Learning in a Virtual World

Reflections on the Cyberdam research and development project

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Contents

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Chapter 1

Learning in a Virtual World
An introduction

Igor Mayer, Geertje Bekebrede and Harald Warmelink

1.1 Introduction

This book is about *Learning in a Virtual World*, more specifically, using the virtual world "Cyberdam" in higher education. The subject raises several questions for the reader: What are virtual worlds? Can university students learn anything useful by playing in a virtual world? And if so, what do they actually learn? And how does that work? What do we as teachers need to do to make it happen? All the chapters of this book are based on our experiences with Cyberdam. Their contents are intended to answer those questions.

Being critical of the use of virtual worlds in education is not a bad thing. Virtual worlds in educational settings are a relatively new phenomenon. And despite the recent rise in interest educational institutions have shown in using virtual worlds as well as in games and simulations, the experience in primary, secondary and higher education is not solely positive. Virtual worlds may have impressive technological, graphical and interactive capabilities, but from our own experience we know that for teachers and students alike, they can also be disappointing.

The authors of this book illustrate how virtual worlds in education, or put more precisely, simulation games played *in* these virtual worlds, can be an extremely difficult matter for all the stakeholders, including developers, educational institutes, teachers and students. This book is the result of a 30-month project given the same name as this book. Learning in a Virtual World is primarily a report of the research and development that took place in and around the Cyberdam simulation game environment. It is a compilation of insights and experiences gained in a digital environment for developing online simulation games. The authors narrate various perspectives of the complex story of Cyberdam: what it is, how it was developed, how the project partners used Cyberdam, the experiences gained and the results of the project. This first chapter gives the Cyberdam story a deeper meaning and relevance by placing it in a broader context: What is learning in a virtual world or simulation game? What are the learning-theory foundations for using virtual worlds or simulation games in education? What are the implications? In the subsequent chapters the authors discuss various characteristics of the simulation game environment, exemplified by Cyberdam, including the game-concept design process and the specific educational level at which one chooses to apply the game.

1.1.1 The structure of this chapter

Because this book is written for teachers and educational reformers who do not (yet) know much about gaming or the use of gaming in education, in this chapter we continue by introducing the main themes of the book. Section 1.2 gives a general introduction of *games* and *virtual worlds* using some eye-catching examples from the entertainment world, such as Habbo Hotel (Sulake Corporation, 2004), World of Warcraft (Blizzard Entertainment Inc., 2004) and Second Life (Linden Lab, 2003). Section 1.3 discusses some of the problems and difficult questions related to the reasons for using games in higher education. We argue for a more nuanced view of the existence and importance of the new "Net generation" and "New" forms of learning. Section 1.4 reflects on the development of simulation games over the past 50 years. On the basis of this reflection we believe that off-the-shelf games add little value in higher education. Section 1.5 introduces one possible solution that led to the initial development of Cyberdam during the *Knowledge About and Through Online Simulations* (KODOS) project, and its advancement during the Learning in a Virtual World project.

Instead of ready-made computer games, we would rather give teachers and students the building blocks and game environments that would let them make their own games to use for their own education.

Finally, section 1.6 summarizes the main conclusions of this chapter and presents the structure of the rest of the book.

1.2 Games, virtual worlds and more…

1.2.1 A second life

A large and growing number of children, adolescents and adults are playing with computer games and virtual worlds. They are extending their real lives into the realms of the virtual, or even live a "second life". They do this with a sense of fun and with some regularity in their spare time. By performing various activities in their virtual lives they mature and learn things which perhaps reach beyond their virtual lives. Probably for this reason, the US computer games and learning expert Marc Prensky entitled his book "Don't bother me Mom, I am learning" (Prensky, 2006). According to Prensky as well as cultural scholar and theorist James Paul Gee, entertainment has finally become educational (Gee, 2003; Gee, 2005).

Throughout this section we use short examples to show the relationship between entertainment and learning. One example would be the result of leading a clan or guild in the online game *World of Warcraft*. Another example is setting up your own hotel room and maintaining friendships in the virtual *Habbo Hotel* or buying land and building your dream home in *Second Life*.

It is not such a strange idea to relate such activities to concepts like personality development, the enhancement of social, organizational and computer skills, but also to the more complex forms of learning we see in higher education: analysis, strategic thinking, personal reflection and systems thinking (Gee, 2003). In real life we would not hesitate to put such activities on our Curriculum vitae but for virtual activities this is as of yet still an exception.

1.2.2 Global popularity

Millions of people around the world – young and old – consider many virtual worlds an everyday reality (Williams, Yee & Caplan, 2008; Woodcock, 2008). In *Habbo Hotel*, kids are not only having fun, they are busy making new friends and keeping up with the latest music, games and so on. An adult entering the hotel, which is actually not supposed to happen, might initially feel like a visitor in a strange and distant country: you cannot understand the (chat) language and customs in this world, which almost immediately makes you stick out like a sore thumb. And this phenomenon alone is reflected in the daily practice of teaching, for example when one observes an increasing distance between perception and language of a student and that of his or her teacher.

Among both adolescents and adults, the online game *World of Warcraft* (*WoW*) has become immensely popular. Just like *Habbo Hotel*, *WoW* is an important social environment in which lasting friendships and communities are formed. Thus, one of the main arguments in the current debate about games and education is the perception that players – children, young people and adults – change in terms of language, attitude, way of thinking and learning mainly because they are growing up and live in a digital culture where games and virtual worlds are a powerful influence (Prensky, 2001; Veen & Vrakking, 2006).

Because they are popular social environments, games and virtual worlds offer interesting opportunities for commercial and non-profit organizations to access difficult to reach target groups: children, youngsters and gamers. In *Habbo Hotel*, magazines, games and songs are promoted and sold, and agencies such as Child Right, Pestweb, and the Foundation Against Senseless Violence playfully address serious issues like child abuse, bullying and violence. In *WoW*, players stick to temporary or permanent groups. In a three dimensional, but fictional world they are engaged in all matters concerning the art of war: strategy, tactics, leadership, cooperation, coordination and heroism. Since its launch in 2004, *WoW* has become a worldwide phenomenon with millions of players, and thus with large commercial interests. The same social behavior emerged in *Second Life*, although not so much a game in itself like *WoW* is, but rather a virtual world in which everything from real life to much more can be built extensively and experienced intensely. *Second Life* is a virtual world in which real life (reality) and second life (virtual life) are similar and overlap through the simultaneous existence of role-playing environments, games and simulations in it (Castronova, 2005). Individuals or agencies may buy virtual land and develop it by spending Linden dollars, which must be bought with real money. Others may think of providing products or services (e.g. making clothes), opening shops, and organizing events and services. For instance, in *Second Life* we can visit virtual Amsterdam, including Central Station, the Dam Square and, of course, the Red Light district.

1.2.3 A serious matter

Applications of computer games and virtual worlds for education, training, marketing, public education, policy, management etc. are obvious primarily because a large audience of all ages spends lots of money, time and attention on different kinds of computer games and virtual worlds. In recent years, we have observed a growing interest in computer games and virtual worlds from public agencies (government, education, defense, etc.) and private organizations (banks and insurance companies) (Kim, Lyons & Cunningham, 2008; Warmelink, 2009).

Educational institutes are observing the possibilities of virtual worlds with great interest. The challenge is finding the most appropriate learning concepts and applications. To date, experiments with virtual worlds such as SL have focused mainly on virtual lectures, readings and images and animations with sound. Particularly in 2005, 2006 and 2007, several American educational institutes, including Harvard University, decided to use *Second Life* in classes, lectures and readings, including classes on law and informatics. Several other universities, including those of Singapore, Nankin and in the Netherlands, VU University, TU Delft and Fontys University of Applied Sciences opened virtual campuses and developed simulations, games or other types of experiences and events in *Second Life* and other 3D virtual worlds.

The advantages of virtual worlds seem evident: the environments are attractive, easily and globally accessible and appeal to an interesting target audience of adolescents and students. Constraints in time and place can easily be bridged in virtual worlds, resulting in the possible forming of global learning and research communities. There are drawbacks, for example, when it comes to conflicting personalities. The entertainment aspect of virtual worlds such as *Habbo Hotel*, *Second Life* or *WoW*, may be affected when many businesses and governments use the virtual world to their own benefit. Conversely, a surfeit of entertainment aspects, such as explicit pornographic content, can harm the corporate image of an organization stepping into the virtual world. These are two main reasons behind the recent outflow of organizations in *Second Life* (Warmelink, 2009). This fuels the perception that good teaching concepts that take full advantage of the characteristics of virtual worlds are still missing (Conklin, 2007).

1.2.4 Games, social interaction, simulations, playgrounds…

So far we have used the concepts of game, role play, simulation and virtual world somewhat interchangeably. Making a sharp distinction between them is not easy but demarcation is inevitable, especially since in this book the emphasis is on simulation games in virtual worlds for higher education. We will not talk about the colorful palette of computer games or even the possibilities of gaming in other parts of primary, secondary and adult education. So, how do the concepts of game, simulation and virtual world overlap each other? In the remainder of this section, we explore how these concepts are coherent and where they differ.

More and more computer games are played massively through the Internet. We call them “massively multi-player online role playing games” or MMORPGs. Computer games like *WoW*, *EverQuest* (Sony Online Entertainment, 2004) and many others, are (usually) beautifully rendered 3D virtual worlds. A player’s control of a digital character – an avatar – enables not only social interaction with fellow players, for example through chat, but also interaction with the simulated physical reality of the game. The avatar can fight, dance, make love, and build castles or societies. Often we can recognize the “gameness” of a virtual world in the graphical design, representing an abstract or fantasy world. But to turn a virtual world into an actual game, the goal (e.g. an individual or group needs to win a battle) and the (game) rules (what you can or cannot do to achieve the goal) are extremely important. Although virtual worlds like *WoW* can be played almost indefinitely, there are clear markers of gameness, such as winning a battle, or achieving a level. Such games are also called persistent, ongoing games or worlds.

In most virtual worlds you can play one or more games, and do other things as well. *Habbo Hotel*, for example, has the specific style of a computer game. But it offers many activities besides gaming, such as chatting with idols or friends about music, clothes, politics or attending a rock concert or dance event. The virtual world offers the opportunity to do things that we cannot do in the daily life because of physical or social constraints. The virtual experience, especially when it has a certain frequency and intensity, can bring a noticeable positive or negative meaning to one's life: virtual friends become true friends, a virtual flirtation develops into true love, the game becomes an addiction or success in the game leads to a social or economic career.

So, where does the game end and the simulation start? Some games and virtual worlds are actually a *mimesis* (an imitation) of the actual social and physical world, although in different forms and with custom rules for social interactions. The systematic study of what happens in these games and virtual worlds (human relations, politics, economics) may lead to new insights into the dynamic behavior of real systems, such as organizations, politics or economics, now or in the future. In other words, by studying the behavior of people, groups or systems in virtual worlds and computer games we can better understand how people organize themselves, how political systems arise and develop, how social conflicts are resolved and so on. In games and virtual worlds, we can even control state changes and improvements so that we can then observe what happens, try to explain why, and draw lessons for the physical reality.

The border between game, virtual world and reality becomes even more diffuse in virtual environments that can be developed, like *Second Life* and *Active Worlds*. In these worlds the virtual representation can approximate reality very closely. However, thanks to the manipulability of the virtual world it is possible to place entertainment games next to social interaction, simulations, 3D-role playing and also next to educational games. In one project that used *Active Worlds* we developed a zone around Delft's railway station as a virtual playground where secondary school students could learn in role play about the special impact of new infrastructures (see Figure 1.1).

Regardless of the coexistence of games and social interaction, both simulations, and virtual worlds or playgrounds are in the first place computer-generated or simulated environments in which players can take on the role of a character and interact online with other people all over the world. The character is a digital alter ego (a politician, a fairy, etc) that can resemble the reality as closely or as far away as wanted. In a virtual world social interaction is very important. Much attention is currently being given to the beautiful 3D (actually 2.5 dimension) design of virtual worlds. But, as we shall see, this is not primarily a necessity. Some of the famous MMORPGs were created as analog games, for instance the pen and paper-based game *Dungeons & Dragons* (Wizards of the Coast, 1974), which asks players to bring their own fantasy to the table, instead of asking the computer to bring it to the screen. It is also possible to create a rich virtual world for gaming and simulation merely by exchanging electronic messages (chat, forums, e-mail), for instance in a *Multi-User Dungeon* (MUD), the first installment of a digital virtual world (Bartle, 2004). To bring a character to life in an online role-playing game, it is often enough to have a single website containing some text or a photo.

Figure 1.1 – A player's avatar in the virtual zone of Delft station (Delft Quest) in *Active Worlds*

1.3 Games as a solution… to what problem?

It is easy to get all enthusiastic about the many possibilities of computer games and virtual worlds in (higher) education. But the mere possibility does not make them compulsory, nor does it guarantee success. It would be wise to first consider why computer games and virtual worlds could or should be applied in education, which is the focus of this section.

1.3.1 The "Net generation" and educational reform

An important starting point for a plea for games in education is the observation that educational institutes have to deal with a new generation of students known variously as the Net, twitch-speed or Nintendo generation, Homo Zappiens, generation Y, digital natives or generation Einstein (Prensky, 2001; Gee, 2003; Oblinger, 2004; Veen & Vrakking, 2006). It is argued that this generation is inherently different – fast, impatient, interactive, multi-taskers – and their education will need to adapt to that. A closely related argument often used is that a considerable group of students has become alienated from traditional education, instantiating a rift between school and non-school environments. The consequences are noticeable in drop-out statistics, disinterest of students and teachers, displacement of school activities by other activities (jobs, hobbies), bad preparation for society and the job market, etc.

While we follow these arguments to an extent, we object to the generalization and exaggeration of the image of the current and future generations of students such theories create. There are large differences among and between age groups, between boys and girls and between income groups (Pratchett, 2005; Sandford et al., 2006; Kennedy et al., 2008; Nielsen, 2009; Schulmeister, 2009). We also note differences between students from different courses of study, faculties, educational institutes and educational levels (INHolland, 2006).

The question is whether the current and future generations of students are so radically different from their predecessors. A more nuanced image is derived from one Dutch empirical study into new forms of education for a new generation of students, where the researchers actually talked with future university students (Akkerman, 2007; Rubens, De Jong & Prozee, 2007). The researchers confirm that ICT is an integral part of the daily lives of adolescents, that they learn by doing and that they are social, interactive and results-oriented. But the researchers also conclude that the prospective students have quite a traditional perception of university, are very much geared towards numbers and performance and are in need of good face-to-face forms of education. From this we argue that it is important to apply games in education with moderation, and customize them so that they take the different target audiences and circumstances into account.

Gaming in education is also often inextricably bound to new forms of learning and the accompanying educational concepts such as life-long learning, competence-directed education, problem-directed learning, learning communities, authentic learning, self-directed learning, student-oriented education, etc. (Kirriemuir & McFarlane, 2004; Beeksma & Hulst, 2005; Van Kranenburg et al., 2006; Sandford et al., 2006). While the connection between gaming and educational reform is important, we simultaneously observe a number of shortcomings and dangers of a one-sided perspective on new forms of learning and educational reform (Jansen, De Jong & Klink, 2006). New concepts of new forms of learning and educational reform seem to be always emerging and the coherence between them is sometimes not very clear. We have seen resistance to contemporary educational theories that oppose or marginalize classical instruction, both in educational studies (Kirschner, Sweller & Clark, 2006) as well as in society in general, i.e. the Dutch countermovement known as *Beter Onderwijs Nederland* (Better Education Netherlands) (BON, 2009).

1.3.2 Learning experientially through gaming

Clearly teachers and educational institutes think very differently about how people learn. They also have different preferences, that is traditional knowledge transfer by the teacher, or experiential learning by the student.

One of the best reflections on learning theories in relation to computer gaming is Egenfeldt-Nielsen’s dissertation (Egenfeldt-Nielsen, 2005; Veen & Roozen, 2006). From it we derive the importance of recognizing that thinking about learning influences thinking about gaming, just as the developments in gaming influence the thinking about learning. Thus, games have a large amount of plasticity. They can fit a wide range of learning theories and learning situations.

For example, behaviorism considers learning as the conditioning of human behavior. According to that theory, a game can be applied as a learning environment for practicing and drilling, that is through rehearsal and repetition. For situations where action needs to be taken quickly, skillfully and automatically, computer training in the form of gaming can be very useful. A contemporary example is the use of computer games as a training simulator for fire fighters (Artesis, 2009; Hazmat, 2005). This form of learning loses value when the student is less capable or motivated, or when the student needs to learn to make a well-informed decision from a range of complex alternatives for action, especially when there is no single best alternative. In that case a different kind of game, focused on building personal and cognitive skills will be more suitable, which can be based on constructivist or situational learning theories.

Although many learning theories are linked to the use of games in educational settings, such as active learning (Gee, 2004; Niemi, 2002), situated learning (Lave & Wenger, 1991; Leemkuil, 2006), authentic learning (Maharg, 2004) and collaborative learning (Kirriemuir, 2002; Kriz, 2003, p. 496), the concept of experiential learning is mentioned most and, as an umbrella term, fits best with the intended use of simulation games in higher education (De Caluwé et al., 1996; Egenfeldt-Nielsen, 2005; Kolb, 1984).

The idea behind learning by playing games is that it follows the basics of learning, namely learning by experience. According to Dewey (Dewey in Kolb, 1984, p. 35) experience is the interaction between humans and their environment including thinking, feeling, seeing, handling and doing. This way of learning, called experiential learning, was further researched by David Kolb (1984). According to his theory, learning takes place on the basis of trial and error and is a continuous experiential cycle of action, concrete experience, reflective observation and theory construction, and back to action again.

While gaming, participants learn on two levels. The first level of learning is how to play the game. The player has to become familiar with the rules of the game, the relation between actions and reactions and the game’s structure. The second level is related to understanding the mechanics behind the game, for example the “Aha” effect, when players become aware of the consequences of their actions or make theories clear. The player can use their growing awareness and increase in skills in reality as well as in playing other games.

1.3.3 A crucial role for the teacher

The form of learning described above is only possible when the learner has a basic knowledge of the concepts, and the motivation and skills for observation and reflection. According to Garris (Garris, Ahlers & Driskell, 2002), it is accepted that games on their own are not enough for learning. Or as Thiagaranjan puts it: “People don’t learn from experience (including simulation experience). They learn by reflection on their experience” (Thiagaranjan, 1994, p. 532). This means that learning needs to be facilitated by the game leader. Research has been done to improve the educational value of games by including reflection in them (cf. Leemkuil, 2006). It seems that games with more complicated learning objectives have to be played in an (educational) context, and include a debriefing.

In games where players act, receive feedback, and are rewarded for their efforts, the game leader has an important role in relating the knowledge learned in the game to real world issues. The game leader is also needed to correct or complete the player's relevant learning experience. As Garris proposes, the experiential learning cycle should be embedded in the game (Garris, Ahlers & Driskell, 2002), not just in the introduction and the debriefing but throughout the different rounds or levels of the game.

The facilitator has four different roles to support the player's learning related to sharing knowledge and competences (Mayer, Stegers-Jager & Bekebrede, 2007). Scientific and practical knowledge is needed to translate gaming experiences into generally abstract concepts and *vice versa* to translate these abstract concepts into concrete starting points for actions in the game. Practical and reflexive competences are needed to interpret and reflect on these experiences. The facilitator can share his experiences by direct transfer before and after the game, facilitation during the game and assessment after the game. This leads to an enriched model of experiential learning (see Figure 1.2).

