COPYRIGHT

4.THE GAMING LANDSCAPE: A TAXONOMY FOR CLASSIFYING GAMES AND SIMULATIONS

Jan.H.G. Klabbers /

ABSTRACT

Following Huizinga's view, the play element of culture is emphasized. While playing, by means of rules, the participants in a game interact with one another to impact on the reference system. Thousands of simulation games are available that depict many different areas and purposes of use. The variety of the gaming landscape is illustrated by linking the various foci and areas of interest in one scheme. To see the wood for the trees, the generic model of games is presented, based on the three interconnected building blocks: actors, rules, and resources. I will point out that even if games have similar forms, their purpose, subject matter, content, context of use, and intended audience(s), may be very different. A framework for constructing, deconstructing and classifying games emerges, based on the combination of the three building blocks with elements of a semiotic theory of gaming: syntax, semantics and pragmatics.

KEYWORDS

Actors, rules, resources, faces of knowledge, interaction & acquisition metaphor, syntax, semantics, pragmatics, classification, taxonomy, gaming, simulation

INTRODUCTION

Human beings are very big-brained animals that show playful behaviour like many other big-brained animals [3], [12]. Their many manifestations and widespread use show that gaming and playing are bound together by an indissoluble tie with human culture [11]. Huizinga stressed in his book "Homo Ludens" *the play element of culture*, he was not referring to the *play element in culture*.

As gaming is so ingrained in human culture and nature, the language of gaming whether for fun or for scientific endeavour is similar. This is an advantage and a disadvantage. It is an advantage because everybody understands their general meaning. It is a disadvantage, because in science that meaning is most of the time different from ordinary use. So, there is a real chance that people think they understand each other, because they use similar terms, while actually they are talking about different things. Besides this potential confusion, the variety of appearances of gaming is so bewildering that it is worthwhile to develop schemes that can help us to see the wood for the trees. Therefore,

before elaborating on a generic taxonomy, it is appropriate to be aware of those terms in the English language that have similar connotations. These terms are: *exercise; play; game; gamble; model; simulation; simulator* [16]. They overlap to a certain extent, representing a continuum of products and activities. I will further focus on these terms from the scientific viewpoint on gaming, because according to my view, gaming encompasses the other terms, and provides a common context for education, training and research.

Playing games means being involved in symbolic acts that - dependent on their degree of playfulness - are valued for themselves. Training and education in industrialised societies stress the instrumental utility of games. In such a context, games are used as tools, or means, to achieve well-defined learning goals. Increasingly, computer or video games are being designed for purely entertainment purposes. While in traditional gaming, designers use reference systems of the real world, video game designers envision imaginary worlds that may show little resemblance with our daily experiences.

THE GAMING LANDSCAPE

Participating in games implies engaging in embodied experiences. While playing, the participants interact with one another and with the reference system, which can be represented in many different ways such as a board, a computer interface with icons that represent a database, a spreadsheet, an information system, and/or a simulation model. Gaming crosses existing knowledge domains. It is a trans-disciplinary field of research, education and training, and links many areas of enquiry and professional practice (See Table 1).

The field of gaming and simulation is illustrated in Table 1. Each cell represents a particular playing field, covering various forms such as role-plays, board games, computer-assisted and -supported simulation/games, behaviour simulations, mock-ups, etc. Consequently, many playing fields are available, each of them representing specific learning environments, offering a great variety of learning experiences.

GAMING FOR EDUCATION, TRAINING AND RESEARCH

Games are used for education, training and research. Video games are mainly designed for entertainment. Marshev and Popov [23] relate the semantics of games with social systems. To understand gaming both from a scientific and practitioners' point of view, it is worthwhile to elaborate on their context of use.

In education, games help in understanding the relationships between content, process and context of a subject matter. Emphasis is on handling concepts, relations, and sharing of explicit and tacit knowledge. In training, especially in professional training, emphasis is placed on abilities and skills to improve performance. For example, management games are media to address a variety of issues such as, managerial behaviour, business economics, group dynamics, leadership, strategy, and ethics. Trainers raise awareness of key issues, and the players develop strategies for coping with organizational and managerial problems.

