EDUCATION

The cognitive psychology paradigm associated with both theory and practice of human learning have raised, during the last decades, a challenge to develop new teaching strategies. There is a wide variety of supplementary and alternative learning and teaching methods to those of conventional lecturing and discussing. Simulation games are one potential tool to gain learning objectives both in the school and organizational contexts.

1.1. What is a simulation game?

The following key concepts are widely used in literature, for example by SAGSET (the Society for the Advancement of Games and Simulations in Education and Training) (1): A *Simulation* is a working representation of reality; it may be an abstracted, simplified or accelerated model of a process (1). It purports to have a relevant behavioral similarity to the original system (2).

A *Game* is played when one or more players compete or cooperate for pay-offs according to a set of rules (1). A game means a setting in which participants make choices, implement those choices and receive consequences of those choices in an effort to achieve given objectives (3). Gaming employs persons in some role, actual or simulated, in its operation in an environment which is either actual or simulated (2).

A *simulation game* combines the features of a game (competition, cooperation, rules, participants, roles) with those of a simulation (incorporation of critical features of reality) (1). A game is a simulation game if its rules refer to an empirical model of reality (3).

In simulation games (or gaming-simulations) the game roles, goals, activities, constraints and consequences, and the links between them, simulate these elements of the real-world system. Simulation game is a hybrid form involving the performance of game activities in simulated contexts (4,5). The distinction between simulations and games is often unclear, for those two terms are used synonymously.

The variety of different kinds of simulation games is wide and they have been used for different purposes in different application areas. There is no clear theoretically based taxonomy of simulation games (4). Most of the simulation games are general games for educational purposes, but more and more company specific games, tailored for specific organizational aims can be seen. Simulation games can be, for example, activity-based, computer-based or manual, like board and card games. In this paper, I will deal with simulation games designed and applied for educational and training objectives.

1.2 Applications for education

Learning and education is the most common application area of simulation games. Their use as an educational tool seems to be expanding. Simulation games have been applied to educational purposes in many fields, like in social research, public policy, urban planning, health education, economics, business and management (usually called business and management games), and production (called production games).

They have been mainly used at schools, in colleges (for teaching languages, biology, history etc.) and in universities for higher education, but also in organizations for personnel development.

Simulation games have been suggested for their visibility, reproductibility, safety and economy (4). Simulation games are also used when there are no possibilities for students to get experience of the systems or situations in the real life; simulation games allow learners to explore systems where reality is too expensive, complex, dangerous, fast or slow (1).

Simulation games are mainly used for two purposes in education (3):

1. They are used to present complex abstract models of reality in experientially rich and concrete forms. Participants are expected to describe, analyze and evaluate the realities to which the games refer. For example, the work processes or production principles can be envisioned and experienced with simulation games.
2. They are used as a training method. Participants are expected to develop participating in simulation games. The goal is that participants should then be able to transfer the skills and knowledge they have learned from simulated context to real life situations, for example, to work activities.

Simulation games are currently used for a variety of purposes (4): heightening interest and motivation; presenting information and principles; putting learners into situations where they must articulate positions, ideas, arguments or facts they have previously learned; or training skills needed later.

Simulation games are generally preplanned, designed and implemented to meet some *specific learning objectives* (4). Simulation games can be applied, for example, to the teaching of facts, concepts and principles, or processes simulated by the game, and to train specific skills (2). Other objectives, presented in an organizational context are, for example (6) to demonstrate, to distribute and to promote an exchange of knowledge among participants, to stimulate thinking and to examine some organizational phenomena.

In working life, technological and organizational changes raise different kinds of learning requirements. Simulation games, like production games, are fruitful for learning task structures, e.g. the management of existing functions in a production department (7). In general, the best approach to ensure effective transfer of procedural skills is to train people on the job. The second best approach is to use simulation games that reflect the job environment (8). Despite the potential advantages, the use of simulation games in corporate training and development settings still seems to be limited.

A novel application area for simulation games, which are tailored for a specific organizational context, is to use them as tools for participative work development and organizational improvement, as well as for managing organizational change in its different phases (9,10).

It is generally recognized that in order to gain learning objectives and to attain the greatest impact, simulation games should be *part of a wider training program* and integrated into the development context. To take the advantage of the learning opportunities when using simulation games, they should be applied in a planned and a purposeful manner. *The role of trainers is essential to facilitate and organize the learning process, and to promote discussion, in other words, to enable the resources to be used as effectively as possible* (1,4,5).