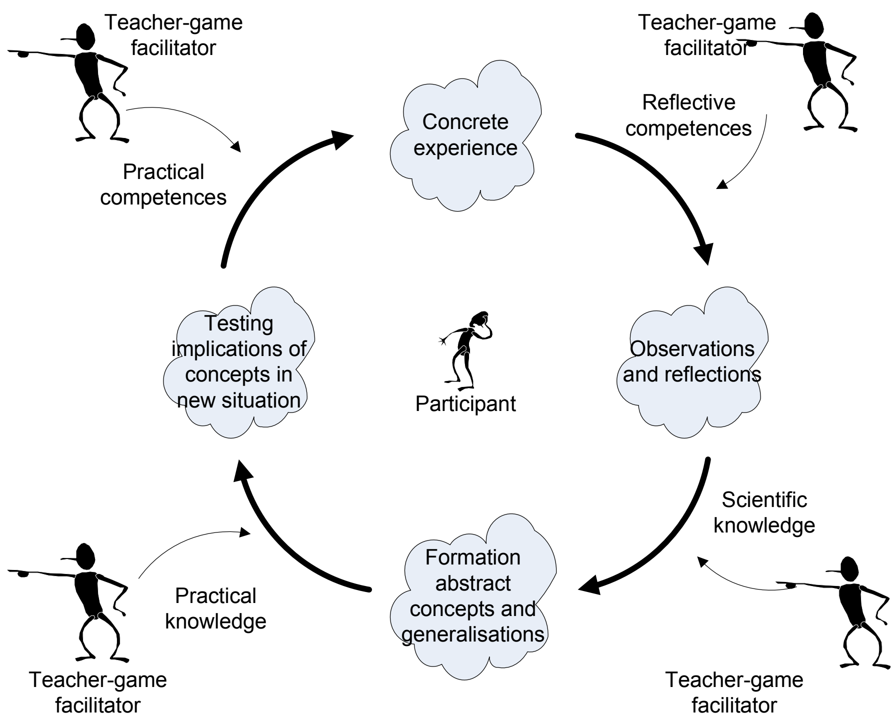

Figure 1.2 – A model of teacher involvement in the student's game-learning cycle (Mayer, Stegers-Jager & Bekebrede, 2007; based on Kolb, 1984)

It is important to reflect on the distinction between competences and knowledge that we make in Figure 1.2:

1. **Competences:** both *practical* (general and job-oriented) competences and *reflexive* (academic) competences are needed to be able to play a game meaningfully in a learning/educational setting. An example of practical competence is the general communicative competences used in giving a presentation or negotiating. An example of reflexive competences is the ability to analyze and structure complex problems.

2. **Knowledge:** *practical* and *scientific* knowledge needed to translate game experiences into abstract concepts, and vice versa, to use abstract concepts as a starting point for game actions. For example, practical knowledge is the ability to read and understand a spreadsheet used in an accounting or business administration game. An example of scientific knowledge is the ability to discern between various models of democracy in a political policy game.

Sometimes students lack the competences and knowledge (or sometimes the will) needed to turn a game played in an educational setting into a learning experience. This can apply to basic game-specific competences a student or teacher might need, like the ability to use the hardware interfaces needed to play a computer game (Egenfeldt-Nielsen, 2004). Missing competences can make playing a game hard work for a student, and will demand lots of explanations or demonstrations. Having insufficient prior knowledge can inhibit advanced-level discussions, or end up in negotiated nonsense and irrational action, for instance, just clicking the mouse to see what happens.

The learning loop can be walked through several times during a game session, depending on the amount of time available and the type of game. In each round the facilitator can be more or less involved; however the facilitator has to avoid disturbing the playing process. Reflection is done after the game play. In some cases it is possible to start a new game session, and test the adapted reference systems again.

1.3.4 What a player learns

In this section we discussed the complex relationship between games and learning. An important observation is that gaming is not particularly suited to transferring detailed, factual knowledge, but is suited to transferring and developing system knowledge and competences. In our opinion the added value of gaming is the ability to let players acquire a satellite or helicopter view of (a certain part of) reality – an argument we develop further in the next section. Gaming is not necessarily a better form of learning, but a different way of learning nonetheless; it is not a replacement for other methods of education, but it is a good supplement to them. While players of a game will undoubtedly remember relevant facts, (most) games are too complex, or not quite efficient or valid enough for transferring detailed facts and content. We briefly discussed research that showed that playing a game can lead to better knowledge retention as a result of contextualization. Games are unique as we can do things with them that we cannot do as well in other learning/educational methods. In a game a player can safely interact and experiment with a dynamic model of reality. A big difference with simulation models, for example, is that the player of a game is part of the model or system. To be effective as a learning experience, a game needs to be optimally embedded in the educational setting. Teacher feedback and advice, and the combination with other methods of education are key to a game's effectivity as a learning instrument.

1.4 Reflecting on 50 years of game research and development

While computer games and virtual worlds are relatively new, our insights into the possibilities of games and game-like experiences for learning and education are not. In this section we delve into the history of developing and applying simulation games as learning experiences. As we do so, we argue that the past 50 years of research has produced a body of knowledge that is important to consider when attempting to actually develop and apply computer games and virtual worlds in education.

1.4.1 Many different kinds of games

The connection between games and learning/education has been studied for quite a while. The Dutch cultural historian Huizinga is famous for his influential book of 1938, *Homo Ludens* (Huizinga, 1938/1952). The current discussion about *serious games* – using computer games for other purposes than entertainment – can be indebted to the central theme of Homo Ludens, that is "the playing people." That theme can be summarized as "playing is a serious matter." To avoid misunderstanding Huizinga's meaning, perhaps "grave" would be a more accurate translation than "serious."

Huizinga's thesis for considering games and play as "grave" is mostly reflexive and culturally philosophical. In his seminal work *Les Jeux et les Hommes*, the French philosopher Caillois points appropriately to Huizinga's omission of the existence and characteristics of other types of games and play (Caillois, 1958). And while competition is an important element, not all games are about winning. Adding to Huizinga, Caillois describes different types of games and play, from improvisation and pretending to strictly rule-bound games like puzzles and chess. With that description, Caillois is one of the first to introduce a typology or taxonomy of games and became one of the founding fathers of ludology – the study of (computer) games (Frasca, 2001).

The question "what makes a game a game, and what types of games are there?" is of course relevant in an attempt to discuss developing and applying games for learning and education. Yet, an exhaustive discussion of game taxonomies is beyond the scope of this book. For that we point to others (Caillois, 1958; Klabbers, 2003; Aldrich, 2005). For the goal of describing developments in the body of knowledge concerning game development, we can simply establish that one can use different types of games depending on the learning goals and situations. It is quite relevant whether we are educating or training doctors, pilots, judges, militaries or welfare workers through gaming. In the *Learning in a Virtual World* project we focused mostly on open games, that is, role-playing simulation games, for higher education.

1.4.2 Business and management games

One of the first and still most common applications of gaming in higher education are business and management games. These simulation games revolve around the question: "how do I successfully lead and/or manage a company?" The first management games emerged in the 1950s, mostly in American business schools (Cohen & Rhenman, 1975; Leemkuil, De Jong & Ootes, 2000). By now there are many varieties of business games, mostly analog, but also more and more digital and online. However, they are often strictly rule-bound for the purpose of training in different well-proven business practices and in running an organization successfully.

Many modern business games are based on an underlying simulation model that mimics the workings of a company, market or logistical system. The graphics and underlying technology of business games is often quite simple. Players take decisions in the game that they or others then enter in a mathematical model, and the results (e.g. turnover, profit, market share, etc.) can then be fed back a few times, leading to a new round of decisions. Playing such a round-based business game can take several hours, days or weeks. In his book *Learning by Doing*, on simulations and e-learning, Clark Aldrich calls such traditional business games *interactive spreadsheets* (Aldrich, 2005). A good and successful integration of business games with advanced computer game genres as we know them from the entertainment sector, e.g. *Railway Tycoon* (MicroProse Inc., 2003) or *World of Warcraft*, has hardly been realized. There is still no proof that advanced computerized business games are any more effective than their traditional predecessors (Blunt, 2006). A fine, known example of a next generation digital simulation is *Virtual Leader*, developed by Aldrich. This computer game about leadership is designed to train leaders in companies and public organizations, such as the army. The story behind *Virtual Leader* is told in the book *Simulations and the future of learning* (Aldrich, 2004). What strikes us the most from that story is the struggle to realize the game *Virtual Leader*. In the end, the game is deemed only effective when the player is given personal counseling. Good coaching turns out to be crucial; as a standalone application, this example of a next generation digital simulation is deemed little effective.

1.4.3 The emergence of educational simulation games

From the end of the 1950s onwards games have been used purposively in the classroom. In their first instances these games were analog, such as puzzles, card games, board games, game exercises, role-plays, social simulations, etc. (Greenblat & Duke, 1975; Greenblat, 1975b; Ellington, Addinall & Percival, 1981; Greenblat, 1988; Ellington, Percival & Race, 1993). Later on computer and simulation models were used as support tools; in the beginning primarily to calculate the quantitative consequences of player decisions which could then be fed back to the players. Experiments with computer-supported simulation games began emerging at the end of the 1960s. Early experiences were not very good. The computer added little to or even inhibited the learning experience (Duke, 2000). Not surprisingly, simulation technology and the human-computer interaction were deemed immature at the time.

An international community of simulation game enthusiasts – thus combining game-play and simulation techniques – emerged recognizably around 1970. For the first time people were systematically studying simulation games for learning and education (Greenblat, 1975c; Ellington, Addinall & Percival, 1981). Several international and regional societies were founded to stimulate research and development into simulation games. The most important is the International Simulation and Gaming Association (ISAGA, 2009). This international simulation game community is greatly influenced by the work of Duke, and in particular his book *Gaming, the future's language* (Duke, 1974), in which he lays the foundations for simulation games and learning (here denoting improving and changing within and of all sorts of social contexts).

According to Duke, simulation games are mostly suitable for gaining insight into complex "real world" situations. Characteristics of complex situations include a large number of variables that influence each other interdependently and a lack of knowledge about and/or fundamental uncertainties in the effects of these variables, which makes it hard to quantify their relationships. Moreover, there is almost by definition no reliable model for intervening and making decisions in these complex situations. The social and political arena of the problem includes a large number of stakeholders that often behave irrationally. The problem also has a strong future-oriented component, for instance 10-30 years, which makes the long-term consequences of the irreversible decisions that we make now unforeseeable, at least initially (Duke, 1980, p. 364).

1.4.4 Making an effective simulation game: do-it-yourself

The work of Duke and others from the 1970s onwards has had lots of influence on the development and application of simulation games for education, training, policy-making and change (Greenblat & Duke, 1975; Greenblat, 1975a; Geurts & Wierst, 1991; Crookall, 1995; Joldersma, Geurts & Van ‘t Spijker, 1995; De Caluwé, Geurts & Buis, 1996; Duke, 1998; Duke, 2000; Duke & Geurts, 2004). Besides systems thinking, Duke’s contribution is the theory that one can understand the art of developing a game or simulation game for serious purposes through a number of principles or steps (Duke, 1974; Greenblat & Duke, 1975; Duke, 1975; Duke, 1980; Duke, 1991). Duke developed a method for designing simulation games. As a result, in theory any teacher can make a simulation game for his or her students to play, or can otherwise adapt existing simulation games for his or her own purposes and specific use, using a computer when needed.

Making a game does not need to take much time. An extraordinary type of do-it-yourself games, called *frame games,* are very useful for education and training. A frame game is an “instant” game, a game “template” in the form of a card or board game, a puzzle or a discussion procedure, to which a user can add his or her own content (Leigh & Kinder, 2001; Thiagarajan, 2003).

Since the 1970s many publications in the simulation game community have elaborated on the added value of simulation games for education and learning. Some of the more important claims are summarized below.

From Greenblat (1975c & 1988):

1. Gaming increases motivation and interest in the subject, the subject area, and into doing more research into the subject, etc.
2. Gaming strengthens cognitive learning, primarily insights into a system (alternatives, actions, consequences, differing roles) and the development of a frame of reference for (theoretical) concepts and (abstract) principles.
3. Gaming enriches a learning/educational situation: the transfer of new and other information as well as the absorption of information that is also passed on in a different manner.
4. Gaming improves such competences as critical thinking, decision-making, and interaction competences like negotiation, communication, and special (vocational) competences like budgeting and crisis control.
5. Gaming changes attitudes, for example to social problems or values, empathy for others and different perspectives or opinions.
6. Gaming enables self-evaluation: insight into and assessment of one’s own knowledge, competences and attitude.
7. Gaming changes the class/learning structure: more participation and involvement in the class/learning situation; better student-teacher relations; more freedom and autonomy for the student, etc.

And from Ellington and Earl (1998):

1. Gaming supports and reaffirms education about facts and principles
2. Gaming demonstrates the application of theories
3. Gaming develops higher order competences

4. Gaming develops information and research competences
5. Gaming functions as an ‘ice breaker’
6. Gaming develops communication competences
7. Gaming develops inter-personal competences
8. Gaming develops competences necessary for interdisciplinary, complex tasks
9. Gaming reaches all sorts of affective goals (more involvement and motivation).

In the above we discussed the emergence and development of simulation games as educational methods. Insights into the development of a body of knowledge on simulation games from the 1950s onwards is important because some of the older themes and questions – for instance, embedding a game in a learning situation or debriefing a game – are still very current. We have observed that young, soon-to-become professionals like to be challenged in an authentic, yet controlled, environment to show off their abilities. We recognize this in most types of games. We can use many types of games for different learning goals and situations. And, making or adapting a game can be just as an instructive or valuable experience as playing a game. We have also argued that a game can be most effective when the players are coached. From the simulation game discipline we learn that simulation games fit well with higher education because they give players the chance to discover the behavior of a complex system through play, to try things out and experience the long-term consequences of decisions. We have argued that in theory teachers can develop simulation games for their students, or adapt readily available simulation games for their own purposes.

1.4.5 The challenge

We do not believe that the ideal use of games in higher education entails using existing entertainment-based computer games or building expensive sophisticated computer games from scratch. We think it better to provide teachers, students and institutes with useful tools, building blocks and assistance and then let them do it themselves. We therefore feel we are in need of flexible and modularly structured virtual environments, with which teachers, students and simulation developers can design and implement new simulation (games) for different learning purposes and educational levels easily. Such an environment would need to be suitable for a colorful palette of games and a broad scale of applications, in which the process of game development takes no more time and effort than absolutely necessary. The developed (simulation) games can possibly be shared via a library system, allowing others to re-use and elaborate them. The teacher withholds the right of ownership of his or her own teaching and determines him- or herself when and how the game is played.

This is not still in the future. Many of these characteristics – modular structure, ease of development and flexibility – are recognizable in the earlier mentioned virtual worlds such as *Active Worlds* and *Second Life*. Moreover, a number of environments have been developed within higher education, with which teachers without a knowledge of programming can develop their own role-playing (simulation) games. Examples of such environments are *Fablusi*, developed in Australia, or *Unigame*, developed by various European partners, and – of course – *Cyberdam*.

1.5 The journey from Ardcalloch to Cyberdam

The story behind Cyberdam starts in Scotland, in the ancient town of Ardcalloch (See Figure 1.3; Glasgow Graduate School Of Law, 2009). Ardcalloch is virtual, it only exists on the Internet. No people really live there. It is no more or less than a bit of city history, an interactive map, a directory of organizations and the people who settled in the city, presenting themselves via their website. Yet many temporary characters in the city are quite real; they are students working on an assignment or, sometimes, they are professionals who answer the questions that students ask.

The virtual learning environment Ardcalloch was thought up and developed by a number of enthusiastic teachers of the Glasgow Graduate School of Law at the University of Strathclyde. One who inspired Ardcalloch's design and development is Professor Paul Maharg, one of the authors of the second chapter in this book.

Ardcalloch is used to prepare future solicitors and lawyers for conducting juridical transactions, such as winning negotiations and writing settlement proposals. Practice-oriented assignments are the red thread throughout the curriculum. Students are assigned the realistic role of lawyer at a law firm with offices in Ardcalloch. In this role they are confronted with juridical cases for which they need to find a juridical solution, for example, determining and claiming the medical expenses of an industrial accident. In Ardcalloch they can find relevant information, for instance, the actual medical consequences of the accident, and negotiate with each other. Teachers coach them through the process.

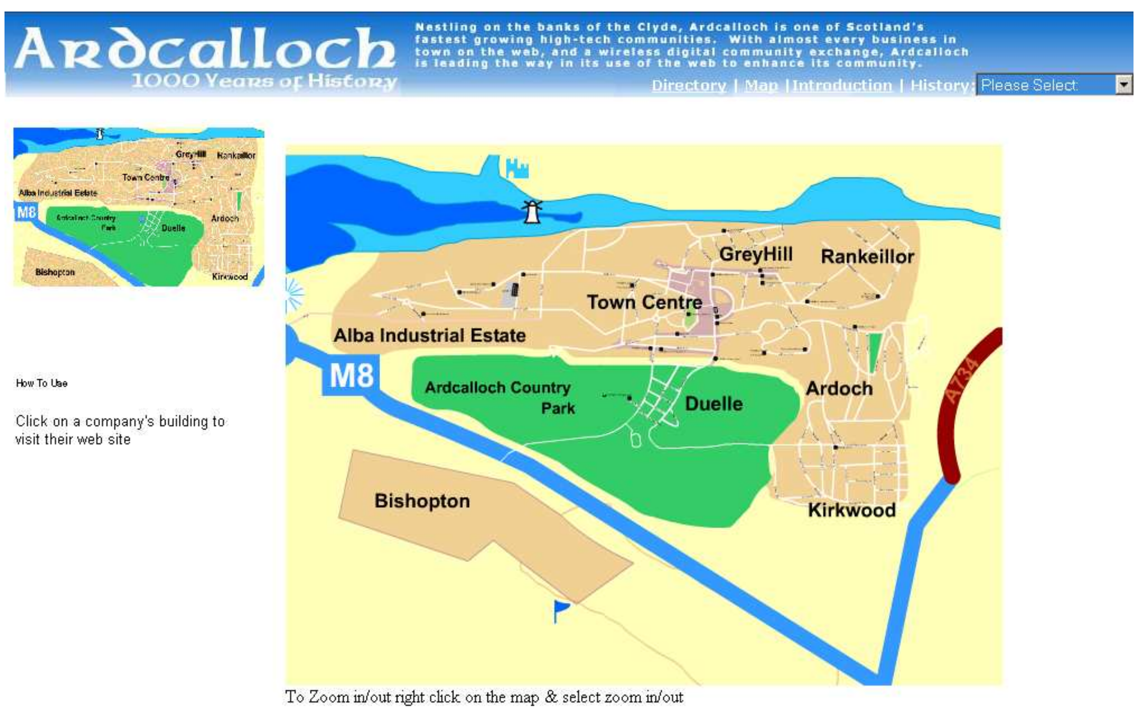

Figure 1.3 – Ardcalloch, the original inspiration for Cyberdam (Glasgow Graduate School of Law, 2009)

The success of Ardcalloch motivated others to think about spreading and scaling up the use of such a simulation game platform to other curriculums, universities and countries. The Dutch VSNU project *RechtenOnline* researched a number of possibilities for the Netherlands in 2002. The limitations of Ardcalloch soon became clear. Ardcalloch was aimed at law education. Pragmatically, only the case descriptions could be replaced easily as the rest of the system was hardcoded. The Dutch education system needed a flexible system which teachers could use to design and develop their own games.