Games are social systems. They are also models of existing or imagined social systems, shaped by the players. While playing a game, people apply knowledge and skills to triumph over difficulties set by fellow players or by socio-economic circumstances. They shape organizations and act within the boundaries of organizations, guided by the rules. This applies to small children playing their imaginary worlds, to teenagers having fun with video games, and also to professionals playing with business

THE GAMING LANDSCAPE:
A TAXONOMY FOR CLASSIFYING GAMES AND SIMULATIONS

	Foci of Interest					
	I. Theory & Methodology					
	II. Instrumental design					
	III. Research					
	IV. Training & Education					
	V. Entertainment					
	Themes					
	competence	**communication**	**knowledge & skills**	**management & organization**	**policy**	***fun***
Areas of application: Reference Systems						
1. Business administration						
2. Public administration						
3. Educational Institutions						
4. Environment						
5. Health care						
6. Human services						
7. Int. relations						
8. Military						
9. Religion						
10. Technology						
11. Human settlements						
12. Imaginary worlds						

Table 1: Realm of Gaming & Simulation [18]

games. While trying to defeat the odds, players try to gain competence, power, and influence. Actors constitute systems of interactions. They draw upon rules and resources while functioning in organizations. In a soccer game for example, the players, the coaches and the referees are the main actors. They interact according to the rules. Their resources are the ball, the soccer field, the stadium, etc. While confirming each other's roles, and making use of the rules and resources, they produce and reproduce the social system concerned (that is, a particular match). By changing the interactions, the rules and/or the resources, they either transform the system or produce a completely new one. They may switch for example to rugby. They can also change position, from inside participant (actor) to outside observer. In this case, they can question the motives and effectiveness of the actors; the rules as applied by the referee; and/or the quality of the resources. That could help to develop strategies for the maintenance or transformation of the social system that is, the game. Underlying this approach to social systems is a notion about terms such as, autopoiesis (self-reproduction), self-reference, and reflexivity (self-awareness) [17].

The communities of gamers such as ISAGA, SAGSET, ABSEL, NASAGA, JASAG, SAGSAGA, DiGRA, etc. represent different gaming cultures. All are involved in pursuing gaming and simulation for research, education and training. All are focussed on learning from and through gaming. Therefore, they need a com-

mon framework for advancing the field, and to understand each other and communicate effectively about what they are doing, taking into account that scholars and practitioners usually operate within a small subset of Table 1.

Due to the great variety of appearances of games and simulations we need to develop a common language, a trans-disciplinary theory of knowledge to be able to develop a meta-discipline. Barth [2] offers an interesting and fruitful approach to that debate. From the perspective of an anthropology of knowledge, he distinguishes three faces of knowledge:

- a substantive corpus of assertions,
- a range of media of representation, and
- a social organization.

They interrelate in particular ways in different traditions of knowledge, and they generate tradition-specific criteria for validity of knowledge-about-the-world. Knowledge, according to Barth, is "a way to understand major aspects of the world, ways to think and feel about the world, and ways to act on it" [2, p4]. Every game is being designed with in mind: a substantive corpus of assertions (rules and resources), a range of media of representation (rules), and a social organization (actors). These faces interrelate in particular ways in different games.

I will paraphrase Barth's views to make them suitable for gaming. Any game represents a tradition of knowledge. It contains assertions and ideas about aspects of the world. This tradition must be instantiated and communicated in one or several media as a series of partial representations in the form of words, concrete symbols, pointing gestures, actions. It is distributed, communicated, employed and transmitted within a series of instituted social relations. These three aspects of knowledge determine, constrain and enable one another. They are embedded in the play element of culture. To paraphrase Chi-Yue Chiu's comments on Barth's paper, "during a game session, meaning is constructed, transmitted and applied in social transactions. These symbolic actions take place among socially situated persons with particular communicative intentions" [4, p.11]. Within such a setting, the interplay between tacit and explicit knowing will bring forward a certain type of cognitivity. Learning has only taken place, if as a result of playing a game, increased cognitivity enhances our understanding of (parts of) the world, our thinking and feeling about the world, and our ways of acting on it.