2. LEARNING FROM EXPERIENCE THROUGH SIMULATION GAMES

In order to understand, on a general level, how the human learning process is assumed to happen during a simulation game, I will present the experiential learning theory (11). The learning cycle is examined in order to understand how learning could be promoted by simulation games. This theoretical viewpoint can be seen relevant because of the absence of theory underpinning practice of simulation games in many cases.

2.1. Experiential learning theory

The importance of the *experiential learning theory* to the practice and theory of simulation and gaming is widely acknowledged, for example by SAGSET (Special issue on Simulation/Games for learning 1986). Simulation games emphasize the relevance of personal experiences through participation. Simulation games are a way to get experiences which resemble the experience in real life. The experiential learning theory by Kolb (11) is suggested as a holistic integrative perspective on learning that combines experience, perception, cognition and behavior. It is originally based on learning models of Lewin, Dewey and Piaget (11). The theory is applied in many adult educational fields, like in management education and in organizational psychology.

2.2. Learning cycle

The *learning cycle*, based on the theory of experiential learning, is widely applied in literature on simulation games for education (11-16). The learning cycle, the process of experiential learning, has four related stages (11):

1. concrete experience
2. observation and reflection
3. the formation of abstract concepts and generalizations
4. hypotheses to be tested in future action, which in turn lead to new experiences.

Learning is understood as a continuous process whereby knowledge is created through the transformation of experience. It is the modification and construction of information, involving transactions between the person and the environment (11). This cyclical model is relevant to the use of simulation games in education and training since they are a type of 'controlled experience' from which learning can happen if the whole experience is used effectively and the learner goes through all four stages (12-14).

It is common to view playing simulation games as a three-phase process involving (14):

1. introduction or briefing before gaming
2. actual game activity
3. debriefing or post-experience analytic process

These phases of the simulation game and the experiential learning cycle are closely linked (14). (Figure 1).

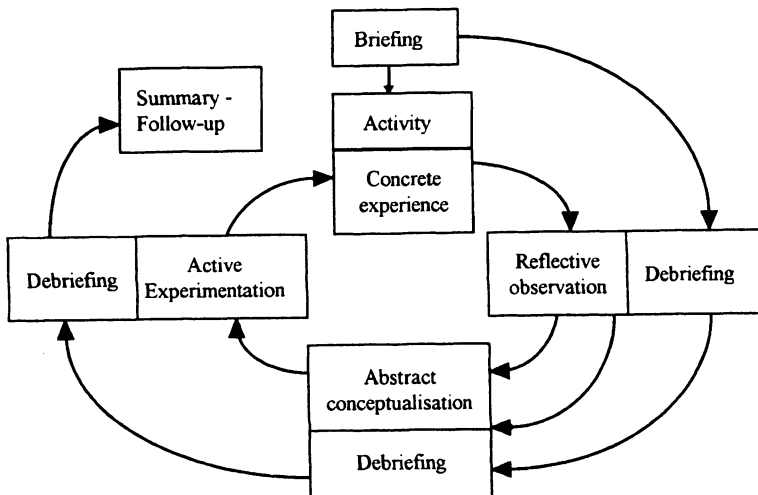


Figure 1. Experiential learning in simulation games. Kolb's learning cycle and the phases of simulation games (12-14).

The trainer should monitor and analyze the simulation game all the time to understand what is happening, and to help participants to summarize the game experiences and to learn from them. Let us look at the significance of each of the stages in the cycle in a little more detail.

2.3. Introduction to the game

For orientation to learning, participants should be carefully introduced to the simulation game. Participants should first be familiar with the game, its rules and directives etc., before (s)he can start learning from the game. There are many steps involved in the process of instructional outcomes of a game (15).

Human activity is goal-oriented and the direction that learning takes place is governed by one's goals. The process of learning may be erratic and inefficient when objectives are not clear. Therefore, in all simulation games, it is important to clarify their educational objectives.

2.4. Game experiences.

The experiential learning model includes first the learners' involvement in some concrete 'here and now' activity. These events may be structured and designed to promote learning, like simulation games (Figure 1).

There are several variables in organizing and running simulation games, which have effects on participants' learning and results of the game session. 'What anyone learns from any experience depends on circumstances' (17): conditions of gaming, administrative variables, internal game variables, as well as group and personal variables.