Thus, the fictional Dutch city of Sieberdam was born. It was developed in an online environment inspired by Ardcalloch (Stichting Rechten Online, 2009). While the underlying technology was different, the functionalities were largely the same. A new addition to the virtual environment was the RechtenOnline Community Service (ROCS) application, which teachers could use to develop and play online simulation games or role plays in the virtual city of Sieberdam. The teacher could design and manage the flow (i.e. the beginning and ending of different phases), tasks and duration of the role play or game.

With Sieberdam/ROCS we had created a tool that allowed teachers to develop and apply their own simulation games. As the system was initially designed for Dutch law education, it raised the question whether it would work outside that field. We had our first experiences with embedding Sieberdam/ROCS role-playing/simulation games in higher education during the KODOS project, running from 2004 until 2006. Initial applications of Sieberdam/ROCS during that project showed the potential of the software for different disciplines and levels of higher education. Yet the software needed to be more flexible for more diverse and extensive application in higher education.

That is why both Sieberdam and ROCS were redeveloped and integrated into one system called Cyberdam in the *Learning in a Virtual World* project, funded by the Dutch governmental office *Maatschappelijke Sectoren & ICT* (Societal Sectors and ICT). New functionalities were added to the software in subsequent versions (2.1, 2.2 and 2.3), which made Cyberdam more flexible and more applicable to different courses of study and levels of education. The project developed, applied and evaluated 20 simulation games in higher education. Thanks to the large scale of this project we have been able to determine the circumstances for embedding the Cyberdam simulation games in higher education, the theme of the last chapter of this book.

1.6 …and further

1.6.1 The core of this chapter

This chapter introduced the subject of *Learning in a Virtual World*. As the book is meant for teachers and others who do not yet have much affinity with games, we have explained briefly what games and virtual worlds are, and how they have become important leisure activities for millions of people worldwide. We have illustrated how gaming in higher education is a difficult matter. Both the basis for gaming as a learning/teaching method as well as the actual development and application of games by teachers are difficult. There is lots to learn and much to improve. When applying games in education, we need to take factors such as the age and current and previous education levels of our students into account. Not all students and teachers are up for gaming in their educational institutes and study programs. It is important to focus on the broad social and educational context in which one attempts to introduce gaming. This calls for custom-made, judiciously dosed solutions. We see few opportunities for commercial entertainment-based games. Instead of applying off-the-shelf games we would rather give teachers and students the building blocks and environments to develop and apply their own online role-playing simulation games on their own. This book presents several ways that Cyberdam has made that possible, based on the authors' own perspectives.

1.6.2 The structure of this book

In Chapter 2, Paul Maharg and Emma Nicol reflect on the influence of the design of the digital environment on the simulation games developed and applied therein. They accomplish this using their extensive experience working with Ardcalloch and its sequel called SIMPLE as well as Cyberdam. In Chapter 3 Kees van Haaster reflects on the design fundamentals and development steps that underlay the 7 Cyberdam simulation games developed by the HU University of Applied Sciences Utrecht during the Learning in a Virtual World project. In Chapter 4 Kees de Vey Mestdagh reflects on the influence of educational level on the design of simulation games, based on his experiences in both Dutch vocational and university legal education. Finally, in Chapter 5, Harald Warmelink, Geertje Bekebrede and Igor Mayer analyze the success of the Cyberdam simulation games from a systems perspective and conclude what the ideal organizational and social circumstances would be for these types of games. Put together, these chapters give you as a teacher, educational policy-maker or parent a good overview of the ins and outs of gaming in higher education.

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Chapter 2

Cyberdam and SIMPLE: a study in divergent development and convergent aims

Paul Maharg and Emma Nicol

2.1 Introduction

It is a design truism that form affects function, and in education it is also generally accepted that functionality affects learning. In truth, all technology both constrains *and* liberates. In the thirteenth century, for example, the massive information overload represented by texts such as Justinian's *Digest* and the proliferation of Church law required scholars and users to create the symbolic tools that would help them to cope with problems of understanding and memorizing the legal information overload (Maharg, 2007). Those tools both enabled legal scholarship to flourish, but also constrained that scholarship by limiting the conditions under which it was produced, for whom, and how. It could be argued that the introduction of moveable type in the fifteenth-century had the same effect (Rhodes & Sawday, 2000).

The same is true of our use of technology in schools, universities and workplaces. Currently, many virtual learning environments (VLEs) used in universities mimic the administrative structures of departments, faculties and institutions. They "push" information at the user. There are few spaces where the user, particularly students, can claim ownership of information, and share that information freely with others. Indeed some would claim that VLEs are constructed and used in such a way as to minimize the amount of disruption that technology adoption causes within an organization (Boys, 2002). ICT thus legitimizes standard, traditional practices and is prevented from challenging the dominant paradigm. It can then be assimilated and becomes institutionalized. For real change to happen, Boys concludes, higher education needs to implement, *inter alia*,

- a problem-seeking, not a solution-driven, approach to ICT
- an explicit model for managing change
- explicit goals, both organizational and educational
- development methodologies centered on quality of content and processes, not technical compatibilities
- involvement of students
- alternative "visualizations" of the functions of a Managed Learning Environment, or MLE.

Simulation environments such as Cyberdam and SIMPLE, it could be argued, are implementations that seek to change disciplinary teaching, learning and assessment in significant ways. One view is that they are containers filled not with institutional information but with student work. Students also have the potential to direct their own work, to shape and control the direction of the game or simulation and the part that they play in it. However to do this requires academic staff to rethink their organization of teaching at a deep level. VLEs such as Blackboard can easily support the status quo for staff, in so doing encouraging shallow learning and a transmission model of learning. Simulation environments such as Cyberdam and SIMPLE can be disruptive to conventional teaching – indeed the very process of thinking how to develop a simulation requires staff to rethink teaching structures as well as the learning resources that will be the context of the game or simulation. In the following sections we shall see how in their different ways both Cyberdam and SIMPLE support students in their learning, and how they are tools with which staff can bridge to new ways of conceptualizing learning and teaching.

2.2 Cyberdam

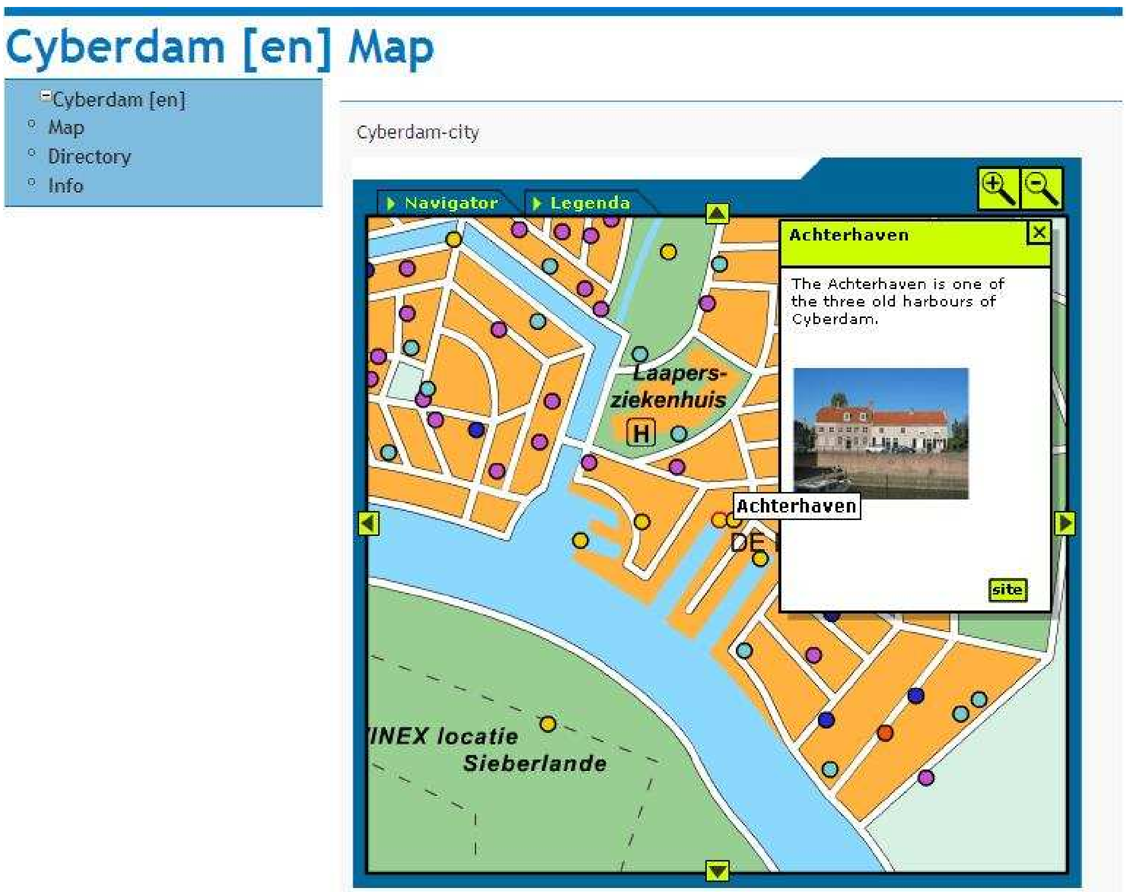

Figure 2.1 – The Cyberdam user-interface

Cyberdam began life in late 2004 as Sieberdam, a virtual Dutch town inspired by the Scottish virtual town of Ardcalloch (Maharg, 2003) as used at Glasgow Graduate School of Law in the University of Strathclyde. Sieberdam consisted of a virtual town, and an e-learning suite called ROCS. The role of ROCS was to facilitate the building of web-based role-playing simulation games. These games would be of a type described as "asynchronous workflow-based group games" (Van der Hijden, 2005). The software for both the virtual town and the e-learning suite was, unlike the first instantiation of Ardcalloch, open-source. During the two years that followed its initial release, three major e-learning projects were undertaken with Sieberdam at their core. These projects ran in the Sieberdam environment at around 15 educational institutions throughout the Netherlands, providing learning experiences in several subject disciplines at various levels of education. One of these projects was KODOS (CPS – Delft Centre for Serious Gaming, 2009) (translating as "Knowledge Development About and Through Online Simulations"), which was funded by the Dutch Organization for Higher Education, SURF, and managed by the Erasmus University of Rotterdam.

By developing and running online simulation games in the Sieberdam environment the KODOS project's investigators were able to conduct systematic technological and user evaluations of the environment with a view to providing data to feed into the development of later iterations of the platform. The evaluations had several key findings regarding the experience and preferences of users of the system. Contrary to expectations, students were largely unfamiliar with online gaming outside of Sieberdam (Bekebrede, 2007). However recent research on the depth of games literacy and other related issues such as digital natives shows that this result is by no means an outlier (Bennett, Maton & Kervin 2008). Most respondents appeared to like using learning games and pointed to the improved student-tutor interaction that the platform allowed, particularly where face-to-face interaction was concerned. Students were on the whole satisfied with their experience of using the platform but pointed to several areas that were in need of improvement. Regarding the tutors' experience, it emerged that the first generation online games they produced for Sieberdam were developed using only a limited set of the available functions. At the same time, it emerged that tutors would require more flexibility and functionality from the platform in order to develop more sophisticated simulations.

Thus it was clear that Sieberdam, while a promising concept, would need to undergo a substantial critical review and significant reconstruction were it to be used successfully in the future (Van der Hijden, 2007). Accordingly, "Cyberdam", a new version of the platform was planned. It would improve on the Sieberdam software and allow the development of a substantial range of new games to be developed and played using the platform. The development was part of an initiative called "Learning in a Virtual World" (LIEVW), funded by the M & ICT Program.

2.2.1 Functionality

Cyberdam provides a suite of tools that allows academics to construct simulations. There are four basic modes in which you can work with games in the Cyberdam environment:

1. *developing* a Cyberdam game from scratch. Given the complexity of development, it is advisable that this activity be done by a team rather than someone working alone.
2. *adapting* an existing game
3. *running* a Cyberdam game (starting game sessions, acting as a game master, etc.)

4. *playing* a role in a game session (Van der Hijden, 2007).

The most complex of these four modes is mode 1: developing a new Cyberdam game. Given the complexity, in order to make game creation manageable the developers recommend dividing this mode into four phases. Thus:

- *definition* phase: analyzing the game's objectives and defining the requirements that the game must meet
- *design phase*: specification of the details of the game
- *realization* phase: preparation of all the materials/resources required for the game; then the game and all its attributes and resources are entered into the Cyberdam system
- *implementation* phase: transferal of the game to the organization that will use it (Van der Hijden, 2007).

A set of tools and techniques has been developed by the Cyberdam project to support the game creator in each mode of operation and in one of the four phases of the development process. Much of the work in the design phase involves the educator defining the various roles that are required for the game, the steps of play, and the instructions for the participants. The support application allows educators to start parallel game sessions, provides a means of monitoring these and allows the educator to intervene in the game when it becomes necessary (Van der Hijden, 2007).

The application consists of three modules: *Playgrounds, Models and Manifests* (Van der Hijden, 2009):

- Each of the *Playgrounds* contains an interactive 2D city map with realistically named city areas, roads, canals, public buildings, private residences and businesses. These entities are listed in a directory that may be accessed in the *Playground* with links to websites containing background information on the town, its institutions and inhabitants.
- *Models* contain the specifications for the roles, stages and variables, and activities defined by the role. These are known as "scripts".
- *Manifests* relate the roles in each *Model* to the objects in the corresponding *Playground.* Roles from one *Model* may be used in multiple *Playgrounds.*

A session facilitator, for instance a tutor, creates a session by combining instances from each of the three modules. The facilitator assigns the roles contained in the module to one or more participants, either students, other tutors or themselves. The roles include burgomaster, shopkeeper, nurse, lawyer, or one of the city's other inhabitants. Each participant is briefed on the goal they must achieve. It is then up to the participant to decide on what they will do next (Van der Hijden, 2009). Following the briefing, each participant is given online access to a "dashboard" (Van der Hijden, 2007), which has a number of functions. The dashboard stores the participant's instructions for a given scenario. It also allows the player to exchange messages with the people playing the other roles in the virtual city, either their peers and teachers or in some cases external experts.

Once a session is up and running, each participant has access to a home page for the role they are playing. Participants can adapt this page according to their preferences and may add documents to supplement the information contained there. The facilitator running the session has access to all of the home pages, which allows them to keep track of activities and the exact times and dates of their occurrence. This transparency allows the facilitator to make appropriate interventions if and when necessary. All the activities are viewable in the form of an historical log of the entire session from start to finish. The log remains available for viewing after the conclusion of the game (Van der Hijden, 2009).

Sessions are conducted in stages, and often sub-stages as well, to make them more manageable. The following general example shows how the game works. It commences with the Briefing stage. Then it proceeds to a stage involving several micro-cycles of consecutive processes, including Events Handling, Producing, Tax Collection and Trading. At the end the final micro-cycle, the game concludes with a stage called Debriefing. Movement between the stages can be prescribed either by a script, or can be expedited by one of the roles played being played by a tutor or other facilitator (Van der Hijden, 2009).

On the participants' home page is a hyperlink called "Contacts" which links to each of the other roles involved in the session. Participants can also see a summary of the messages they have received and the files that have been uploaded to date. Messages are sent in a manner very similar to email. The participants' home pages remain available for viewing long after the conclusion of a particular game. For the person or persons facilitating the session there is a additional feature, a list of activities that have been carried out. Facilitators also have a table on their home page that specifies the stages and sub-stages of the session and the progress made on these. Some activities in the sessions are described as "optional" and the number of these varies from session to session.

Participants may encounter five key types of activity (Van der Hijden, 2009):

- *Input*: where the role player is asked to complete a form. The information provided is then input to the prescribed scripts in the model of the session
- *Output*: where certain information is displayed to the role player
- *Upload*: where the role player must upload a file
- *Message*: where the role player must send a message to one or more other role players in the session
- *Move*: where the role player is invited to move the session on to another stage.

As the game session proceeds, the instructions may change from those outlined initially. A game session ends when either the permitted duration of the game as defined at the outset is finished, or the goal(s) specified in the instructions have been reached. As participants in Cyberdam do not have to be online simultaneously in order to participate in the game, a typical session with a Cyberdam game may take a whole week to complete, while the actual playing time for each participant in the game may be a couple of hours at most. Evaluation of typical games in Sieberdam/Cyberdam has revealed that the average game takes around 5-7 weeks to complete (Van der Hijden, 2005). However not all interaction takes place online. In addition to the online interaction, there are often timetabled face-to-face meetings between participants in the game. Participants take part in the meetings in-role to carry out synchronous activities, that is, those activities that require the presence of each participant in the same place at the same time. Any activity occurring in the game during the rest of the time is "asynchronous" (Van der Hijden, 2005).

2.2.2 Learning outcomes

The overriding aim of the Sieberdam/Cyberdam projects was to teach complex decision-making through the use of gaming and to attain learning outcomes through both active and authentic experiential learning (Bekebrede et al., 2007). To better understand the possible learning outcomes that might be produced on a system such as Cyberdam it makes sense to look first at one of the simulations already carried out on it. It is important to understand the context in which the students and their tutors might find themselves, the types of activities they might be involved in undertaking and the main tasks that have to be completed during the game. What follows is an outline of the main elements of the *Spoorzone* simulation that first took place in Sieberdam in 2005.

2.2.3 Example: Spoorzone

The scenario revolves around the administrative restructuring of a problem area of ground near a railway track. Besides ownership, there are professional and ethical issues of urban planning and poverty. The municipal authority needs to write a plan for the area using participatory decision-making. The game events and resources include a briefing, a concept plan, an appeals procedure, the formulation of final plans, and at a certain point during the game a crisis involving loss of electrical power due to heavy winter snowfalls.

The simulation involves such actors as municipal officials, residents, housing associations, representatives of the railway organization, and SMEs (small to medium-sized enterprises). The job description for each role includes the goals to pursue and the interests they represent. Tutors play the role of council officials in order to monitor progress, the quantity and quality of interaction and the quality of task completion by students. The students' tasks include organizing meetings, undertaking study (e.g. a cost-benefit analysis of moving the track), and formulating new development plans for the area (Bekebrede, 2007).

Participation in a simulation of this type can facilitate many potential learning outcomes. A key aspect is consolidation of knowledge – making disciplinary theory encountered in texts or in lectures more comprehensible for the student. Added to this, the game gives students the opportunity to generate new subject-related knowledge. Students can also be encouraged to learn to think beyond disciplinary boundaries and see the links between different subject areas that they might previously have regarded as discrete because of the academic boundaries of the program, module or topic.

Beyond disciplinary knowledge generation and consolidation, participation in a simulation such as *Spoorzone* can encourage learning of team-working skills, improve communication skills, improve discussion and reasoning skills and lead to improved negotiation skills. There is a particular focus on skills related to professional life beyond college or university (Bekebrede et al., 2007). The integration of such skills with disciplinary knowledge is a powerful motivator for students, for the disciplinary knowledge can then be perceived as being used in much the same way as professionals would use it. The issue is of course a highly complex one; and one would not want to draw close analogies without further research. Nevertheless it is undeniable that an environment such as Cyberdam, with a well-designed scenario such as *Spoorzone*, affords the opportunity not just for the close integration of skills with disciplinary knowledge, but the practice and analysis of professional thinking and action.