Media of representation and communication run in the field of gaming and simulation from game boards, paper and pencil, snow cards, and computer interfaces vis-à-vis underlying mathematical models, to web-based multi-media configurations. Different branches of academic knowledge use different media of representation. Mathematical knowledge uses computations, gross anatomy series of atlases, microbiology its technical laboratory equipment and chemical models, geography atlases and scale models, and so on. Barth points out that these representations shape both thought and action and thus the practices of professionals in different disciplines. They shape the style of the game design when designers choose the media or representation in the game. By selecting certain media of representation, game designers construct imagery that affects the learning that is, the construction of new knowledge. In addition to and distinguished from the modes of representation, the organizational face of knowledge determines criteria of validity, trajectories of evolving knowledge resulting from the negotiation of meaning, and forms of coherence that govern knowledge. The organizational face of knowledge in a game results from the systems of interactions between the actors, which are governed by the rules, and constrained the available resources.

Considering the organizational face of knowledge, the idea of duality of structure is relevant. "Interaction is constituted by and in the conduct of subjects; structuration, as the reproduction of practices, refers abstractly to the dynamic process whereby structures come into being. ...Social structure is both constituted by human agency and is at the same time the *medium* of this constitution" [8].
Actors constitute systems of interactions. They draw upon rules and resources while functioning in organizations. By changing the interactions, the rules and/or the resources, actors either transform the system or produce a completely new one. Because of the duality of structure, they can also change position, from inside participant (actor) to outside observer. That could help to develop strategies for the maintenance or transformation of the social system, in our case, the game. Such a transformation will impact on all three faces of knowledge, on the substantive corpus of assertions, the range of media of representation, and the social organization. Such transformations are beyond the scope of rigid rule games, which presume that participants play by the rules without questioning them.

About learning

All education and training aim at developing expertise. Five interacting key elements are: meta-cognitive skills, learning skills, thinking skills, knowledge and motivation [28]. These five key elements should be seen from the viewpoint of individuals operating in so-called contextualized environments such as in games. The controversial nature of current learning theories offers an interesting view on the potentials of and problems with interactive learning environments. I will highlight two competing frameworks, the acquisition metaphor versus the interaction metaphor. They implicitly play a key role in understanding the meaning of the five elements pointed out by Sternberg [29]. Although Sfard [27] uses the participation metaphor, in this paper I prefer to use the concept of interaction. I will not elaborate on epistemological and ontological foundations of both learning metaphors.
Sfard has pointed out that since the time of Piaget and Vygotsky, the growth of knowledge in the process of learning has been studied in terms of concept development. The learner is a person who constructs and negotiates meaning. Sfard states: "The language of "knowledge acquisition" and "concept development" makes us think about the human mind as a container to be filled with certain materials and about the learner as becoming an owner of these materials" [27, p5].

The following terms fit into the framework of the acquisition metaphor: knowledge, concepts, conception, notion, misconception, meaning, sense, schema, fact, representation, material, content. Terms that denote the action to become owner of knowledge are: reception, acquisition, construction, internalisation, development, accumulation, grasp. Acquired knowledge, like any other commodity, may be applied, transferred and shared with others. The acquisition metaphor is strongly entrenched in the rationalist tradition in science. In this tradition, knowledge is composed of abstract, context-independent, formally interconnected domain-specific concepts [15].

The interaction metaphor has recently started to develop. Rogoff [26] speaks of learning as an apprenticeship in thinking. Sfard signals an extensive change by the fact that, although referring to learning, recent literature does not mention "concept" or "knowledge". They have been replaced with the noun "knowing", which indicates action. She states: "The talk about states has been replaced with attention to activities. The image of learning that emerges from this linguistic turn, the permanence of having (*knowledge*) gives way to the constant flux of doing" [27, p6].