A game experience as such does not necessarily lead to learning. The situation does not tell us what there is to be learned. On the contrary, game experience might lead to the strengthening of old habits and wrong routines. In order to learn from experience participants need to observe and reflect on their experiences, and to conceptualize and generalize them.

2.5. Observation and reflections of experiences

The next phase of the learning cycle (Figure 1) offers an opportunity to *reflect* on and *observe* experiences from many perspectives, for example, by sharing reactions and observations in discussions with other participants. This may happen during or after the game session. It is the process which provides a crucial link between experience and the process of change and adaptation of the knowledge base. Reflective observation is described as the process, where participants start to question, to sort out and to classify the main events of the experiences in the simulation game. It helps to clarify ideas, sort out the elements of the event and to make sense of it (12-13).

Reflection is defined (18) as a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to understand them better. The process of reflection includes recalling the experience, attending to feelings involved in the experience and re-evaluating the experience. Cognitive and affective domains are interrelated, because learning may be either promoted or inhibited by feelings raised in the game.

2.6. Abstract conceptualization

In *abstract conceptualization* (Figure 1), the participants generate generalizations and integration of the material encountered, for example, in group discussions. The reflections have to be transformed into abstract ideas in order for them to be stored in our knowledge base. Abstract conceptualization is the process by which we store abstract ideas and the outcome of reflections on our mental representations for future use (12,13). Participants create concepts that integrate observations into logically sound theories (11,14).

2.7. Debriefing

Debriefing is frequently referred to as the key process in learning from the use of simulation games (Figure 1). It is an integral part of any learning experience. Debriefing is the process by which the experience of the simulation game is examined, discussed and turned into learning. It consists of drawing out and summarizing the main learning points to be derived from game activity. If there is insufficient attention in linking simulation game experiences with reality, the learning process might be destroyed (12-14).

Debriefing can be seen as a process of reflection which provides detailed order and meaning to participants' experiences - what had occurred in the game from the point of view of each of the participants. Debriefing could include, for example, the *following themes* (12-14):

- Identifying and considering the simulated process and modelled system.
- Clarifying the facts, concepts and principles which were used in or related to the simulation.
- Identifying different views which each of the participants formed, of the nature of the process and the experience.
- Identifying the emotions involved in the simulation session.
- Identifying the impact of the experience on each individual and evaluating the simulation game experience as whole for the group of participants.

When simulation games are applied in the organizational context, participants and game designers can discuss validation of the simulation game compared to a real work system and verification of the model underpinning the game. In debriefing, feedback can also be gained on the whole simulated work system and participants can present ideas and suggestions for improving it. This is the way simulation games can be easily linked to participative development of, for example, real production systems or processes.

The debriefing can be *organized* in a number of ways: from informal or structured discussion to some form of written report or response questionnaire. The post-game discussions in groups may be the most common way to handle issues raised during the game session.

2.8. Active experimentation.

Active experimentation of learned principles can be applied both in the game and in reality. The simulations can be used to make hypotheses of reality and to test them *in the game* (Figure 1). Different kinds of solutions can be tested and probable consequences can be seen. These 'prototype solutions' can then be corrected, modified and retested (13-15).

It is assumed that learning goes through *a series of cycles*. At each stage active experimentation in a game leads the participant to a new and enriched concrete experience. As the experience evolves, the reflective observation becomes more articulate and the abstract conceptualization more complex (12-15).

Simulation games provide an opportunity for participants to make *experiments* with modelled reality and to see results before applying these actions to real work systems. Participants can learn the relative costs and benefits, risks and potential rewards of alternative strategies of decision making in gaming. This is the way simulation games can be used as a method for planning and designing work systems or production processes (10).

According to Kolb (11), active experimentation means testing implications of concepts in new situations *in real life context*. After a training programme with a simulation game, participants should be able to apply learned principles to new situations. They will have active experimentation abilities to use theories, make decisions and solve problems, for example, in a work context, like working in a small group, in customer-service or production management.

3. THE EFFECTS OF SIMULATION GAMES ON PARTICIPANTS, AND TRANSFER TO REALITY

What kind of psychological processes occur, when a person or a group participates in a simulation game? In general, from the perspective of modern cognitive psychology, it is a question of learning from experience followed by a series of complex mental activities to make some kind of sense of that experience. This active mental process of trying to analyze and understand a new experience is transaction between earlier learned mental representations. The process involves identifying, changing and modifying of the knowledge, skills or attitudes which result from the game experience, and relating them to our knowledge base. Learning can be seen as a gradual construction and modification of the knowledge base of possible situations and solutions through game experience, which can be shared by other participants.