Experiential learning that takes place through such games as Sieberdam/Cyberdam is of course a moderated and evaluated process (Bekebrede et al., 2007). The need for moderation and evaluation in learning using simulation is motivated by a number of factors:

- lack of clarity as to what drives the experiential cycle and what ensures that it continues
- lack of clarity as to the role of knowledge transfer and formal instruction in the cycle
- the need for outside intervention to prevent decisions based on "negotiated nonsense"
- issues of time. Experiential learning tends to be slow and therefore needs to be "moved on" by a facilitator.

One of the most important outcomes of using Cyberdam to create a simulation such as *Spoorzone* was its effect on the quality of learning and teaching interactions. There are two key elements to this interaction, namely quality of student-student interaction and quality of student-tutor interaction. Students indicated that theory became more comprehensible and they learned much more about the subject. In evaluations of Cyberdam simulations it is plain that the interventionist role of the tutor in learning through simulation is critical. Students had varying experiences of performing the same simulations compared to others in their cohort and this was often due to the quality and nature of interaction with the tutor to whom they had been assigned for the duration of the game (Bekebrede et al., 2007). Again, this is not new: as McKellar & Maharg report with regard to implementation of multimedia webcasts, the integration of e-learning within the more conventional affordances of seminars, books, etc. is often critical to the success of an e-learning initiative (2005).

2.3 SIMPLE

SIMPLE (SIMulated Professional Learning Environment) grew out of an approach to legal education that began with the founding in 1999 of the Glasgow Graduate School of Law (GGSL), a joint school of the universities of Glasgow and Strathclyde. The School adopted several unusual approaches to the professional education of law students on a postgraduate vocational program called the Diploma in Legal Practice. All were inspired by John Dewey's approach to democratic education and experiential learning. Simulation was one of the key approaches. To achieve the sense of entering a learning space different from other academic and professional learning approaches, we built a fictional town on the web, called Ardcalloch – a typical west coast Scottish provincial town. It consisted of a map and directory and had over three hundred citizens, institutions, businesses and other organizations that could be used in simulation projects.

The GGSL's educational approach was based upon the constellation of concepts summarized by the phrase "transactional learning". The idea of learning as a form of transaction is of course not a new one. It can be traced back to Dewey's fundamental argument that education arises from the interaction of a person's internal life and external conditions. Experience, he held, consists of an *interaction*, a transaction between individual and environment (Dewey, 1981, p. 25). Indeed it would not be saying too much to describe it as the educative process. Others have taken up this transactional relationship and developed it in different directions.[1] Chen, for instance, has applied it to the concept of distance in use of the web for distance-learning (Chen & Willitts, 1998);

[1] Dewey states in an albeit early article: "I believe, finally, that education must be conceived as a continuing reconstruction of experience; that the process and the goal of education are one and the same thing" (1981, p. 91).

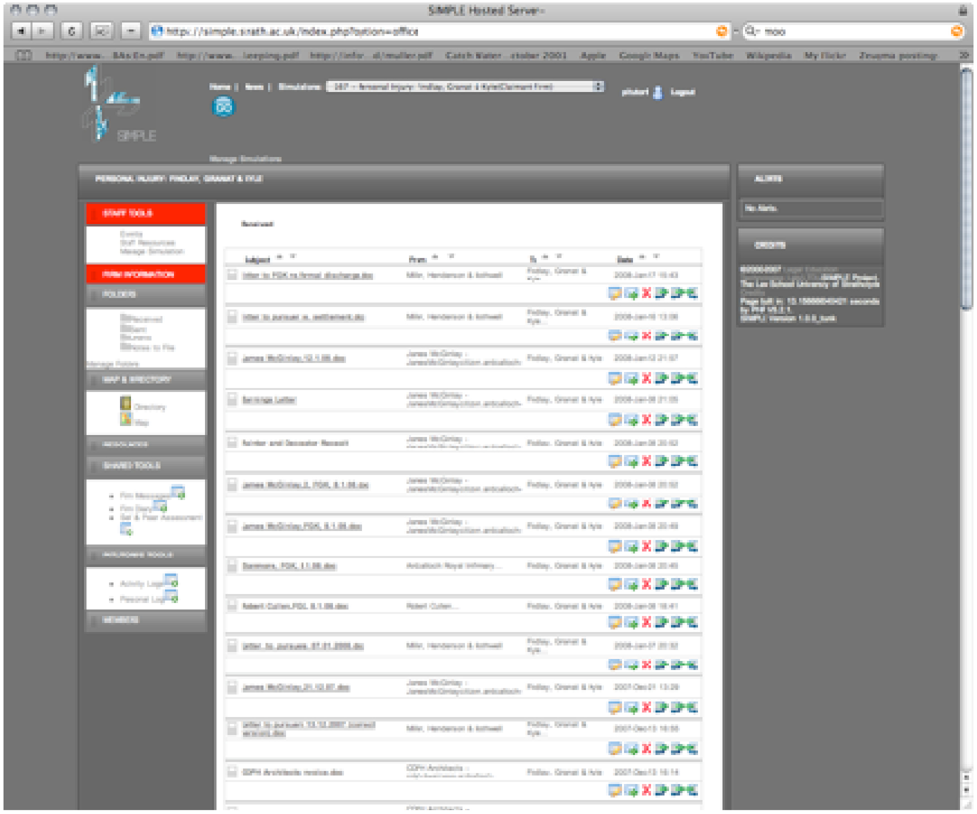

Figure 2.2 – The SIMPLE user-interface

Garrison and Anderson (2003, p. 19) note that in the construction of distance-learning theory recently there has been a shift of focus from “organizational and structural constraints” (such as those of geographical distance) to “transactional issues and assumptions” of teaching and learning. For Garrison, the shift is nothing less than a movement from industrial-era conceptions of learning at a distance to post-industrial learning where peer collaboration and dialogue lie at the heart of the educational experience (Garrison & Archer, 2000).

Peer collaboration and dialogue lie similarly at the heart of transactional learning approaches in the GGSL. Extensive student feedback was gathered every year, and the simulation approaches of the design team in the Learning Technologies Development Unit were developed iteratively in response to this feedback. The simulation project was thus a long-term design and specification project, with each stage creating a new iteration of the software and the educational approach. The approach has been refined over a number of years by Maharg and others (e.g. Maharg & Owen, 2007; Barton, McKellar & Maharg, 2007). The approach is now characterized as:

1. **active learning**
2. through **performance in authentic transactions**
3. involving **reflection in & on learning,**
4. deep **collaborative learning**, and
5. holistic or **process learning,**
6. with **relevant professional assessment**
7. that includes **ethical standards.**

Initially applied to one subject in the Diploma in Legal Practice, transactional learning now spans across five subject areas in six projects, all of which now use the SIMPLE software described below.

In the period 1999-2005 the technical implementation and design iteration of this educational simulation paradigm was complicated and, while sophisticated on an educational level, needed applications programming at almost every level to design, build and maintain the software. In the period 2006-2008, with the aid of funding from JISC (Joint Information Systems Committee) and HEA (Higher Education Academy, through the Law subject centre, the UK Centre for Legal Education at the University of Warwick), the design team at the Learning Technologies Development Unit in Strathclyde University Law School specified, designed, built, used and evaluated a new environment called SIMPLE. The environment is open-source, and was a much more stable environment than any of its predecessors.

2.3.1 Functionality

Early in the design process a small but crucial series of decisions was taken about the functionality of SIMPLE. It was decided that the resultant software would be developed to sustain the pedagogy of transactional learning that we had developed. This did not rule out the application being used for other purposes, but it did mean that the pedagogy was used to direct and prioritize the potentially huge range of functionality that could be built into the environment.

At present, SIMPLE consists of a simulation authoring tool set and a simulation platform upon which simulations for professional learning can be run with users. The platform functions as a basic type of case management system. While many of the simulations were based in Strathclyde Law School or in four other law schools (Stirling, Glamorgan, University of the West of England and Warwick, user participants in the project also included Management Science, Social Work and Architecture. The simulations were used by a range of undergraduate and postgraduate programs, proving that in-depth simulations can be used throughout the student cohort, and across a range of professions.

The authoring tool set is the construction yard for simulations, where designers create simulation “blueprints” that contain not just the structure of the simulation but all necessary roles, resources, information, texts and other resources, e.g. graphics, video, etc. SIMPLE documentation advises blueprint creators to start with paper and basic flowcharts. Thereafter, authors are advised to use the Narrative Event Diagram (NED), which enables authors to set out simulation structure as a series of event nodes on a pre-set grid of lines, namely Critical Events, Player Characters (i.e. users), Non-Player Characters (all virtual roles) and Staff. Using this form of graphic notation blueprint authors can set out the structure, timing and nature of events and communications within the simulation.[2] They can also upload all resources to be used in the simulation. Variables can be inserted into the simulation resources, so that the same simulation can be deployed within a large group of users, while retaining unique markers for any particular single instantiation of the simulation.

[2] The analogy to contemporary forms of music annotation is not entirely coincidental – for examples of fascinating analogies for simulation notation see http://en.wikipedia.org/wiki/Graphic_notation.

Once a blueprint is complete, it is tested and then uploaded to the platform. Users are assigned roles, and the simulation is ready to begin. Documentation for this and many other procedures is available from the SIMPLE community of practice website at http://simplecommunity.org.

The platform interface is similar for both student users and staff. The only distinction is the addition of two tabs for staff that enable them to communicate with users as virtual characters, and to have access to the simulation structure. There are Received, Sent and Drafts folders that are generic to all instantiations, and by means of which users create and retrieve their work, and communicate with real and virtual characters. Users have the opportunity of adding to this list by creating and naming their own folders. They have access to a map and a directory that may be of a real or a fictional town that can be customized by blueprint authors for specific blueprints. In addition the GGSL has developed extensions of the application in the form of activity and personal logs, and self- and peer- assessment questionnaires.

2.3.2 Example: Personal Injury Negotiation Transaction

We can appreciate how SIMPLE can be used if we consider briefly a sample simulation, namely the *Personal Injury Negotiation Transaction* (PI), used at the Glasgow Graduate School of Law on the postgraduate professional program, the Diploma in Legal Practice. The transaction is carried out by 68 firms each consisting of four students. Half of the firms represent an employee injured in an accident at work while the other half represent the other side in this adversarial transaction, namely the employer’s insurance company. Students have 12 weeks to achieve a pre-litigation negotiated settlement of the claim. They play the part of lawyers for each side, and can contact any one of around 17 fictional characters for real-time information. During this time they need to discover what exactly happened to the injured employee in the incident, precisely what his injuries are and the medical prognosis for his quality of life in the future, as well as what effect legal regulations and case law have upon their client’s case. Information is communicated to students by eight “PI mentors” – a group of postgraduate students, trainees and newly-qualified lawyers trained to answer in character and also to give feedback to the student firms.

The transaction is a high-stakes assessment for students: they must pass in order to be granted a Diploma at the end of the year. They are assessed on the quality of the case file that they keep throughout the transaction, and assessment criteria are based upon this quality. Throughout the process of case construction, therefore, students are required to produce evidence that they have completed the following to specific standards:

1. fact-finding from fictional characters and construction of the client case
2. professional legal research
3. formation of negotiation strategy
4. performance of that strategy.

The simulation has been described in detail elsewhere (Maharg, 2007). Noteworthy is the substantive legal understanding that students achieve through this form of problem-based learning, and which they frequently comment upon in feedback. Also of note is the level of commitment they bring to the project. There is also the broad range of skills they practice: legal writing to a wide variety of audiences, problem identification and problem resolution, collaborative working and case management being amongst the more obvious skills.

2.4 Game or simulation?

There are many differences between Cyberdam and SIMPLE. They range from relatively minor differences in user interface (SIMPLE uses English dialogue texts while Cyberdam supports multiple dialogue languages) to broader issues of approach to game theory and educational design (SIMPLE is in essence a single-player system which can accommodate multiple groups within a single transaction, while Cyberdam is a multi-player system). There are too many to be analyzed in depth in this chapter, so we focus on a single difference and explore how it affects the two simulation environments. In doing so we compare instances of each platform – for SIMPLE, the *Personal Injury Negotiation Transaction*; and for Cyberdam, *Spoorzone* and another simulation called *Border Crossings* (BC). We also consider some feedback from Scottish students on a joint Scottish-Dutch project called *Maternity Leave* (ML), that used the Cyberdam platform. BC and ML are briefly introduced below. It may be argued that any single instance of a game or simulation scarcely does justice to the range and flexibility of either platform. This is true, but any discussion of functionality would be rather dry without examples. These examples, particularly the points raised by students in the ML discussion, also lead us to consider educational outcomes and pedagogical issues.

2.4.1 Game / simulation: student experience on Maternity Leave (ML)

This was a joint project between the University of Strathclyde and the Utrecht Hogeschool, where law students from each institution represented one of two sides in an international employment dispute. It was a pilot project for the volunteer Strathclyde students, but was a high-stakes assessment for the Utrecht students on their undergraduate law program. The simulation was a fascinating combination of SIMPLE approaches to transactional learning, matched to the program requirements of third level students on a law program at HU University of Applied Sciences Utrecht. Scottish students were postgraduate law students, most of whom had completed the Diploma in Legal Practice as well as an undergraduate LLB.[3]

Student feedback from eight Scottish students was obtained in a single focus group meeting at which both authors were present. The feedback gave us interesting user perspectives on the experience of taking part in an international simulation. We discussed with the students their experience of using the Cyberdam platform and of working through the simulation as legal advisors to the Dutch students. Most of the students were already familiar with the SIMPLE platform, and we asked them to bear that experience in mind when commenting on the experience of using the Cyberdam platform. The resulting conversation, which was recorded and transcribed, casts light on the differences between the two platforms.

The variation in workload surprised students. We had told our students what to expect from those to whom they were acting as legal advisors on the nature of Scots and European employment law. Nevertheless they felt it worth commenting on that they

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[3] See http://www.cyberdam.nl/mod/data/view.php?d=16&mode=single&page=20

needed to research issues that were not entirely clear to them, and had very short deadlines in which to complete the research work:

> "You wouldn't do any work for a long time and then suddenly you would have to do loads of work in one day."

The nature of the advice-giving process was also problematic, and the reasons for this were interesting:

> "They [the Dutch students] asked a huge question! They asked us, 'Tell us about employment law in Scotland.' They had specific facts but they didn't ask specific questions until the very end, when they had lots of new information."

Clearly the Scottish students were struggling here to play the role of client advisors, and in particular the role of advisor in helping a client to articulate concerns and issues. The problem is not quite one of communication, certainly not of substantive knowledge. It has more to do with management of the professional relationship between client and advisor. The Dutch students, for example, could be expected to have specific facts, since that was what they were required to collect. But it was not entirely their job to formulate specific questions about the facts. That was partly the task of the Scots law students, who needed to be more proactive not only in thinking about the types of questions that the Dutch students would ask, but also about the types of information they would need in response to those questions. As advisors they needed to help the Dutch students formulate the important questions of the facts and the legal topic. Since they did not think about this client-based aspect of the simulation, they found themselves uncomfortably short of time to answer queries.

One student admitted,

> "We didn't know what to expect."

Another student commented, ruefully:

> "We were all over the place. If at the very beginning they had given us all the information they wanted […] then obviously we would have been able to make inquiries about all that from the outset. But we got into the position where we, like, could almost answer everything."

Another agreed:

> "We didn't know what to expect, everybody was all over the place. It [the agenda] was set by [our client]."

This was borne out by other comments on the nature of client communication in the project. When asked about the differences between the PI transaction and the international scenario, a number of students talked of the other side as if the Dutch students were a black box: information was going in, but nothing seemed to be coming out. Three comments are evidence of this:

> "We didn't know about their deadlines. For us, deadlines were a lot more relaxed."

> "In PI we had lots more information about our deadlines, we were clearer about when things needed to be done."

> "We didn't know what they were doing in between their deadlines."

Here the problems had to do with communication issues that should have been resolved. In the real workplace trainees would of course consult senior staff to learn what the culture of the workplace would treat as acceptable and capable behavior. Here, the students did nothing to resolve the difficulty, and the result was an uncertain, unnecessary distance between the Dutch clients and their Scottish advisors. If this simulation were to run again, this issue would be addressed as part of the iterative improvement, either by more communication or more social contact between the two groups (e.g. a video conference at the start of the simulation).

It was interesting to hear that the experience of many Scottish students (who had already participated in at least five SIMPLE projects that year) carried over to the Cyberdam project, and helped them to work with a very different interface.

> "Everything was easy to do because of the experience of the Diploma, because of the experience of doing the Personal Injury project and the Civil [Court Action Transaction]. We were used to dealing with the environment and found it easy to do because of that."

> "Quite easy for me in the end and I did enjoy it."

One student who had not taken part in any SIMPLE projects was much attracted to this way of learning:

> "A whole new experience for me. But the whole concept of the project […] interacting as we did, was quite new. I found it very interesting."

Another student agreed, commenting on the use of authentic tasks against a more conventional way of teaching and learning:

> "You wouldn't have learned as much as if it [the simulation] were a course."

When asked about what they liked in detail about the experience of working in the Cyberdam simulation as opposed to conventional teaching and learning, students were fairly unanimous:

> "It's definitely [a] much more practical way of learning. I'd never written a [professional] letter in my life [before this], unless it was a letter to complain about something. Being told how to write a letter in a lecture hall isn't the same as sending it and someone getting back to you and saying we don't know what you're saying."

Another commented on the new genres that students encountered on the simulation, and how simulation helped them to develop their capability:

> "We don't know how to present a report. These [i.e. Cyberdam and SIMPLE] are very useful tools for that. I've enjoyed the projects on the Diploma and this one. I think it's a much better way of learning."

Another assented:

> "I'd agree with that. I wish we'd done things like that during the [undergraduate] law degree rather than just on the Diploma because it seems like we learnt a lot more on the Diploma than we did in the four years [on the law degree] at university [by] using SIMPLE and doing practical cases like you do on a job."

Students who had worked on projects such as PI, where they were expected to work in several domains of law, commented on the scenario's complexity:

> "I was surprised at the simplicity of the problem. I don't know how common that is in practice. [But] there was a lot of work involved [in discussion of issues]."

In a sense the student answered her own point about the problem. The complexity of a real-life problem is not necessarily the complexity of appeal court cases that are analyzed in academic legal programs, but is the complexity that arises from law as it plays out in social contexts, in real life.

Students noted that the simulation design broke up the employment law problem into neat stages and commented on this:

> "I think it would be more helpful if it came not just in neat packages like, this is a labor issue, strictly labor, but if it cut across various aspects of life."

In part this may have been a function of our inexperience in international project development. It may also be a function of the Cyberdam authoring environment, which allows staff to set stages or phases to the game, and this was used by staff when constructing the scenario. If SIMPLE simulation blueprints are structured, it tends to be by assessment points in bounded transactions. Otherwise, like the PI transaction, they are open-textured in the sense that students conduct the transaction at their own pace. The Cyberdam simulations, by contrast, tend to be structured like turn-taking in games, or sections of game practice.