The new set of key words is "practice", "discourse" and "communication". They suggest that the learner is a person interested in participation in certain kinds of activities rather than in accumulating private possessions. From the viewpoint of the interaction metaphor, learners contribute to the existence and functioning of a community of practitioners [27]. Greeno [9] defines learning as "improved participation in interactive systems."

The dilemma of this metaphor is phrased in the question:" How are learners able to build for themselves concepts that seem fully congruent with those of others?" This simple question is difficult to answer. It is out of the scope of this paper to elaborate on it. (More information, see [15, 16, 17, 19,21]).

Considering the wide variety of games, and areas of application, the gaming landscape is so diverse that investigating questions about learning cannot yet be addressed straightforwardly. Even if games have similar forms, their purpose, subject matter, content, context of use, and intended audiences, may be very different. Questions of learning and knowing through gaming and simulation are not being addressed adequately as long as assessments and evaluations, debriefing included, are limited to the specific game or simulation in hand. Therefore, I have made the following proposition: *Studying interactive learning through gaming and simulation can only be productive if a suitable epistemology is available to connect learning through specific games with learning through gaming [21].* The basic question concerns the kinds of learning and knowing that emerge while playing a game, any game. Such learning and knowing should be linked to the *play element of culture*. It should as well pay attention to the specific learning environments provided. A comprehensive theory about learning and knowing through gaming and simulation is not yet available due to competing epistemologies. Moreover, the community of gamers seems to be more interested in the instrumentality of games that is, in methods and techniques of game design and use. Methodological questions have not yet drawn wide attention.

STEERING IN SOCIAL SYSTEMS

Interactive learning environments based on simulation models, view the social system as allopoietic or artificial. The behaviour of such a system is controlled by the function it fulfils in the larger social system and by the input it receives from its environment. It is viewed as an instrument, produced and used by another external system to reach its goals [24].

Interactive learning environments based on the gaming, particularly free-form gaming, view the system as autopoietic. It is not structured by external information it receives, but by its system of interactions. Therefore, the (meta-)cognitive structures used by the system are constructed (produced) by the system itself. Maturana and Varela too reject the concept of knowledge as a representation or image of some external reality. Cognitive interaction between the system and its environment is restricted to triggering of internal processes by external perturbations [10]. Evidently in social systems these internal processes are enacted by the actors, which produce a system of interactions. They form the autopoietic (self-reproducing) forces within the system.

From epistemological point of view, I see a strong link on the one hand between learning according to the acquisition metaphor, allopoietic steering and simulation, and on the other hand between learning according to the interaction metaphor, autopoietic steering and gaming.
Designers of the interactive learning environments have the option to balance the acquisition and inter-

active metaphor. They can offer learners the possibility for learning concerning terms such as practice, discourse, communication, interaction, and improved participation in interactive systems. They should however keep in mind the limitations of rule-based simulations and games with respect to the self-reproduction of the subsystems of rules and resources. That restriction hampers the actors to distance themselves from the rules and resources to devise strategies for their transformation. That option would provide the conditions for interactive learning environments to become self-organizing [17]. Truly self-organizing learning environments stress that the ideal of objectivity, that is, universal knowledge, and knowledge as accumulation, needs to be replaced with inter-subjective agreement within a historic community. This notion is the quintessence of the interaction metaphor.

CLASSIFICATIONS

In this section I will select several classifications of games to show that different approaches give meaning to different characteristics. For a start, a simple definition is presented. A game is a contest (play) among adversaries (players) operating under constraints (rules) for an objective (winning, victory or payoff) [1].

Ellington *et al*. [6] identify two essential features for describing games. The exercise, or activity, must involve overt competition between individuals or teams, or between the individuals or teams, which are competing against "nature". In addition, the exercise must have rules. The players must operate under a set of guidelines specific to the particular game. They relate three related sets of exercises, namely, games, simulations and case studies that partly overlap each other. Based on this scheme, they distinguish the following three pure types and four hybrids:

- pure games
- pure simulations
- pure case studies
- simulation games
- simulated case studies
- games used as case studies
- simulation games used as case studies.