3.1. What is learnt?

What do participants learn from simulation games? To what extent is their understanding improved? And how are their attitudes modified? These questions are very difficult to answer. Only a few studies of the educational effectiveness of simulation games have been conducted (19,20). Much of the work concerning the evaluation has been descriptive, anecdotal or judgmental. A review of studies reflect a trend to use descriptive reports rather than empirical studies (17,20). Most of the studies have been conducted in school environments. There is only a few studies from organizational contexts. For some reason, production games are not included in recent reviews (5,17, 20-22).

Simulation games have been successfully designed and utilized to meet a number of *teaching and training objectives*, including cognitive, motivational and affective or attitude effects (5,17,20-22). Those effects presented in literature reviews are grouped here on three levels: 1. effects on individuals, 2. effects on group behaviour, and 3. transfer effects on later activities.

3.2. Effects on individuals

Research efforts concerning simulation games and their effects have been focused primarily on cognitive learning (19). The cognitive domain deals with recall and retention of knowledge, and with development of skills and abilities (19,22).

Cognitive learning outcomes or skill development presented in literature (5,17,19,21,22), dealing with different kinds of simulation games, could be summarized in the following descriptive way:

- conveying information about facts
- general principles of the subject matter simulated in the game
- systemic understanding of structures of simulated systems
- critical thinking and analysis
- decision-making skills and problem-solving
- the relationship of a specific role to an overall system
- a broadened awareness of options, policies and issues
- a broadened awareness of probable consequences of particular policies or events
- particular skill development, such as budget preparation, forecasting sales, from given information, proposal writing, summarizing radio accounts etc.

Effects of simulation games on participants' *attitude changes* could be summarized (5,17,21,22) in the following general way:

- attitude towards subject matter addressed by games
- attitudes toward social phenomena, like ethnic groups or economic institutions
- attitude toward oneself
- social attitudes and values, such as cooperation or competition.

It has been presented that participating in simulation games is itself interesting and challenging, which may increase interest and commitment to learning in general. By simulation games, *increasing motivation and interest* has been gained, for example (17, 20, 21):

- in the subject matter or topic of the game
- in the general field of the study
- in doing further research on the topic of the game.

3.3. Effects on groups

In simulation games, it is essential for experiential learning (11-13) that participants share their experiences together and hear each others' viewpoints about the subject studied. That kind cooperative or interactive learning could lead to so called distributed or *shared knowledge* among participants.

It has been claimed that simulation games may have following positive *effects on groups* of participants (17,21):

- better communication and cooperation
- development of interactional skills, such as bargaining and negotiation
- increased knowledge of other participants, and greater peer acceptance
- changes in classroom relations, like empathy for those in other roles.

Simulation games are increasingly being used to develop group skills, like communication, decision-making and conflict resolution in teams (23).

3.4. Transfer to reality

Transfer of skills can be defined as the generalizations of knowledge, general principles, skills, or attitudes from the game to a variety of real-life situations. In general, transfer is the degree to which a behavior will be repeated in a new situation, for example, at school or at work (23).

It could be argued that if simulation games are not used to develop transferable skills, then the methodology is being mis-applied. However, ensuring and proving that transfer takes place from the simulation games to the real world activity is not easy (23).

There have been claims about changes *at schools* in the character of later course work and classroom structure, like general atmosphere and greater participation (5,17,21).

Simulation games have been utilized to promote participants preparedness for specific future tasks, such as counting, managing employees on a team or coping with emergencies. However, there seems to be little knowledge, whether participants apply their learning outcomes on the job, and few empirical studies about effects of simulation games on *real work activities*. Although the power of production games for changing attitudes, knowledge and behavior is realized (24), there seems to be lack of empirical studies about these issues.

Attempts to integrate simulation games as part of corporation training and development have not always been successful. Some reasons for limited use of simulation games in this context are, for example, limited knowledge in companies about benefits of simulation games as well as problems with evaluating effectiveness of simulation games (25).

3.5. Effects of simulation games compared to other methods

In summary, the majority of previous reviewers (17, 20, 22) have concluded that simulation games are at least as effective as other conventional methods for teaching knowledge about facts, concepts, and generalizations and application of knowledge. The reviews tend to support the belief that simulation games have greater effects on participants attitudes than other instructional techniques.