2.4.2 Game / Simulation: pedagogical and platform differences

One subtle but important difference between SIMPLE and Cyberdam lies in the area of design approach. This was partly the result of recently funded initiatives and the revisions that took place within those funded initiatives, as described above. Reincarnating the Ardcalloch environment as SIMPLE refined the application into a professional, case management environment. The revision of Sieberdam to Cyberdam has produced an environment that supports both games and simulations, perhaps more than was the case before. It may be argued that Cyberdam is currently more amenable to games than simulations. The Dashboard interface for instance is a communication area, but not primarily a professional simulation tool. It was noted during the design process of ML, for instance, that the Dashboard as currently instantiated did not allow for as much immersion in a professional environment as SIMPLE did. On the other hand, SIMPLE does not have the flexibility to be used in imaginary games environments that Cyberdam currently supports.

One example of Cyberdam's flexibility in this regard is the *Border Crossings* (BC) game. This Cyberdam game is quite different to PI. Students are told they are travelling on a two-week business trip abroad, and "discover it takes more than just cunning and deceit to be a successful international manager."[4] The students (third and fourth year students on an undergraduate International Business & Management degree) encounter textual summaries and graphics of scenarios one is likely to find while travelling. They have to respond to situations by stating what action they would take from a set of options, and are given feedback on their responses.

Much depends, of course, on how one defines a game and a simulation. Each has a distinctive design and research pedigree. The literature is considerable (Rieber, 1992; 1996; 2003). Margaret Gredler defined the differences well. Simulation, she points out, is an "evolving case study of a particular social or physical reality in which the participants take on *bona fide* roles with well-defined responsibilities and constraints" (Gredler, 2003). By contrast, a game's action is "governed by rules of play (including penalties for illegal action) and paraphernalia to execute the play, such as tokens, cards, and computer keys" (Gredler 1992). The difference is more one of emphasis than a category difference; but it is influential in subtle ways. It affects the ways that players / users enact roles, carry out tasks, and learn from their actions in the virtual world. We can appreciate this if we analyze in more detail five aspects of game / simulation research, design and play using the examples we have briefly described above:

1. *Transaction context vs. game context*
   The transaction context of PI is different than the game context of BC. The provision of real-time information broadens the scope of the transaction, introduces unforeseeable elements. In BC, the game is far more strictly controlled, through scenarios and question sets, and imaginary rules. To be sure, these are based upon real activities in the world – the ancient trope of a journey to strange lands, problems encountered on the way, etc. – but this is different than the grounded reality of the legal transaction. BC, however, fully exploits the imaginary environment of the game, and for educational purposes. Character types are drawn from mythology and history, for example – something that would sit very oddly in the SIMPLE environment. SIMPLE is therefore more focused on transactional simulations, while Cyberdam can support games with imaginary elements as well as simulations such as *Spoorzone*.
2. *Sense of place and topographical representations*
   The map in Cyberdam, with its foregrounded game environment, is more essential to its projects than the maps used in SIMPLE projects. In our use of SIMPLE in the GGSL we have found that students may be interested in the map at first, but use the directory more than the map during transactions. The predominantly textual focus of most of the student work area means that this is foregrounded while the map is backgrounded as a distant and fairly minimal resource. This does not preclude projects being developed that may use the topography of a region or district in more detail in a transaction, or which require a sense of place as an essential element of the game (both *Spoorzone* and BC are good if different

[4] See http://www.cyberdam.nl/mod/data/view.php?d=16&mode=single&page=8

examples of this; an architectural game or simulation would be another). The place of the map in the design could thus contribute to the design of games and simulations with topographical resources being used as they would normally be by the disciplinary discourse. This means that maps, in both SIMPLE and Cyberdam, need to be far more dynamic resources in their own right, with interactive functionality similar to that provided by, for example, in Google Maps and Google Earth, and a more fluent interface between topographical and textual data.

3. *Learning about personal qualities*
   All games and simulations have the capacity to facilitate learning in this domain. However games in Cyberdam seem to be able to directly address personal issues. BC is a good example of this, where discussion of choices leads to wider points about one's personality and the social and relationship choices one makes in the world. Current SIMPLE functionality requires more emphasis on reflective learning, particularly during a debriefing session, to bring this to the foreground (though this is remedied by use of self- and peer-assessment questionnaires as described above). Having said that, it is clear that much personal discussion takes place between participants during a game / simulation in both Cyberdam and SIMPLE, as student feedback on the ML simulation proved.
4. *Literature and models of learning*
   There are differences in the background literature that tend to be drawn upon by each platform. Generalizations are dangerous in this regard. We have only begun the process of writing about both Cyberdam and SIMPLE so there is little literature to draw upon. Interestingly, though, Cyberdam authors seem to reference classical games literature (which tends to be more available in continental Europe than in the UK), while SIMPLE literature tends to refer to constructivist sources, and the literature of professionalism and rhetoric. This is also evidenced by the language of games design used to support the creation of games and simulations in Cyberdam (described in Section 2.2).
5. *Open and bounded simulations*
   Both Cyberdam and SIMPLE can accommodate what Barton and Maharg term open-textured and bounded simulations (2006). They define the characteristics of the different types of simulation, but perhaps the key distinction is the provision of complex information in real-time during a simulation. SIMPLE transactions often make use of live information fed in real-time to the participants in answer to queries. This can of course happen in Cyberdam, but it seems to happen less than in SIMPLE. Again, this may be symptomatic of the games base of Cyberdam. Live information has the advantage of making transactions more authentic and sophisticated than they would otherwise be. However the process can be dangerous and has to be carefully managed or it can easily derail a transaction. In that sense it contributes to the build-complexity of a simulation infrastructure.

2.5 Conclusions

In spite of the divergences of the two applications, some of which are stated above, there are many similarities in pedagogics and technologies, and we shall end by pointing out some joint convergences in research that can be achieved by the two projects.

In our conclusion to the SIMPLE Project Report, we state that our experience of the two-year project had confirmed that simulation is a powerful heuristic, capable of enhancing student learning and supporting transformative shifts in education. This is nothing new. However it was also clear from our project that to implement simulations and games, staff need to be committed to changing some of their fundamental practices. They need design support in order to create effective simulations, and this includes integrating the outcomes and methodologies of teaching and learning. They also need practice in designing innovative forms of learning, in building resources for simulation and in re-thinking feedback and assessment practices. Management at departmental, faculty and probably institutional level need to give thought to different employment practices within staff cadres in order to support such forms of learning, resource building and assessment. In addition simulation practice could (and did) facilitate forms of collaborative activity between institutions and disciplines, and internationally.

We would suggest that this may also be true of Cyberdam, and we base this not just on our separate readings of SIMPLE and Cyberdam, but on our experience in co-designing the *Maternity Leave* simulation with Utrecht Hogeschool staff, and using Cyberdam in the simulation. Above all, we would argue that much more research is needed on these and many other issues. We commonly frame our discussion of games and simulations in terms of technologies and outcomes. We need to re-frame this discussion to take account of the considerable body of research literature that already exists on influential models of learning and interaction – on writing and rhetoric (Goodfellow & Lea, 2007) for example, or on social interaction theory (Goffman, 1961), or on situated action models (Suchman, 1987). Such research should probably be carried out in collaborative projects, in order to increase the research base and general understanding of gaming and simulation in environments such as Cyberdam and SIMPLE. Below are some examples of areas requiring further research.

2.5.1 Simulation spaces *vs.* teaching interventions

One difference between in-depth simulation and conventional teaching is the emphasis on space. Teaching is normally defined as some kind of activity. Simulation by contrast can be defined as a space designed for learning. The metaphor of the stage is apt: staff activity takes place behind the scenes, at the planning stages (as playwright) and in role play with students (as actor). The result of this is, curiously, that staff can be perceived by students to be more remote from their learning activity, precisely because they are not present in conventional roles.

The problem is not just one of new staff roles, but also the management of student expectation. In the simulation spaces, communication and feedback require new forms of intervention. In-role feedback is possible. New varieties of forms of feedback can be designed. In the GGSL PI transaction, students received feedback on issues from negotiation tutors at “surgeries” – effectively brief sessions with tutors lasting no more than 20 minutes, where students came to discuss and receive advice and feedback on specific issues relating to their transaction. Students need to know precisely how the surgery will operate before they can feel comfortable with it, precisely because the discourse at such an event is quite different from a tutorial, seminar or workshop. Staff need to know how to structure and manage the surgery. Simulation and game designers need to know how to use such innovative teaching designs.

2.5.2 Management of communications data

Communication channel management becomes more critical in environments such as Cyberdam and SIMPLE, for online simulation space relies more on such communicative channels for learning and feedback to take place. It is probably true to say that both platforms require further diversity in the communication channels they offer – discussion forums, IM, mobile phones, voicemail, texting, video, Twitter are some examples – but even more essential is the toolset that enables users to manage the complexity of information streaming in through these channels. This in turn requires research into user needs, patterns of data usage and the types of tools to be developed.

2.5.3 Large-scale collaboration and collaborative inquiry

Large-scale collaborative projects such as Cyberdam and SIMPLE have the capacity to challenge institutional orthodoxies. Institutions commonly organize their knowledge in LMSs, silos of knowledge behind intranet walls. Products of the teaching process include handbooks, CDs, closely-guarded downloads, and are password protected. Content is organized into programs and modules, within which there is snapshot assessment of taught substantive content in examinations and other forms of assessment. Use of simulation together with large-scale collaboration over simulation design and implementation is one way to present alternatives to the *status quo*, and we should be seeking ways to develop further collaboration and collaborative inquiry. In this way we can contribute to the understanding of how institutions affect the implementation of innovative technologies.

2.5.4 Simulation, gaming and institutional structures

There are much wider implications raised by both SIMPLE and Cyberdam. Simulation frequently inverts what might seem to be the natural order of things in our teaching institutions. What if we look not just at how institutions affect the implementation of innovative technologies but instead ask how such innovations can effect change in institutions? If SIMPLE were to be in widespread use, what might its effects be? With its propensity to be a multi-user platform across a range of institutions, Cyberdam would contribute to the weakening of institutional boundaries, but paradoxically could strengthen the presence of institutions, precisely because it is capable of supporting and organizing resource-based, integrated learning networks, with open access. MIT & OU, with their open courseware initiatives, show us the way forward in this regard.

But these institutions are still acting as single institutions. What is uniquely different about platforms such as Cyberdam and SIMPLE is their potential for global take-up, and interdisciplinary collaboration across institutions, across disciplines, and across systems of higher education. In such an environment it may be more possible to focus not on static content but on web-based, aggregated content, where e-learning is integrated with other forms of teaching and learning as understanding and conversation, as just-in-time learning; and where assessment takes place as assessment of situated learning. Such an environment can be termed trans-systemic in its potential effects.

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Chapter 3

The Seven Pioneers
A case description of the development of e-learning simulation games in higher vocational education

Kees J.M. van Haaster

3.1 Introduction: towards e-learning simulations

This chapter presents a case description of the introduction and development of seven e-learning simulation games at the Faculty of Society and Law (FM&R) of the HU University of Applied Sciences Utrecht. These seven new games were developed in the project Learning in a Virtual World (LiaVW). Seven different curriculum programs, divided over four institutes, were involved in the project.

In this project we consider an e-learning simulation game a role-playing game in the context of the objectives of a particular curriculum program. We expect simulation games to provide opportunities for learning by experience, bring knowledge into action, support training of professional skills, and prepare for performance in internships. Role play is acted out in scenarios, based on relevant situational knowledge and experience. Students are grouped in teams, each team playing one of the roles, and experts from practice and teachers can take on specific roles, as consultant or assessor or as non-active players to monitor or moderate games and for interventions. The challenge to players is to develop good comprehension of their own and other actors' roles, interactions and interests. We find it necessary that the internet application offers various ways of using narrative and interactive media tools to enhance the "look, feel and touch" of a simulation. Communication between players is mainly effected by a built-in mail server, but we also like to use other dialogue forms such as chat, instant messaging, headers, virtual conferencing, and even face to face encounters between role players, outside the simulation. Essential to simulation games is a well argued combination of play/game: which element provides both a gaming characteristic and "fun" and how is it woven into the game activities? The task challenge should be in the "zone of proximate development" of the participants.

In this chapter, we first introduce the various simulation games in the context of this project. Next, we highlight the design fundamentals to explain some of our starting points for the development of the e-learning simulation games. After that, we present a practical model, based on the design fundamentals, that was applied to guide the development of each of the seven games. Finally, we reflect on the evaluation and learning effects, and end with some conclusions.

In several places in this chapter, we point out some interesting remarks that were made during a round of reflective interviews with all the developers and managers (n = 14). To illustrate the text, we use examples from the Vision game. This simulation game has been extensively tested and evaluated and can provide for occasional explanations.

Our faculty at the HU University of Applied Sciences Utrecht has shown fundamentally positive support for this project. First, we believe that narrative constructivist methods and multimedia techniques can be combined very well in e-learning simulation games. A second favorable influence on the project is our concern to establish ways of distance learning and our efforts to integrate internet applications in our programs. A third supportive power is our historical focus on creativity and the arts as inspiration for professional performance. Some institutes in our faculty (Arts Therapies, Community Development, Care) have a long tradition in education through the arts and in the development of creative methodology in professional practice. We think e-learning simulation games offer opportunities to integrate play and game methodology in learning processes and believe that experiments with new technologies and devices could stimulate theory development and method innovation.

There were also some constraints to our engagement in this project. To be honest, we were confronted by certain limitations in most of our teaching and research staff in terms of technological experience and orientation. In addition, it is obvious that in such professional fields as Social Work, Law, Pedagogy, Security, where face-to-face communication (F2F) prevails, the introduction of computer-mediated communication (CMC) needs some persuasion. However, we think that CMC in simulation gaming can have a valuable complimentary significance to F2F communication. In our faculty, some of the most convincing arguments to start developing e-learning simulation games dealt with the possibilities for training and demonstrating competencies in a manipulated virtual professional environment. They also pointed persuasively to the benefits of contextualized information searching, social and constructive learning, collaborative performance in workplaces and in teams, and bridging formal, non-formal and informal learning. We knew that the integration of e-learning simulation games would demand new or adapted teacher skills and reconsideration of effective teacher-student interactions in the e-learning environment. Student coaching can take place time-and-place independently and on an individual level. Besides the teacher-student interactions, e-learning simulation games would require more intense teacher-teacher relationships, particularly if simulation gaming is integrated in a broader curriculum program that is developed, presented and supervised by various lecturers, teachers and trainers.

For decision-makers in curriculum development, an interesting question was if simulation gaming can be cost-effective and time-effective if it is integrated on a larger scale. But this was not the most persuasive argument. Simulation games in educational contexts offer possibilities to experiment with the integration of knowledge and practice. This is precisely what all curriculum developers hoped to establish in this project. In games we deemed it possible to intertwine the process of knowledge acquisition with acting processes. We expected first and above all that simulation gaming would benefit the engagement of students in understanding professional circumstances, methods and skills, and to gaining an understanding of practical dilemmas and operations. Processes of learning (knowledge) and doing (professional actions) in simulation gaming can be mutually supportive (Crookall & Thorngate, 2009) and therefore the focus was on offering students the possibility of action-knowledge symbiosis. Concrete experiences in simulated actions and interactions can be used in reflective observation and abstract conceptualization, in order to become effective as action-into-knowledge and knowledge-into-action cycles. This demands feedback loops on simulation results in lectures and tutorials. The interchange of play (action) and dialogue (reflection) in simulation gaming was one of our most convincing arguments towards building support for the participation in the LiaVW project. It would also enable using simulation gaming for low-risk experimentation. Students could act as practitioners in simulated practice situations, but if they made mistakes or miscalculations, there would be no damage to people or real situations. The important question for all game developers was, however, to what extent would the simulation reflect real-life situations and to what extent could students transfer their gaming experience to professional practice? We had to start experimenting to find out.

3.1.1 Experiments

The development of e-learning simulation games must be based on an effective connection between curriculum requirements and narratives from the reference field (professional practice), as shown in the Figure 3.1 below. The steps on the line between curriculum and narratives must be coherent and logic.

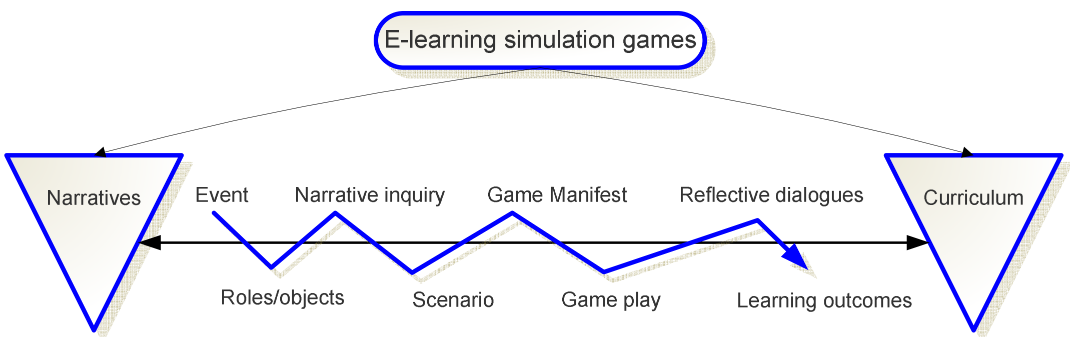

Figure 3.1 – Dealing with curriculum requirements and narratives from the reference field

For studies that prepare for “people professions” (Society and Law), narrative approaches (storytelling, voicing, listening, interpreting and dialoguing) are evident. With the computer’s central position in this project, it became obvious that we needed to construct and use narratives for the creation of explicative models that show the dynamics of complex professional situations and that support operations in social systemic conceptions. We think that in professional arenas with deep and fast-changing dynamics, as in Social Work, it is imperative that (future) workers learn to be “flexibly purposive” (Eisner, 2002). This implies that professionals are competent in adapting their objectives and operations to new situations and emergent change. Narratives help to visualize interrelationships in system disciplines from a holistic perspective and when used in simulation scenarios, narrative dialogue and interpretation support flexibility and adaptation to external changing conditions. Narrative approaches induce analytic and creative thinking and train multilingual expression and understanding. The use of modern media enables the merging of text, video, audio and effect to build stories that can be used as resources in game scenarios. Narrative approaches in stories, inquiries, interviews, through audio, film and photography, can bring forward the actuality of situations and contexts in various types of discourses on situational knowledge and professional development. For each of the seven simulation games, we correlated the curriculum requirements (competencies, learning objectives, and envisaged outcomes) with relevant narrative resources in websites, attributes and assignments. In all cases we started with an event or practice situation as a replica of a professional dilemma or problem that had enough possibilities for the elaboration of the curriculum requirements in a simulation game. We advocated the use of appealing events from professional practice, conceived in holistic narrative representations, as constructing material for the development of scenarios. We encouraged creative game concepts that would challenge dynamic discourses of static narratives (plots, scenarios, story texts) and constructed narratives (dialogues, interpretations, interactions) by the players of the game. To give an idea of a developmental framework of one of our games, we refer to the developmental history of the Vision game in Table 3.1.