Ellington *et al* then classify games according to their format, the means through which the game is presented, see Table 2.

Caillois [5] developed a classification of games, based on two dimensions. The first one refers to four categories: AGON, ALEA, MIMICRY and ILINX, the second one to the rule base: PAIDA and LUDUS, see Table 3. MIMICRY and ILINX reflect the playfulness of activities, while AGON and ALEA represent mainly gamesmanship, see Table 3.

Shubik [28] has developed the following scheme, see Table 4.

Psychomotor skill games	**(Computer-based) manual games**
field games	soccer, baseball, golf, tennis, etc.
table games	snooker, pool, etc.
simple manual games	charades, crossword, puzzles, etc.
card games	bridge etc.
board games	chess, go, monopoly, etc.
device-based games	Rubik's Cube, etc

Table 2.: Classification of games according to format (adapted from Ellington et al. [6])

PAIDA <----------> LUDUS (freedom, free improvisation (rules & conventions)
AGON - races, wrestling, ---------- soccer, chess (competition: equal probability of success)
ALEA - counting rhymes ---------- lottery (luck: players cannot exert any control over outcomes)
MIMICRY - childish imitations ---------- ---------- theatre (mask: players pretending to be someone else)
ILINX - merry go round ---------- acrobatics (vertigo: attempts to disrupt regular perception patterns)

Table 3: Classification of games (adapted from Caillois [5])

Table 4: Taxonomy of games (adapted from Shubik [28]).

Use	**From –> rigid-rule games:** manual games	computer-based games	**To free-form games**
Training			
Teaching			
Operational: • policy formation • dress rehearsels • sensitivity analysis			
Experimentation: • theory generation • theory validation			
Futures Studies (structural brain syorming)			

These classifications emphasize the functionality and/or goals of a game. Different gaming formats might have similar functions. Such classifications do not provide valuable information about their architecture, which is a precondition for understanding their differences and commonalities of design. In order to present principles underlying the architecture of games and simulations the following basic form is presented. It is based upon key characteristics of human organisations, and in more general terms, of social systems.

A GENERIC GAMING AND SIMULATION MODEL

Games represent social systems in all their variety. Although games and simulations can be very different as regards their format and content, they have in common the following basic form of social systems [15]. Their architecture is defined by three interconnected building blocks:

- Actors
- Rules
- Resources.

In each game, the players (actors) interact with one another, while applying rules, and utilizing resources. General management games model companies that

are operating in the same market. The acting teams apply similar rules and apply similar resources to compete with one another. Urban management games, which aim at enhancing policy development and urban planning, can be envisioned to include actors that represent different interests and positions in the political arena. The actors may apply various rules, while having different resources available. On the basis of this generic model, numerous configurations of games and simulations can be described and envisioned.

Marshev and Popov [23] developed a semiotic theory of gaming.
They distinguish three viewpoints:

- syntax of a game -
  arrangement of elements and rules of a game;
- semantics of a game -
  interpretation and meaning of elements of a game;
- pragmatics of a game -
  design and use of a game.

By integrating both viewpoints, the emerging framework enables to characterize games and simulation in great detail [16]. It enhances the understanding of commonalities and differences between the design of specific games and simulations.

A TAXONOMY TO CLASSIFY GAMES

Combining social systems theory [13, 14, 17] with semiotic theory of gaming [23] offers an integrated framework for understanding the basic elements of gaming. Each game with its specific structure of actors, rules, and resources is a language with its particular syntax, semantics and pragmatics. As a language it conveys and produces meaning and context dependent, situational knowledge. It also shapes the system of interactions and consequently the internal organization of the game. The purpose of a game can be autotelic or allotelic. It is autotelic if the players have the freedom to act according to own goals and sources of motivation. They are free from dependence on authority and be allowed to reason for themselves [25, p.18]. Knowing is gained mainly through interacting. A game is allotelic if the players act according to outside goals and sources of motivation, embedded in the rules. Their activities represent means to some end. They are mainly recipient of information. They depend on the authority of the game facilitator and are forced to reason according to the knowledge provided by the game manuals. Knowledge is mainly gained through acquisition.