The review article (22) of recent research of the effectiveness of games for educational purposes, compares the instructional effectiveness of games to conventional classroom instructions. Business, management and production games are not included, partly because of the difficulty of specifying what subject matter was taught. The review examines results for mathematics, languages, logic, physics, biology and social sciences over a period of 28 years. Of the 67 reviewed studies, 38 show no difference between games and conventional instructions; 22 favor games; 5 favor games, but their controls are questionable; and 3 favor conventional methods. The authors concluded that subject matter areas where very specific content can be targeted are more likely to show beneficial for gaming.

4. DISCUSSION

According to literature there seem to be advantages of using simulation games as a method for learning and education. Next, some of the arguments on behalf of using simulation games will be summarized. Finally, I make some suggestion for further studies.

4.1. Advantages of simulation games

In simulation games participants are *active learners*. Several learning theories have stressed the importance of a student's active involvement in working on the material or skill to be learned. In simulation games participants are active learners, instead of being passive recipients of information. They have an active role in analysing, constructing and modifying information. They are involved in making decisions, articulating positions and seeing consequences. Simulation game is a student centered method. It provides experience through the exploration and discovery of issues, rules, methods and interpretations.

Simulation game is a fundamentally *dynamic method*. It deals with situations and processes which change, and which demand flexibility in thinking and preparing as well as responsive adaptation to circumstances as they vary. Simulation game is an activity oriented method emphasizing learning by doing. Participants are engaged in the working system and they can experience simulated consequences which relate to their decisions and performance. Simulation games are useful for conveying system characteristics and systems in operation offering the possibility to perceive the topic as a whole. Simulation games can form a dynamic learning environment reflecting the real work situations or contexts.

Simulation games can be seen as a *multisensory media*. The focus is on concrete activity, on 'doing', in addition to the 'listening' and 'watching' that occur in more traditional lecture classes. In simulation games, participants can process information through several channels. It is an illustrative and concrete way to present and clarify complicated (work) systems and processes. It has been found that visual and concrete representations may promote problem solving better than an abstract and symbolic presentation.

Simulation games may offer possibilities to *interactive and cooperative learning*. Simulation games are usually based on participants' social interaction and communication. Simulation games offer opportunities to learn about social systems and to train social skills. They present an informal and work community related approach to understand situations from the different perspectives of other employees.

4.2. Suggestions for further studies

The learning cycle based on the experiential learning theory, introduced in this paper, provides a way of understanding, on a general level what is happening to participants when engaged in a simulation game. This framework can be applied to facilitate planning a learning event that makes use of a simulation game. In practice, applying of experiential learning theory can offer possibilities for practical guidelines, for trainers and game designers, to support participants' learning through simulation games.

However, deeper *theoretical understanding* of how learning occurs and what kind of learning takes place in a simulation game, is important for trainers and game designers to promote learning and to effectively use that educational method. The fundamental psychological questions still remain to be answered about the relations between cognition and work activity in learning, and the role of simulation games in this complicated process. Modern theories from cognitive psychology and activity theory seem to be fruitful for further research.

As a conclusion from several studies of the *effectiveness of the simulation games* as an educational method, mainly in school environment, it could be assumed that simulation games are at least as good as other educational methods and possibly better. Further *evaluations* should show more exact results, which are especially needed from the work and organizational context, like production management.

Transfer can be seen as a key determinant of the effectiveness of simulation games for training. Because the learning process mediates the effects of simulation games into work practice, the problem of transfer seems to be essential for further studies. The efficiency of simulation games in the transfer of skills can be improved by applying of principles from cognitive psychology.

In result-oriented training with simulation games, focus should be on learning the skills, knowledge and attitudes required to perform a job, or improving upon the current work performance. The impacts could be seen for example, as a more effective task handling or as a better co-operation in a team.

The training programme including simulation games, could contribute to impacts on a unit or a department in the organizational level, for example, in increased productivity, better quality of customer service or more fluent work flows. Effects of educational events are mixed with other social, cultural, technical and organizational variables. Therefore the evaluation is difficult.

It is a challenge to *broaden the application area* of simulation games for work and organizational development. When the simulation game is closely linked to ongoing development or redesign activities within a specific organizational context, then the simulation game provides an immediate experiential reference that promotes learning and guides the real-time development efforts of the personnel.

Simulation game can be seen as an attractive and encouraging method for personnel training in companies as well as for promoting learning in organizational development.

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