Our practices and learning experiences with the Vision game were of great help to new participating parties in the LiaVW project. The first transfer of practical know-how was done in the Institute of Pedagogy, which took Vision as an example for the construction of a completely new simulation game (Youth Policy) in one of the Pedagogy programs. An important facilitating factor was that one of the teachers at Pedagogy had been involved as a game instructor in the Vision game. We emphasize that this practice works well. Teachers without previous experience with simulation gaming in education run into more difficulties in the design and development of a new game than people who have already taken part in other games. Another teacher with previous experience in the implementation of Vision was asked to develop a third game: Dilemmas in Outreach Care for the Research Centre for Social Innovation. Initially this game was meant to be an assessment tool for in-company training programs at Social Work institutes. The first tests were conducted with part-time students/professionals in one of our Bachelor’s programs. The development of a fourth new simulation game was taken up by a young teacher, who was responsible for a relatively new study program at the Institute of Security Studies. The fifth and sixth simulation games were developed for programs in the Institute of Law, one of them (Maternity Leave) in cooperation with University of Strathclyde, Scotland. The international context and cooperation in Maternity Leave complicated its development (bringing together two national law systems; differences in planning of education). Elements of play, game and narrativity are less evident and known in the curricula of Law studies and therefore more unfamiliar to their program developers, in contrast to developers from Social Work and Pedagogy. The seventh simulation game, Assessment on Participation, was worked out for the new study program of Social Management. Since the total study program was reconsidered and altered several times during the course of the project, the game design had to be changed accordingly.

3.1.2 The Seven Pioneers

The impact of simulation games on learning and thus on our curriculum, both positive and negative, has been considerable. E-learning simulation games alter the didactic style

Game	The Vision simulation game
Program	Social policy. Social policy participation by professionals from different social work organizations.
Playing field	Five Social Work sectors with roles for five different professionals, situated in the virtual city of Digidam.
Objective	To introduce and practice systems thinking and systems operations with regard to policy preparation from a professional perspective. The aim of the game is the collaborative development of a vision paper on an actual Social Work theme, resulting in a policy advice, presented to local authorities, and a narrative dialogue with clients that are affected by, or are involved in, or that benefit from this policy advice (in as-if situations).
Didactics	Seven weeks of lectures, tutorials, and workshops. Teachers cooperate and adjust content and approaches in order to reach consistency and high quality. Contents of the program are collaboratively developed, evaluated and improved. Alignment of lectures, tutorials and instruction with the process and activities in the simulation game is a continuing development objective.
Game concept	The game concept is based on elements of cooperation and competition. Game activities are stimulated (and frustrated) by the interdependency of players in the cooperation chain and collective development of congruent opinions on an actual Social Work theme. Main characteristics are project management of inter-professional collaboration and content management of a co-constructed vision.
Pragmatics	With some experience of and full access to the earlier prototype of Digidam, we were able to design, build, implement and improve the Vision game right from the start. We used the Digidam prototype on a separate server to avoid unforeseen technological problems and difficulties occurring while we reconstructed and updated the new Cyberdam environment. This was important, as we could not afford system failures or other technological constraints when hundreds of students were using the game in the course of ongoing education. During the project course (LiaVW), we were able to test Vision eight times with an average number of 200 students, divided over 10-15 sessions in each period. In total some 15 teaching staff members were involved in the development and implementation of Vision, which was certainly of advantage for the dissemination of practical experience and knowledge in our faculty and for the further development of this particular simulation game.

Table 3.1 – The development framework of the Vision game

and workflow in education and have a specific impact on the teacher-student interaction. At the start of the development of each new e-learning simulation game, we asked program leaders and curriculum developers to reconsider and theorize the requirements and most eloquent didactics of the program involved. Although the teachers who volunteered in our project had a good grounding in media knowledge and computer skills, additional training appeared to be necessary. The introduction of e-learning simulation games in their programs required a specific task-technology fit in the developers (all young professional teachers), as well as other teachers and tutors involved in the same curriculum program. Didactic and instructional strategies in the program as a whole had to be altered as online learning leads to specific and new learner responsibilities.

This case description refers to the new e-learning simulation games as the Seven Pioneers. Figure 3.2 provides an overview of the Seven Pioneers, listing each curriculum program first, then the title of the game (in bold), and following this with a short descriptive text.

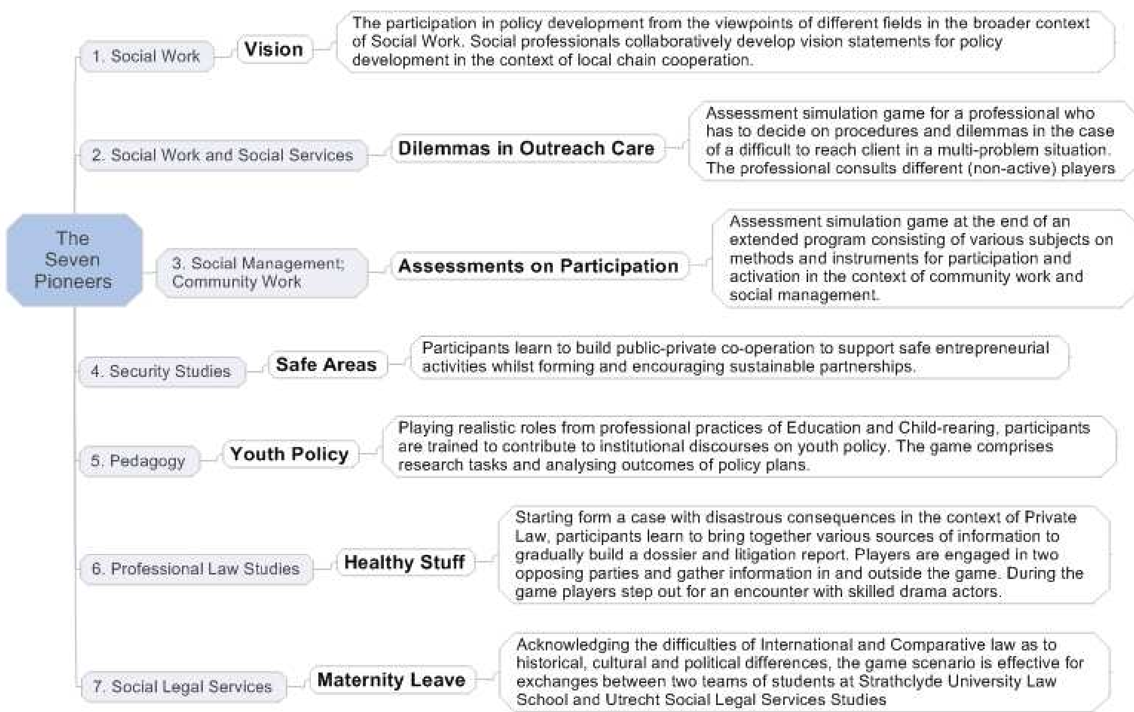

Figure 3.2 – The Seven Pioneers

During the development of the first seven simulation games it was made clear that the program developers stayed close to the well-known paths of curriculum design and did little or no experimenting with didactic alternatives in the learning trajectories. Theorists of modern digital media call this the “horseless carriage” syndrome: the inclination of newbies (newcomers to the internet and modern media) to deal with new technologies in terms of well-known and old practices. The unique possibilities of modern media (and modern didactics) referred to are not yet sufficiently explored and employed in our seven games. Further development of the seven simulation games could provoke more experimenting with the specific possibilities of narration, game concepts and interactivity that are feasible in online simulation gaming.

3.2 Design fundamentals

In this section we describe the principle elements that underlie the design of the Seven Pioneers. These design fundamentals supported the developers in their thinking, argumentation and decision-making on play and game, game strategies and game structure and on motivation and learning through simulation gaming. We discuss these in this paragraph

The training sessions for game developers, offered by the LiaVW project proved to be valuable assets, but they were often poorly attended for various possible reasons. Perhaps we had been insufficiently clear on the outcome and benefits of attendance for the participants. It also seemed difficult for teacher/developers to be present at the training sessions, often because of other (teaching) obligations. In view of these practical obstacles, it would have been a good idea to have had training material available, such as a methodological framework that could be studied and used independently of the training sessions. The programming of the training sessions could also have been better. Our training sessions had a general instructional character with much openness and no strict agenda. The intention was to provide practical help and deal with specific questions by the developers. It might have been more useful if we had programmed half-day training sessions around every simulation game. Each developer would probably have actively participated in his/her own session, presenting plans, schemes and concepts or by conducting practical tests. This could have enhanced participation and the effectiveness of the training sessions. Some of the simulation designers felt like lonesome pioneers, lacking feedback and practical, educational and technical support. An exception to this was the developer from the Institute for Pedagogy, who could share her process results and intermediate advancements with her colleagues on the team. The Pedagogy team even decided to play the game's conceptual version with all team members involved, in order to be able to give functional feedback from a practical and participative perspective. This turned out to be very helpful to the developer in question. She could share her doubts and anxieties as to the game concept, the simulation's content and its place in the curriculum program. In a reflective interview after the simulation game was delivered, this developer postulated that the positive attitude and position of her team might have come about through the explorative and innovative atmosphere at the Pedagogy Institute and with the team's characteristic attitude towards ecological pedagogy, and subsequent implications for learning processes.

3.2.1 Play and game

The first design fundamental is about play and game. For many game developers and methodologists Johan Huizinga is an important reference with regard to the meaning of play in culture. Huizinga states that play is "a voluntary activity or occupation executed within certain fixed limits of time and place, according to rules freely accepted but absolutely binding, having its aim in itself and accompanied by a feeling of tension, joy, and the consciousness that it is different from ordinary life" (Huizinga, 1938/1952). It is widely acknowledged that play is important for learning and this notion has been one of the motivational factors for participating in the development of simulation games in our faculty. For the development of the Seven Pioneers it was important to discuss the differences, relations and complementarities between the words game (form of play with rules or principles) and play (free form). Both diverse and broad concepts served as basic theories for the game developers to understand possible functions for learning. Makedon (1984) gives us a clear distinction by arguing that play is subjectively grounded in the player, while a game is objectively grounded in its rules or principles. Both terms are interlinked in the concept of playful gaming. There are countless forms of play and game, as Roger Caillois states: “La multitude et la variété infinies des jeux font d’abord désespérer de découvrir un principe de classement qui permette de les répartir tous entre un petit nombre de catégories bien définies. En outre, ils présentent tant d’aspects différents que de multiplies points de vue sont possibles.” (Caillois, 1958, p. 45). Despite the immeasurable variety, we thought a basic game classification would help game developers to decide what general game concept would be appropriate for the learning objectives at stake. Game concepts for e-learning must serve the curriculum objectives in the first place, but a well chosen game concept contributes considerably to the engagement of the participants and to the quality of the learning experience. For the Seven Pioneers, the distinction Caillois made between Paidia for free forms of play and Ludus for rules and principle-based games was a guiding principle. Paidia and Ludus must be understood as extremities of a gradually shifting variety of flexible possibilities. Free forms of play for simulations could be used to explore situations without a leading purpose or to engage different stakeholders in exchanging (tacit) knowledge about an openly defined subject. For the Seven Pioneers, however, we chose rules and principle-based games as the curriculum programs prescribe learning objectives, assessment requirements and predefined outcomes or game results.

3.2.2 Four game strategies

Caillois placed the Paidia-Ludus continuum in the perspective of four different, but interlinked types of game activities, as “un petit nombre de catégories bien définies.” We used this categorization to determine the structuring game concept of each of the Seven Pioneers, but game masters and tutors should also be aware of its function to help determine the strategy of control when a game is tested or implemented. During the evaluations, we returned to this categorization and chosen game concept.

1. Imitation or simulation (mimicry), as in role-playing and simulation games. This is the dominating concept in the games Vision, Youth Policy and Maternity Leave.
2. Competition or assessment (agôn). Competing with the system or with other players for optimum results. Competition is the main element in Assessment on Participation and Safe Areas.
3. Chance or unpredicted, unforeseen events (alea). Play-actors have limited control over game results, but must show their ability to cope with unanticipated or sudden changes and interferences during the game. In the games Outreach Care and Healthy Stuff the developers incorporated some unexpected and dynamic elements to challenge adequate behavior.
4. Risk or disruption and disorder (ilinx). In Caillois’ theory ilinx or vertigo refers to activities that change or disrupt regular perception, balance and movement, such as in fairground amusements and mountain climbing. If we interpret ilinx as “playing on the verge of balance and control” we might use this game concept in simulation games that engage players in risk management in order to challenge competences to survive difficult and hazardous circumstances. What could we

learn from the disruption of regular perception patterns from real life situations (turning situations upside down) or by acting out conflicts, turmoil and dangerous situations in a virtual and manipulated environment? We imagine that this could lead to transformational learning experiences for students and professionals in dynamic fields as Social Work and Security Studies. For our Seven Pioneers, however, we did not use this category of game strategy.

The four cultural categories of game strategy can be combined in order to allow players to have greater or lesser control. For example, if a game was developed from the concepts of agôn or mimicry, players experience more control over process and outcome. With alea and ilinx, sudden events and unforeseen circumstances minimize or even obstruct the actors' control. For education and training, this is an important consideration. By applying smart combinations of the four categories, richer game scenarios might evolve, for example by blending elements of alea (chance) with mimicry (simulation) or agôn (competition). In e-learning simulation games, competition makes sense, as students normally compete for the best results. In certain professional practices (future) experts need to learn how to deal with hazardous situations. In this case, the game elements of alea or even ilinx could be used, for example, to learn to deal with sudden changes, risks and stress. In cases where it is important that participants learn to explore the perspectives and interests of opposing parties, elements of alea or ilinx could be mixed with mimicry or agôn. In the Seven Pioneers, we made use of three of these four game strategies. Each game concept combined two strategies, with one always more significant than the other. To give an example, in Safe Areas the participants compete (agôn) to get the best safety cooperation agreement, by establishing the best alliances with local professional partners. This means that constructive cooperation is rewarded and partners performing badly are expelled. As the scenario demands that players adhere closely to realistic professional roles and conditions, a dimension of mimicry, imitation of professional practices, is added. In Figure 3.3, depicting the two concepts used for each game, the colored strategy is the dominant.

Figure 3.3 – Game concepts in the Seven Pioneers

Each of the Seven Pioneers was developed from the idea of “experience and knowledge in action” in order to make the game action challenging and appealing for participants. After the first experiments we came to the conclusion that the “fun factor” in most of the new games was too low and the task challenge was too great. For a successful learning experience with simulation gaming there must be a good balance between game-pleasure and game-challenge. In effective e-learning simulation games, the participants enter the “magic circle of playful gaming” (Klabbers, 2008) within the limits of time and space, to enact roles and positions and interact with each other in “as-if” situations. They engage in meaningful learning experiences through contextualizing cases taken from professional practice. In the Seven Pioneers, actors enter a virtual professional arena, wherein they discover, construct or develop (stories of) relationships, perspectives, interests and objectives and in which they train their future skills and response repertoire. The achievement of a high standard of quality in the Seven Pioneers demanded a distinctive view on play and on game strategies for learning.

3.2.3 Game principles, resources and immersion

In spite of the differences between the seven games, they all can be classified as principle-based, as opposed to rule-based (actors must obey strict rules) and free form games (no rules at all). Principle-based games have rules and resources that structure the performance of participants. The actors must show their capacity to interpret and understand the rules, by following certain guidelines and checklists.

For example, the Vision game is principle-based because it is important that actors understand and demonstrate professional attitudes (reliability, responsibility and performance). In reflective dialoguing (before, during and after the game, in briefings and debriefings), participants and the game master (tutor) exchange thoughts, feelings, expectations and experiences that emerge from the narratives, the game scenario, the process and outcome. It is an essential objective in Vision to help students make the transfer between game experience, theory and methodology, and professional practice.

The game resources in the Seven Pioneers are derived from professional practice and have been worked out in narratives and multi-media representations. We used role and object descriptions, websites, texts, video, digital storytelling and live actors. The quality of these contextualized artifacts depends on their resemblance to real life situations and on the players’ recognition in the game. We think the story line and the impression the game narratives (texts, images, effects, video and sound) make on the participants are important indicators for the level of immersion in gaming, the learning process and success of a game.

3.2.4 Learner’s abilities and motivation

In e-learning simulation games, an effective intersection and fine-tuning between the pedagogical content and the game model are essential for the learning outcomes (Mishra & Koehler, 2006). Our game developers had to think about the relationship between input (content requirements), process (simulation game) and output (learning process and product), against the background of the learner’s abilities and motivation.

The first challenge in the design of each of the seven simulation games was to find out how to stimulate the student’s motivation and pleasure by thinking about the game concept, the rules of the game, the creative design of game artifacts, and the shaping of interactions, relationships and assignments. Each design model should convey a certain number of meaningful actions by the players and should support dialoguing and reflective argumentation on learning processes and outcomes. This required a well chosen level of the learner's motivation, abilities and competences. In each of the game concepts, we tried to support the intrinsic motivation for learning by paying attention to specific game characteristics such as autonomy and flexibility of the player's actions and responsibility. Another important feature that we wanted to integrate in the new games was peer interaction and feedback (Vision, Safe Areas, Youth Policy). Strategic management and strategic thinking are features that can be found in Safe Areas, Participation and Outreach. The introduction of critical events to influence processes and actions plays a small but important role in the game concept of Healthy Stuff. The construction and development of practical knowledge is a general objective in all seven games, as well as the development of expertise, the exploration of the student's perspective on professional practice and the improvement of competencies in each field of reference. However, all seven games reveal different meta-cognitive skills. To give some examples, critical and analytical thinking is a quality of the games Maternity Leave and Healthy Stuff, whereas challenges to creative professional performance can be found in both Vision and Outreach. Teamwork conditions are important in Safe Areas, and the training of individual professional competences appear particularly in the games Youth Policy and Participation.

The drive to fully engage in playful gaming comes from two kinds of motivation that are challenged in each game: achievement motivation and competence motivation (Klabbers, 2008, p. 53; Elliot & Dweck, 2005). Achievement motivation is generated by tasks that are not too complicated or too easy. Game tasks must appear in the zone of proximal development (Klabbers, 2008; Otha, 1995) and must stimulate players to improve their accomplishments. Competence motivation refers to the encouragement to solve problems. Achievement motivation can be stimulated by designating different levels to roles and tasks. In each game, achievement motivation and competence motivation can play a part in different types of tasks: collaborative, cooperative, individual and competitive assignments. For example, in the Vision game, there are five roles in a session, each representing a different sector/organization of Social Work, and every role is assigned to a team of three students. The teamwork planning enables us to differentiate task levels of achievement and competence (e.g. as manager, expert or client). The quality of both game design and tutoring is rooted in the correct linking of tasks to the learner's abilities and motivation.

Student feedback during the Vision simulation gave us a good impression of the quality of the challenges in the game and their correspondence with the students' learning abilities and motivation. During the first year we experienced many technological problems with the playground environment (the application and server) but students remained uncomplaining and understanding. In general, our students appreciated the new didactic experiments and our efforts to introduce modern media in their programs, despite the many technological inadequacies of the system during these early tests. The first sessions of the Vision simulation game had to be played on a surrogate playing field because of technological problems. We had to move all materials and assignments to our intranet platform (SharePoint) and manage the sessions "manually." Even under such difficult and non-game-like circumstances, students were very considerate and supportive.