SYNTAX

The syntax defines the grammatical arrangement of a game.

Actors

Players: Participants of the social system. The number of people participating in the game can play multiple roles. They shape the social organisation.
The number of places for actors: actors are capable of carrying out activities in the game. They can be individual players or teams.

Rules

Manipulation set of the game: this subset of rules defines the manipulations, the possible moves with the pieces, as transformations of the positions.
A set of game positions: the arrangement of the set of pieces at a certain moment in time defines their position in the scheme of the game space. Rules describe the initial subset of positions. Dependent on the type of game, they may also define the intermediate and final subset of positions, including the rules for finishing the game.

Both the game manipulation set and the set of game positions are related to the media of representation.

Resources

Set of pieces to play with: these pieces symbolize a real or imaginary world.

Game space: the pieces and the way they interrelate are defined by the rules. The pieces are allocated in the game space via an initial setting and they change during the process of playing. The set of places is the game space, and the set of places with its structure: the arrangement is the scheme of the game space. The configuration of the game space depends on the substantive corpus of assertions, made by the designer.

Valuation set: assessment and valuation of initial, intermediate and final position for each player and team.

SEMANTICS

The way a game corresponds with our understanding, with our conceptual frames - the general interpretation - is called the semantics.

Actors

Roles: the 'role' is a key term in the semantics of a game. It provides a context for interpreting a game space. It offers a lens and a perspective for interpreting and acting. The role structure gives shape to the theoretical (formal) structure of a social system. Actors take those roles and express them according to formal and informal rules.

Actors take different roles according to the rules. They have available pieces of different types with the positions taken by these pieces. They can make a sequence of moves with these pieces while trying to achieve their goals. They have access to various sorts of information about the game, and during the game.

Rules

Relationships between roles: a game is a symbolic representation of the actor structure of the social system. The relationships show the communication and coordination structure of the social organisation. Who is allowed to interact with whom?

Cultural, socio-economic situations: the placement of pieces according to the scheme of the game space is the position at one moment in time. It is understood as a particular state of the social system. Through that state a particular cultural and socio-economic situation is expressed.

Places for resource allocation: during the game pieces are allocated in the game space. This allocation, from its initial position, can be well-defined by the rules, or is for the players to decide. Initial and intermediate positions are evaluated to make subsequent moves.

Resources

Resources: the symbolic meaning of the pieces in the game space, referring to reality.

PRAGMATICS

The methodology and methods for designing, preparing, conducting and assessing a game comprise the pragmatics of a game. The design process includes the specific arrangement of the rules, the scheme of the game space, the game positions, the actors, their roles, and their correspondence with a symbolic world. During the preparations, the game operators or facilitators, the players, and the teams are allocated. The materials for the game, the facilities and equipment are prepared. Conducting a game starts with the instructions to the players and proceeds by assisting, guiding the process, and performing an extensive debriefing. The pragmatics are embedded in the ***macro-cycle of a game session*** *[19].*

Actors

Allopoietic vs. autopoietic steering: if the goals of the game are external, as usually happens in professional training, its steering is allopoietic, emphasizing the training of skills. If the goals are autotelic, steering is autopoietic. The resulting game is self-organizing.

Knowledge as acquisition, as interaction: if knowledge transfer is the primary goal, in terms of concepts, cognitive maps etc., the minds of the players are viewed as mental containers. That knowledge needs to be acquired. If knowledge is the result of negotiating meaning between the players, knowledge is the consequence of the system of interactions.

Rules

The team of facilitators: the facilitators are the referees or coaches who act according to the rules.

Format: the format defines the procedure for conducting the game. Games can be open, so-called free-form, or closed, so-called rigid-rule games.

Assessment function: assessing a game, after its final position has been reached, starts with the debriefing and may continue with a thorough evaluation of the subsequent positions of the scheme of the game space, the moves the actors have made and the motives for making those moves.

Resources

Materials, paraphernalia: the players receive instruction material, paraphernalia. They may use equipment such as computers. For conducting games appropriate facilities are needed.