Vision is a role-play game that encourages problem-solving, effective communication, responsibility, creativity and entrepreneurial skills at a micro level. The constructivist and collaborative way of working is indispensable in this type of simulation game and does not allow for much intervention by tutors during the game. Solving your own operational troubles is part of the game. Thanks to the many sessions we conducted, however, we found out that most of the students were over-challenged by the work-structuring requirements of the game. Generally speaking, project planning in Vision was under-performed. The simulation game offers sufficient chances for good results and as students work in small teams, the blend of abstract thinking, collaborative work and holistic, narrative representation in the game, makes it possible to assign different tasks (cognitive, creative, social) to individual levels of interest and competencies. But still, our first year students had many problems in their team work and needed much process tutoring (outside the game). Team work and coordination of tasks, acting responsibly and reliably, and being engaged as real professionals, are strenuous tasks for most students at this preliminary level.

3.2.5 Game structure

Before actually working out the game structure, which contains the syntax, semantics and pragmatics of the game, each developer had to have a clear idea of program requirements, desired outcomes, situational references, and sketch a first rough idea of game strategy. We decided to limit the number of phases in each game as we anticipated that having many different phases would unnecessarily complicate the design process. For example, a developer could introduce four phases, such as information search, exchanges or consultations, analyzing of findings and production of results. In addition, the developer had to think about the interplay between game phases and elements. The game elements emerge from the concept. If, for example, competition was the leading game idea, the developer had to work this out in various competitive challenges and rewards in the activities of the various phases. In a game overview, the developer displays a first impression of how phases (the octagons) and game elements (the stars) are interwoven in the design concept (see Figure 3.4).

Figure 3.4 – Example of a game overview

The first game overview symbolized an encouraging milestone in the development process of each of the seven simulation games. Yet, for all developers this initial preparation produced much confusion and everyone found it rather hard to oversee the various options and steps in the developmental process. Therefore, we thought a structuring framework could give insight into the various game development tasks, as a backbone to foresee and plan successive steps in the process. The theory of syntax, semantics and pragmatics (Klabbers, 2008) helped to describe the game overview, phases and further elaboration in a game manifest (see Figure 3.5). The syntax defines the outline and general draft of a game (macro). The semantics describe the game on a meso level of roles, objects and resources. Pragmatics or practical details (micro) are specified in the final state, in order to actually play the game. In the grid below, the workflow of structuring the game is shown with the dominant (dark) and subordinate (light) sequence of syntax, semantics and pragmatics. In the Seven Pioneers, we worked from a rough sketch in the game overview (1), through defining phases (2) and their content, to the more complex and detailed work of the game manifest (3).

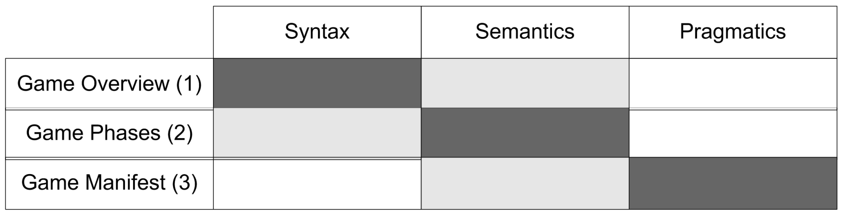

Figure 3.5 – Syntax, semantics and pragmatics in game structure

First, the overview (syntax) of each game was shaped by defining the macro features:

- curriculum context
- position of the game in a specific learning program
- number of participants and other logistic data
- envisaged outcome
- type of game (game concept)
- organization of game phases
- general rules of the game
- learning activities (collaborative, cooperative, collective and individual)
- game monitoring, tutoring and mastering
- planning and communication (macro level)

The game phases in each of the Seven Pioneers were worked out as semantics of the game:

- game mechanics
- roles and objects
- rules for each role in each phase
- game resources (documents, audio and video)

Detailed information was elaborated as pragmatics of the game:

- planning and communication at meso and micro levels
- learning strategies
- didactics in the game and in the scaffolding of other learning activities
- tutorials, help functions in the game, program literature
- instructional design and instructional materials
- task descriptions and criteria
- assessment and evaluation of outcomes

3.3 Seven development steps

Having explained our philosophy of game design, in this section we describe the step-by-step model followed in the development of our seven online simulations. Although we adapted our approach to the contextual facts of each individual game, the overall method follows the overview presented in Figure 3.6.

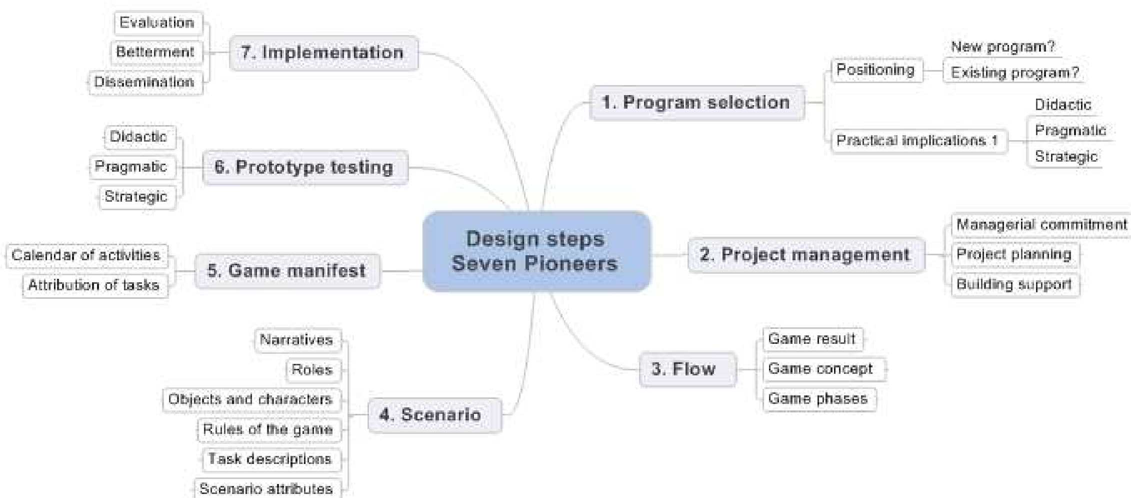

Figure 3.6 – Seven Pioneers development steps

Here follows a brief description of the development steps.

3.3.1 Step 1: Program selection

For each game, the starting point was where and how to position the new e-learning simulation game in the curriculum. It makes a difference whether you develop a game in an existing program or start from scratch. Following previously defined objectives and principles of an existing program imposes certain limitations and prerequisites on the design. It is important to know the arguments for choosing a simulation game and to study the history of the program to see what the exact expectations are and if they convincingly legitimize a simulation game. Proposing a simulation game in a new, yet to be developed program helps to determine the content of that course, and offers more freedom of design and content. But it requires strategic planning, as later alterations in the program as a whole could have an impact on the game development work done earlier, making extra revisions necessary, as was the case with the Participation game.

Implementation of our seven games prioritized a careful description of didactics (learning objectives, teaching method, etc.), pragmatics (planning and embedding in the broader educational context) and strategy functions, depending on learning objectives and competencies that must be achieved or demonstrated. Depicting the didactics, pragmatics and strategy in the first step helped us to analyze cause-effect relations during the testing of the games later on (step 6).

3.3.2 Step 2: Project management

Effective project management for the introduction of e-learning simulation games involves managerial support and team commitment. Novice developers need sufficient time and should be adequately informed of the project's position in a broader plan of curriculum innovation, such as practice learning, digitalization, internationalization, the use of modern media and adaptation of new pedagogic views. The relations and congruencies of each new game with the curriculum content and the preparation of internships need much deliberation in program teams. Simulation game development requires inclusive ways of consideration and thinking: every step must be thoroughly analyzed against the background of all other scaffolding program elements (lectures, tutorials, etc.). If various lecturers, teachers and tutors are engaged in a program with an e-learning simulation game, the best way to involve all is to have each one play an active or inactive role in the game (as consultant, assessor, expert, client or as game master). Playing the game is the best way to get an idea of the game concept and flow.

3.3.3 Step 3: Flow and phases

The next step is to decide what the final result of the game should be in terms of product, process and effect. A clear motivation or argumentation for using e-learning simulation games in the program is necessary to define the type of performative action or product in each game. Once the outcome of a game was clear, we were able to distinguish the most appropriate game concept to make the planned results possible. We looked for natural correlations between desired processes, products and elements of play and game. In every game, three categories of play were used: imitation, competition and chance, in an overall setting of cooperation and collaboration on game tasks. After defining the game concept, we could outline the game phases, paying particular attention to a logical sequence for the phases of each game, and considering the levels of work, type of activities and contribution of each phase to the desired total outcome. The definition of game phases helped us to manage the relation between tasks, assessment and the admittance to next levels.

3.3.4 Step 4: Scenario development

Suitable scenarios for the Seven Pioneers were all built on realistic situations, taken from the professional reference systems. Imaginative power and practical narrative techniques are indispensable for scenario constructing. In this project, most of the scenarios and narratives were constructed on the basis of literature searches and evidence-based practices, but we think valuable scenarios can also be constructed through qualitative narrative inquiry in professional practice. The most obvious roles, characters and objects for the game emerge naturally from the situation at stake, but deeper exploration might lead to unexpected or sidelined alternative characters or roles that could be of equal or even greater importance. Most roles and objects were created specifically for the scenarios involved, but for some games (Youth Policy, Safe Areas) certain objects and role descriptions were copied from the existing address books in the game play environment. In each new game, roles were assigned to objects, for instance a manager to a school, a solicitor to a law office. It should be mentioned here that the chosen game concept influences the selection and description of roles and objects. Evidently there must be a logical alignment of game concept, narratives and both role and object description.

Our game developers found it difficult to keep track of the interrelated elements of scenario development. They felt that scenario development required creative imagination, and most game developers needed more coaching and technical help. Some of the pioneers confirmed that the options and tools of the game-play environment can be improved to promote these creative and narrative challenges. Apart from this, the quality of every game also relies on the intelligence level of the game rules system and how successful these rules are translated in a packet of realistic and yet evocative performance tasks. All sorts of special attributes, such as documents, protocols, checklists or practical examples must contribute to a feeling of logical unity. In the player's perception, there must be coherence between narratives, scenario and task descriptions. Not every game of the Seven Pioneers did equally well in this respect. Despite the efforts and careful elaboration in this development step, the differences between the Seven Pioneers are considerable, which is also due partly to the variation of contexts.

3.3.5 Step 5: Game manifest

During the LiaVW project, new game development was done simultaneously with the upgrading and reconstruction of the Cyberdam playing field. This meant that some games had to be introduced, tested and executed in unfinished versions of Cyberdam. This was a complicating and sometimes frustrating issue for all developers. By the end of the project, however, all the scenarios were inserted in the latest version of the Cyberdam environment. Developers built their game manifests by following the guidelines and logical steps for building a game model displayed in the application. A model consists of metadata, a calendar of activities, resources, and variables. This step of the model inserts all the previously developed material in the game-play environment.

A calendar of activities is a particularly useful software tool for developers to get an overview of the game, to re-arrange all phases, roles and assignments and to attribute different variables and resources to tasks. The calendar shows how roles, objects and tasks are interrelated and enables the game master to get a quick overview, to make changes or adaptations and to monitor the game. Figure 3.7 displays a calendar of activities.

3.3.6 Step 6: Prototype testing

Prototype testing is a complicated design step because test results often demand a partial reconsideration of game concept, scenario, task descriptions and artifacts. Prototype testing may reveal weaknesses or failures in the game design or didactical approach. Tests of the Seven Pioneers demonstrated that we often had to understand failure in the context of insufficient understanding of the possible effects that simulation gaming has on the learning process. In Vision, for example, we noticed that the interaction patterns that emerged from the game tasks had more impact on the learning process than anticipated.

The testing of Maternity Leave, Healthy Stuff and Participation was limited to the project's requirements, whereas the other games were assessed more deeply and repeatedly. Of Vision, Youth Policy, Outreach Care and Safe Areas, the game concept, usability of scenario, learning tasks and processes, outcomes and effects were thoroughly discussed in view of ongoing development and betterment. The prototypes of these simulation games (except for Outreach Care) have in the meantime been updated for re-use. Outreach Care did not fit in well with the larger group didactic planning and the game's advancement is subject to further study and decisions on game concept or didactic approach. All simulation games were reviewed in the context of the broader framework program of lectures, tutorials and trainings, but some (Vision, Youth Policy and Safe Areas) were scrutinized and adapted more precisely to the content and activities of the other curriculum parts involved and vice versa.

Activity schedule

	Start	fase 1 Orientation	fase 2 Consultation	fase 3 Exchanges	fase 4 Analyzes	fase 5 Advice	End
Professional		Progression Message Upload	Message Upload	Upload Message	Message Upload	Message Upload	
Actor 1			Progression			Progression	
Actor 2				Progression		Progression	
Actor 3					Progression	Progression	
Game master	Start						End

Edit

Activities

Activity Type	Activity
Progress activity	End
activitytype.event	Event
Message activity	Message
Progress activity	Progression
Form activity	Register
Progress activity	Start
File-upload activity	Upload

New upload activity | New message activity | New progress activity | Add form activity | add.event.activity

Resources

Resource name	File name	File size
Doc 1.doc	Document 1.doc	24064 bytes
Doc 2.doc	Doc 2.doc	24064 bytes
Reg 1.doc	Reg 1.doc	24064 bytes
Reg 2.doc	Reg 2.doc	24064 bytes
Adv.doc	adv.doc	24064 bytes

Figure 3.7 – Calendar of Activities

The prototype testing of all seven e-learning simulations had didactic, pragmatic and strategic aspects:

1. Didactic. Intelligent briefing and effective introduction to the concept of the game and its rules are important conditions. The same applies to smart tutoring of learning activities by all participating teachers and trainers. The quality of these didactic aspects has a crucial influence on the success of learning results.
2. Pragmatic. Preparation of testing and implementation requires perfect logistic support. Apart from technical support as to server and application, each session needs careful preparatory actions as to registration and the provision of log-in details, but also the allocation of roles to participants. This calls for a close cooperation with student administration bureaus and the application's helpdesk.
3. Strategic. This aspect concerns the method and approach of the program as a whole and the alignment of different teaching, instructing and learning activities. We learned that implementing a simulation game as a coherent element in a curriculum program asks for strategic content cooperation and agreements with all

involved teaching staff. A simulation game is not an “annex” to a program, but deserves an integral and meaningful place.

Checklist for the design and evaluation of the Seven Pioneers.
• The end-state results (product and process) are formulated. • The learning objectives are clearly defined. • The learning activities are well articulated and divided over different phases of the simulation game. • The pre-knowledge of participants and tutors has been defined and properly assessed, before the students enter the game. • There is an appropriate game concept to guide and motivate the participants and that suits the desired outcome of the game. • The rules or principles of the simulation game are unambiguously formulated. • The roles, objects and narrative artifacts of the simulation game are of excellent quality and fit in with the reference field. • All game-supportive materials have been properly defined and prepared. They are available at the start and are easily accessible in the course of the simulation game. • The assignments in the simulation game have been proven and tested in order to avoid permanent under- or over-challenge of the level of complexity and learner’s abilities. • The simulation game offers players enough room and opportunity for different alternatives in decision-making and acting. • Practical manuals, checklists and other supportive materials are available to guide participants at crucial moments in the game. • The participants are given the opportunity to do an equivalent task in case they fail the simulation requirements. • Adequate theoretical materials and lectures have been prepared to support the game action. • The facilitating and tutoring prerequisites have been developed, shared and discussed with all teachers involved. • There is good and effective support by trainers and tutors in order to enable high performance at briefings and debriefings. • The organizational schedule and logistic structure of the simulation game are defined and agreed upon. • There is sufficient and adequate technical support available to provide an easy and intuitive access to the simulation game and its environment. • The simulation game is adequately embedded in the broader context of the curriculum program. • There is an effective communication with the manager and team involved in order to supply information about the proceedings of the simulation game and to enable feedback and support from colleagues. • Continuous evaluation, feedback and discussion on results maintain ongoing improvement of the simulation game.

Table 3.2 – Checklist for the design and evaluation of the Seven Pioneers.

Gradually we developed a practical checklist, delineating the most important input variables, for the evaluation tests. It goes without saying that the items on this list must be in accordance with the design fundamentals described earlier. In Table 3.2, we list the input variables that served as guide lines for the design and evaluation of the Seven Pioneers. We have compared and adapted the items on the checklist to the much more elaborate “list of criteria for the quality of simulation games,” as described by Kriz and Hense (2006).

The testing focused in the first place on the effectiveness of the objectives, processes and outcomes of the Seven Pioneers, but it was equally important to analyze the general expediency of the newly emerging didactic approaches. The Seven Pioneers were tested according to an input-process-outcome model (Garris, Ahlers & Driskell, 2002). Input refers to program content and game properties. Process concerns the game cycle of participants behavior and system feedback and user response. Outcome means the effects of reflective dialoguing on game processes and products. Debriefing is essential for collaborative learning, but also in view of improving the simulation game. Each of the Seven Pioneers was evaluated from this perspective, by analyzing the input-process-outcome cycle against the background of the game’s characteristics and the curriculum content. System feedback and user information were compared with the views and observations of lecturers and tutors, and in reflective dialogues with students on processes and outcomes. Process results and outcomes were analyzed against the background of the learning objectives and the game concept of each simulation. When a game concept worked well, it showed richer user comment and user behavior. If process results and outcomes were not in accordance with our expectations, this meant either that the game concept had not been sufficiently clear to the participants, or it indicated that the game concept itself had to be changed. The game masters of the Seven Pioneers considered several options to assess game proceedings during the game process. As a part of the game concept, players can respond to and evaluate the performance of other players during the game and in their role play. Intelligent peer-assessment in a game helps a game master to control the flow of work, and has specific didactic advantages. Peer assessments on task performance were used as an effective and helpful tool to manage the game process of Vision and Safe Areas.

3.3.7 Step 7: Implementation

Regular evaluations and analyses of processes and outcomes are sources for improvement and dissemination of simulation games. For evaluation of each of the Seven Pioneers we used the above mentioned logic model, which meant the linearity of input-process-outcome could be analyzed in context. A logic model in the context of the institute’s curriculum and following selective criteria from professional practice helped us to analyze and control causal effects between envisaged objectives and outcomes (in process and product). To paraphrase Raser in Peters, Vissers & Heijne (1998), a logic model can be considered as valid, when learning in the game provides comparable outcomes as in the reference system. A valid representation of the reference system in the model is a first criterion. Following Peters Vissers & Heijne further, we looked at four aspects of validity:

1. Congruency of displayed situations. Although the simulation is a simplified representation of structural features of the reference system, it should demonstrate sufficient congruency with realistic professional situations.
2. Convincing and realistic scenario. The game must contain a convincing or realistic scenario. We compared players' performances with statements on their perception of the tasks as realistic representations of professional challenges.
3. Coherence between tasks. There must be convincing coherence between the model and reference system as to processes, interactions and workflows.
4. Consistency of learning activities and outcomes. We gain confidence in the learning effects of simulation games by producing enough predictions (and postdictions) of outcomes and effects in processes and products. This means that a simulation game should be extensively tested and analyzed in order to provide sufficient accurate data.