Table 5 wraps up this taxonomy, including key aspects related to the specifications of design.

CLASSIFICATION OF SIMULATION/GAMES

Based on the building blocks of social systems, from the perspective of model building, it is possible to distinguish between gaming and simulation, particularly computer simulation of social systems. If no actors are involved, two options of simulation are available for modelling rules and resources [14]:

- pure simulation of resource processes with for example input-output models. Rules are rudimentary.
- via rule-based systems, simulation of information feedback systems such as in use with System Dynamics (see Table 6).

If resources are not explicitly defined, only actors and rules are involved. Actors and rigid-rules are the ingredients of theatre. Actors and free-rules shape role-plays (see Table 7).

If actors, rules and resources are explicitly defined, then we are in the domain of gaming (see Table 8).

With the framework depicted in Table 5, the variety of entertainment, educational, experimental, research, operational, manual, computer-based, rigid rule and free-form games can be coherently described both for newcomers, practitioners and researchers. From semi-

Table 5: Framework for a taxonomy of gaming (adjusted from [16])

Design specifications	1. Client 2. Purpose 3. Subject matter 4. Intended audience 5. Context of use		
Social System	**Syntax**	**Semantics**	**Pragmatics**
Actors	Players Number of game places	Roles	Allopoietic vs. Autopoietic Steering. Knowledge as acquisition as interaction.
Rules	Game manipulation set Set of game positions Final game positions Evaluation functions	Relationships between roles Cultural, socio-economic situations Evaluation of places for resource allocation, and position within team of players	Team of game facilitators Format: rigid-rule vs. free-form Assessment functions
Resources	Set of pieces Game space	Resources Set of places	Paraphernalia Equipment Facilities

otic viewpoint the difference between a computer-based and manual game, such as a board game, is not fundamental. From the perspective of media of representation they make a difference. This is for example the case with the computer-based and board game versions of PERFORM [13, 20]. The image of the games pieces and the game space, and therefore their gaming experience are different. Their symbolic meaning in terms of the substantive corpus of assertions remains the same.

	RULES rule-driven <–––––––––––––––––––––> open
RESOURCES	feedback models––––––– input-output models

Table 6: Simulation with no actors involved

	RULES rule-driven <–––––––––––––––––––––> open
ACTORS	Theatre––––––––––––––––––––––– role play

Table 7: Gaming with no explicit resources

	RULES rule-driven <–––––––––––––––––––––> open
ACTORS RESOURCES	Rigid rule games––behavioural simulations––– free form games

Table 8: Fully-fledged gaming

The level of abstraction of the taxonomy presented in Table 5 allows a detailed description of games, with all their variety in appearances. It connects design-in-the-small with design-in-the-large [22].

The taxonomy has been used recently to classify two similar but different games in an arbitration case about intellectual ownership, in designing new games, and in deconstructing existing games to understand their basic architecture. Among professionals and students it has enhanced considerably the mutual understanding of the architecture of the games involved.

REFERENCES

1. Abt C. Games for learning. In Boocock, S. S. and Schild., E. O. (eds) Simulation Games In Learning, Sage, (1968), Beverly Hills.

2. Barth, F. An Anthropology of Knowledge. Current Anthropology, 43 (1), (2002), 1-18.

3. Byers, J. A. The distribution of play behaviour among Australian marsupials. Journal of Zoology (London) 247 (3), (1999), 349-356.

4. Chi-Yue Chiu's, Comments on Barth's paper. Current Anthropology, 43 (1), (2002), 11-12.

5. Caillois R. Les jeux et les hommes. Gallimart, Paris, 1958.

6. Ellington H, Addinall E, and Percival, F. A handbook of game design., Kogan Page, London, 1982.

7 Fodor J, Concepts. Where cognitive science went wrong. Clarendon Press, Oxford, 1998.

8. Giddens A. New Rules of Sociological Method, Polity Press, Cambridge, 1993.

9. Greeno J. On claims that answer the wrong question, Educational Researcher, 26(1), (1997), 5-17.

10. Heylighen F. A new transdisciplinary paradigm for the study of complex systems? In Heylighen F, Rosseel E, and Demeyere F, Self-Steering and Cognition in Complex Systems. Towards a new cybernetics, Gordon and Breach, London, 1990.

11. Huizinga, J. Homo Ludens (in Dutch), Wolters-Noordhoff, Groningen, 1985.

12. Iwaniuk, A.N, Nelson, J.E, and Pelis, Sergio M. Do Big-brained animals play more? Comparative analyses of play and relative brain-size in animals. Journal of Comparative Psychology, 115 (1), (2001), 29-41.

13. Klabbers, J. Instruments for planning and policy formation: some methodological considerations, Journal Simulation & Games, 16(2), (1985), 135-160

14. Klabbers, J. The frame of reference underlying the user-oriented taxonomy of games and simulations. In Crookal D, Klabbers J, Coote A, Saunders D, Cecchini A., and Delle Piane, A (eds) Simulation-Gaming in education and training, Pergamon Press, Oxford, 1988.

15. Klabbers, J. Problem framing through gaming: Learning to manage complexity, uncertainty and value adjustment. Journal Simulation & Gaming, 27 (1), (1996), 74-91.

16. Klabbers, J.H.G. Three easy pieces. In: D. Saunders & J. Severn (Eds.) The International Simulation & Gaming Research Yearbook. Vol.7: Simulation and Games for Strategy and Policy Planning. London, Kogan Page, 1999.

17. Klabbers, J. Learning as acquisition and learning as interaction, Journal Simulation & Gaming. 31(3), (2000), 380-406.

18. Klabbers, J.H.G. The emerging field of simulation & gaming: Meanings of a retrospect. Simulation & Gaming, 32 (4), (2001), 471-481.

19. Klabbers, J.H.G. Framing Internet Games: potentials and limitations. Das Internet als

Platform für Planspiele in Aus- und Weiterbildung. In Mandl, H., Keller, Chr., Reiserer, M. and Geier, B. (Eds.) Planspiele im Internet. Wirtschaft und Weiterbildung, Band 26. Bielefeld: W. Bertelsmann Verlag, 2001.

20. Klabbers, J.H.G. Enhancing Corporate Change: the case of strategic human resource management. In: Frizelle, G. and Richards, H. (eds.) Tackling industrial complexity: the ideas that make a difference. Proceedings of the 2002 conference of the Manufacturing Complexity Network, University of Cambridge, UK, 2002. http://www-mmd.eng.cam.ac.uk/mcn/proceedings.htm

21. Klabbers, J.H.G. Interactive learning what? In F. Percival, H. Godfrey, Ph. Layborn & S. Murray (Eds.), The International Gaming Yearbook. Volume 11: Interactive Learning through Gaming and Simulation. Edinburgh, UK: SAGSET, 2003.

22. Klabbers, J.H.G. (In Press). Gaming & Simulation: Principles of a science of design. Journal Simulation & Gaming.

23. Marshev, V., and Popov, A. Element of a theory of gaming, In Ståhl, I (ed) Operational Gaming, Pergamon Press, Oxford, 1983.

24. Maturana, H, and Varela, F. Autopoiesis and Cognition: The Realization of Living, Reidel, Dordrecht, 1980.

25. Moore, O., and Anderson, A. Some principles for the design of clarifying educational environments. In Greenblat, C., and Duke R. (eds.) Principles and practices of gaming-simulation, Sage, Beverly Hills, 1975.

26. Rogoff. B. Apprenticeship in thinking: Cognitive development in social context, Oxford University Press, Oxford, 1990.

27. Sfard, A. On two metaphors for learning and the dangers of choosing just one, Educational Researcher, 27 (2), (1998), 4-13.

28. Shubik, M. Gaming: A state-of-the-art-survey, In Ståhl, I (ed) Operational Gaming, Pergamon Press, Oxford, 1983.

29. Sternberg, R. Abilities are forms of developing expertise, Educational Researcher, 27 (3), (1998), 11-20.