3.4 Learning Effects

We found that the actual learning results of some of our simulation games did not substantially reflect enough the knowledge and theories or skills and competencies of the curriculum program. This was certainly the case with Healthy Stuff and Maternity Leave and probably also with Participation. The assessment character of the Outreach game did not fit in very well with the group work and didactic approach in the program. Either the program or the game has to be adapted for better learning results. For these games more tests are necessary to be able to make sensible cause-effect analyses of the learning outcomes. Nevertheless, some remarks on strengthening the learning effects can be made. The first is to revalidate the artifacts of some scenarios as to content and degree of correspondence between the reference field and the simulated model. According to one of our developers in Law Studies, the quality and credibility of the paraphernalia must be extremely high in simulation games and this takes more preparation time than actually invested. Strengthening the artifacts would be an important asset in the further development of all seven games. Another trajectory could be improving the game concept. In Law Studies, the teachers involved would like to focus more on practice simulation, with less gaming. They propose strengthening mimicry, by improving the imitation of professional roles and situational décor in a scenario where there is more room for unforeseen events and players' interaction (alea). During the reflective interviews both managers and developers in the Law Studies Institute maintained that the degree of correspondence between the professional reference system (Law practice) and the simulated model was too weak. On the other hand they acknowledged that conducting only one single test as with Maternity Leave and Healthy Stuff lacked methodological rigor and offered only "anecdotal evidence". Further tests, evaluations and subsequent improvements will afford more validating knowledge of the working substance of these two games, which, in fact, also accounts for the other Pioneers.

The simulation games Vision and Youth Policy were extensively evaluated over two years and with the involvement of up to 15 teachers. The practice of evaluating these games resulted in considerable enhancements to quality and effectiveness. One of the most critical conditions for successful implementation appears to be strict adherence to game rules and time schedules. It applies to all participants in the game, including all teachers in the program. Some teachers had difficulty in sticking to the arrangements, the agreed deadlines and activities. Effective teacher cooperation in e-learning simulation game programs is best achieved by allotting (non-active) roles to the teachers. It is, for example, possible to assign all teachers to the role of game master or to a special (non-playing) expert role. This way, it is possible for them to continuously retrieve significant feedback for lecturing, teaching and tutoring. Evaluations and analyses help them to discover the most effective ways of instructing and coaching participants and to understand the underlying cognitive and interactive processes and effects of computerization upon students. To give an example, in Vision we learned that it is imperative to give sufficient attention to the briefing: the concept must be absolutely clear to all participants before the start of the game. A good understanding of the game concept and one's role and responsibility is vital for the effectiveness of the learning process, but also for the proper appreciation of game concept and fun. The specific dynamics of the players' interaction and strategies frequently showed unpredictable (positive and negative) learning outcomes. It is wise to keep an eye open for unexpected and unintended, but eventually, valuable, side effects on learning and preparation of job performances.

We noticed that it takes several sessions in practice before trainers and tutors find the right approach and understanding of the game. The teaching team on the Vision game, for instance, organized frequent meetings to exchange ideas on the content, didactics, concept and results, for the betterment of the total program. In the Pedagogy Institute the transfer of know-how and expertise seemed to be a natural element of team practice. Expertise was passed on to colleagues who were either involved in the implementation of Youth Policy or in the development of new game plans for the Bachelor's programs. The manager of Security Studies explicitly advocated circulating experiences to other team members and closer cooperation with partners from professional practice.

3.5 Conclusion

To close this chapter, we draw some conclusions on the design, development and implementation results of the Seven Pioneers. The model of design fundamentals and its emerging seven development steps proved to be adequate starting points to analyze and validate the game results and to help ongoing development. Nevertheless, it became clear that each institute involved in the project needed its own strategies and game concept that truly fit with standards and practices in its own reference system of professional practice. The general design fundamentals chosen for all the games showed more success in Social Work, Security and Pedagogy, than in Law. Elements of play, game, narrativity and creative design seemed unfamiliar to or less relevant for the program objectives of Law studies. As simulation games are reductions and abstractions of practice reality (Peters, Vissers & Heijne, 1998), it is advisable to ask for expert comment from the professional reference field on game construct and resources. This helps to challenge the validity of outcomes. In all seven games, this is an aspect for improvement and further development.

To come to a grounded conclusion about the learning effects and to underpin statements on the value for curriculum innovation, more tests on most of the games are necessary. This conclusion corresponds with the findings on game validity by Peters, Vissers & Heijne (1998). This point was also acknowledged by the managers and developers during the reflective interviews at the end of the project. The more we play the game the better our understanding will be of the dynamics of the game concept and the effectiveness of the game resources. Repeated experiments give us a better understanding of the players' attitudes and behavior and of the most effective ways of tutoring. As mentioned earlier, repeated tests and analyses help to construct a logic model (Kriz & Hense, 2006) for evaluation and re-design of the game. Finally, we can conclude that the learning effects are fully dependent on the quality of the action-knowledge cycles (Crookall & Thorngate, 2009). New games need time and sturdy efforts to effectively link various sorts of knowledge to learning experiences (and vice versa), as has been done in the games Vision and Youth Policy. The other newly developed games need more time and experimenting to reach a proficient level in their curriculum programs.

A sideline conclusion is that although e-learning simulation gaming offers interesting possibilities for international exchange, it is a complicated business to align program requirements and logistic planning between national institutes, as we have seen in the collaborative development of Maternity Leave between University of Strathclyde and HU University of Applied Sciences Utrecht.

In the evaluative interviews, it became apparent that game developers need more time to study theory, methodology and good practices of e-learning simulation games. A logic model or a comprehensive list for conducting a theory-based evaluation (Hense, Kriz & Wolfe, 2009) is necessary, but has to be developed, to make it possible to bridge theoretical and empirical knowledge. Exchanging experiences and collaborative studies of theories and methods by developers and users will facilitate the learning process initiated by the project. The embedding, dissemination and improvement of the seven developed games require more training and instruction, and a specific managerial support. It can be fruitful to participate in specific training programs, such as summer schools, workshops and clinics for the transfer of expert knowledge in the field of e-learning and game development. When confronted with the evaluation results, some of the responsible staff members confirmed that adaptation of the didactic approach and augmentation of team cooperation are necessary for better results.

Another important evaluative criterion was to see if simulation gaming could work as an apt device for practice learning. Not only for preparation of internships in real practice, but also as an instrument for transitional learning (knowledge-into-action; action-into-knowledge). All developers of the Seven Pioneers agreed that their simulation games offer alternative effective ways to prepare students for internships and that the learning-by-experience approach in simulation gaming helps to provide students with self-confidence and realistic expectations as to what may be encountered in real professional situations. *Condicio sine qua non* is a realistic reflection of professional situations, dynamics and problems and high quality artifacts in the games. Evaluation of the transitional learning effects to real practice requires additional research. On the policy level, some curriculum managers see e-learning simulation games as potential distance-learning devices. Developers and managers stated that games could facilitate (cost-effective) ways of joint actions for professional innovation and workplace learning. This is an interesting point to be worked out in forthcoming experiments.

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Chapter 4

Learning from the Law Game
The simulation of legal tasks as a teaching method, considerations concerning the cohesion of levels of performance, education and simulation

C.N.J. (Kees) de Vey Mestdagh

4.1 Introduction: simulating legal tasks as a teaching method

> Academic education should be directed at enhancing and professional education at reducing doubt. (CNJdVM)

In the past decade I have developed a general theory of legal knowledge, described this theory as a formal model (the Logic of Reasonable Inferences), and implemented it as a computer program (Argumentator, a legal expert system shell). I have acquired and modeled legal knowledge from various domains, including environmental law and notarial law, and represented this knowledge in Argumentator. Finally I have put the resulting expert systems to the empirical test, e.g. the Expert System for Environmental Permit Law and the Estate Apportionment Quality System (De Vey Mestdagh, 1998). And with success: the expert systems proved to be tenable models of human legal knowledge processing. In a different mode of operation, their capacity to improve the quality and efficiency of legal decision-making exceeded expectations. The Expert System for Environmental Permit Law improved the quality of 66% of the complex decisions examined and the Quality System Estate Apportionment proved to amend previously unnoticed complex errors in apportionments and reduced the processing time by 90%.

We are now able to model legal knowledge to such an extent that the resulting models can function more or less autonomously, that is with little human intervention. Consequently, the models can serve as dedicated communication partners of human or computer agents. Autonomous expert systems, just like human experts, can be communication partners in various roles. They can act as advisors (the classical use of expert systems as decision support systems), but they also can act as fellow experts (combining expertise in a dialogue) and even as teachers (transferring knowledge). In recent years I have also explored expert systems in their potential role of co-expert and teacher.

In the ANITA (Administrative Normative Information Transaction Agents) project[1] we are building a multi-agent system for regulated information exchange in crime investigations (De Vey Mestdagh, 2003; Dijkstra et al., 2005). Local computer agents negotiate with computer agents from other localities in a network of distributed criminal intelligence about the legitimate and optimal exchange of information. The agents are equipped with individual expert systems that combine general legal knowledge and shared policies with local knowledge (local interpretations, policies and interests). In the Law Game project[2] we investigated a variety of technologies, including expert systems, in an academic educational context. Finally, we experimented with a simple simulation of legal tasks in the CSI project[3] which was aimed at virtual legal consultation in a professional educational context. In this project the Cyberdam environment was used to develop a round-based as opposed to real time role-playing game (RPG).

This research looked into the development and application of legal expert systems in various roles (decision support, multi-agent, and educational systems). Lately, the research looked specifically into the application of legal expert systems and a legal RPG in different legal educational contexts (academic vs. professional). The results enable one to theorize about the effectiveness of these techniques at different educational levels. The second section of this chapter elaborates on the relation between levels of education and levels of simulation. The third section describes the active and passive application of an expert system as part of a legal tasks simulation in an academic educational context (the Law Game). The fourth section describes the active and passive application of a round-based RPG (Cyberdam game) in a professional educational context. Finally the concluding section (4.5) combines the experiences and relates them to the discussion presented next.

4.2 Levels of education and levels of simulation

Education is aimed at the transfer of knowledge and skills.[4] The level of education should be determined by the level of the legal tasks it is supposed to prepare for. In this way the student's level of aspiration will eventually match the level of the tasks he is expected to perform and he will be technically able to perform them. Educational tools should also correspond with the expected level of performance. Consequently, levels of simulation should match levels of education.

[1] The ANITA project (4 PhD studies) is financed by NWO, the Netherlands Organisation for Scientific Research (project director C.N.J. de Vey Mestdagh).

[2] The Law Game project was carried out in 2003-2004 at the Centre for Law & ICT of the University of Groningen. It was co-financed by the Rechten Online research program (VSNU).

[3] The CSI project was carried out in 2008-2009 at the Institute for Legal Education of the Academy of Amsterdam by the author and M. Gerrebrands. It was co-financed by the Rechten Online research program (project CSI08MG).

[4] In knowledge-oriented professions and education *skills* and *abilities* overlap fully, so I use the most common concept (skills) in this chapter.

4.2.1 Levels of education

The experienced lawyer in action is the most extreme form of a simulation of the execution of a legal task. Real life or legal practice is the most complete “imitation” of itself. So, to interact with an experienced lawyer could be the utmost educational experience, using a simulation. For centuries this *expert-apprentice model of education* has been predominant. The increase in volume and importance of academic (as opposed to professional) knowledge has led to the prevalence of an *academic model of education* characterized by the transfer of *abstract* knowledge and skills as opposed to *concrete* skills. To be explicit: in an expert-apprentice relation the apprentice learns to hammer and heat the iron bar in a fixed sequence of actions resulting in the production of a blade of good quality; in an academic relation the blacksmith transforms into a teacher and the pupil learns about the physical and mechanical properties of different kinds of metals. A dynamic world actually requires a *third (professional) level of education*, one that just transfers the *abstract* skills that enable us to adapt to a world of constantly changing assignments and knowledge. Adhering to the metaphor: at this level the pupil learns variable sequences (so not a fixed chain) of actions (to hammer and heat using various methods and techniques) which he can vary according to specific knowledge about the characteristics of the object (the metals) and of the expected result of these actions (the processed metals). The changing part of this knowledge is not transferred by education but in practice. Actually, the rise of the academic model of research and education created the conditions for the introduction of this third level of education. On the one hand it added to the dynamism of the world and on the other it described the abstract skills needed to cope with it.

Historically we can distinguish three levels of education:

1. **Practical training**
   Learning by example (imitation) concentrates on concrete knowledge (know what);
2. **Professional training**
   Learning by doing (association of actions and results), concentrates on abstract skills (know how) and cooperation;
3. **Academic training**
   Learning by analyzing (understanding the structure and operation of a knowledge domain), concentrates on the monopolization of specialized knowledge (know what) and designing new solutions (know how).

By definition, this distinction perfectly fits the actual levels of education found in educational practice. But do these levels correspond to typical legal tasks and if so do we have the technical means to simulate these tasks?

4.2.2 Levels of simulation

Three parameters determine useful levels of simulation in legal education The actual (contents, structure and operation of) legal tasks, the required level of performance of these legal tasks (and its associated level of education) and the technical feasibility of the simulation.

The main aim of legal education is to transfer legal knowledge and mainly general cognitive and communicative skills. Therefore use of simulations in legal education comes down to using a computer model to transfer legal knowledge (know what) and legal skills (know how). The model has to be based on the *contents, structure and operation of actual legal tasks* and thereby defines the bandwidth of useful simulations by subject. In general these tasks can be described along the lines of the following (a) *passive* and (b) *active* variants of *the legal work flow* (1-4):

1. (a) **Collect case data**, using a (mental or material) model of a class of case data or (b) Design a model of a class of case data[5];
2. (a) **Acquire legal knowledge**[6]or (b) Design a model of legal knowledge acquisition;
3. (a) **Apply legal knowledge to case data** or (b) Design a model of (new) legal knowledge to apply to a certain class of case data;
4. (a) **Formulate legal decisions** or (b) Design a model of a class of legal decisions (a format).

In legal practice all or part of these tasks can be performed individually or in cooperation depending on the scale of the legal organization and on the level of expertise needed in each phase. Different clusters and levels of these tasks define specific legal jobs.

The level of job performance in practice determines the required level of education. It appears that the three levels of education introduced above can be translated to the legal domain using descriptions of *legal tasks* clustered into *three classes of jobs:*

1. **Basic support level.** The cooperative execution of completely predefined legal standard tasks, like filling in standard forms, collecting and applying legal knowledge following a *fixed scenario* (a fixed scheme, script or checklist representing the solution of a singular legal problem) and completing legal standard documents;
2. **Professional support level.** The cooperative execution of legal tasks according to a *fixed strategy* (a predefined set of various general problem solving skills) but with *variable appointments* that require the acquisition of *variable legal knowledge*;
3. **Expert level.** The individual execution of legal tasks on the basis of expertise. Expertise consists of detailed knowledge of a specialized legal sub domain that is complex enough to be monopolized as well as the ability to construct new solutions ((interpretations of) rules and the associated models of classes of case data).

Each of these levels of performance is associated with typical legal jobs. The basic support level is associated with the common deployment of experienced secretaries preparing cases for professional and academic lawyers, providing *dedicated solutions* for *easy cases* and therefore mainly applying *a priori substantive knowledge*. The professional support level is associated with the professional support lawyer solving a multitude of easy cases and preparing hard cases for the academic lawyer. It is also

[5] A class of case data is a data model at the academic level, a legal problem area at the professional level and a form at the practical level.

[6] Legal knowledge consists of formal and informal rules with which an actual situation can be qualified normatively (i.e. in terms of rights and obligations) and of decision rules with which to choose from alternative qualifications. Formal sources include legislation, legal principles, jurisprudence, and policy rules. Informal sources include moral principles, social scripts, protocols, (technical) instructions, rules of thumb, and rules of play. The dynamic character of these sources forces lawyers to ‘acquire legal knowledge’ each and every time they engage in legal-problem solving.

associated with managing the access to legal knowledge in his organization, thus providing *general solutions* for *easy cases* and therefore mainly *finding and applying a priori procedural knowledge*. Finally the expert level is associated with the academic lawyer individually solving hard cases and designing new solutions, that is *specific solutions* for *hard cases* and therefore mainly *creating* new legal knowledge by applying *a priori (analytic) structural knowledge*.

The transfer of legal knowledge and skills at any of these levels can only be achieved using feasible (existing or developable) technological aids. Specific *technological aids* are associated with the legal tasks distinguished above:

1. **Digital forms** (models of case data);
2. **Legal information systems** (models of legal knowledge);
3. **Legal expert systems** (models of legal knowledge applied to case data);
4. **Digital documents** (models of legal documents).

There are also technological aids associated with the complete workflow (1-4), i.e. work flow systems and knowledge management systems.

These technological aids can be associated with the levels of performance (job levels) in legal practice:

1. **Practical level**: Digital forms, digital scenario's (e.g. decision trees) and digital documents;
2. **Professional level:** Legal information systems, knowledge management systems, work flow systems, legal expert systems (for easy cases);
3. **Academic level:** Legal expert systems (for hard cases).

A role playing game is not a specific technological aid but a specific use of technology to support the interaction between students playing different roles in performing legal tasks.

The next two sections discuss the application of most of these technological aids in terms of two projects. The first of these projects (the Law Game) mainly applied academic level simulation aids in an academic educational context. The second (CSI) used professional level simulation aids in a professional educational context. The results of these projects support the assumption made at the beginning of this section, that the level of simulation should match the level of education.

4.3 The Law Game, a management game for the legal domain

4.3.1 Introducing the Law Game and its educational aims

In a management game the players take decisions that are usually taken by the management of a business. A management game can be developed to suit the two higher levels of education distinguished above. It can consist merely of instructions to solve a specific business problem and a description of one or more adequate solutions. Students are provided with the description of the problem and are asked to construct a solution. The solution is evaluated by comparison to standard solutions. A more advanced version of the game also offers a data model of the business in case and a decision-making model consisting of both the decision rules (a model of the operation of the relevant market) and decision-making procedures. The students are provided with a description of the problem and are asked to solve it by choosing the correct decision rules. Entering their choice in the decision model will result in a certain solution that can be compared to the desired outcome. Finally a management game can offer the possibility to construct and enter new decision rules and to evaluate the results in the context of given business data and decision rules.

Legal problem solving can be compared to problem solving by managers of businesses in that it also starts from a given context of data (the legal case), has a goal (achieving a certain normative situation or the solution of a legal conflict), and an *a priori* set of problem-solving strategies (decision rules and decision-making procedures). In the legal domain decision rules are the formal and informal legal rules used to infer normative qualifications of the actual situation (the *object rules*) and the formal and informal rules used to decide for one of the competing qualifications (the *meta rules*). Decision-making procedures mainly consist of deductive reasoning (applying the object and meta rules to the case data and the inferred qualifications). Legal expert systems are models of legal cases, legal aims and legal problem-solving strategies. They can therefore be used to simulate legal problem solving in an educational context.

The Law Game (see Figure 4.1) was developed at the Centre for Law & ICT of the Faculty of Law of the University of Groningen for use as an advanced management game in a web-based environment. In order to cover the full range of expert level (level 3) tasks (i.e. using specialized knowledge to solve hard cases and design new solutions) the Law Game combines the passive (consumptive) use of an expert system (ES) with the active (productive) use of the ES in combination with its knowledge engineers editor (KEE). Students can solve hard cases in interaction with the ES, using it in the traditional way as a decision-support system. Alternatively, they can design new solutions using the KEE and evaluate the new solutions by entering them into the ES.

This choice of simulating technology enabled us to demonstrate the feasibility of the application of the Law Game in an educational setting and to answer the research question, whether this kind of simulation is suitable for learning how to use specialized legal knowledge to solve or create new solutions for hard cases.

According to its mission statement on academic education, the Faculty of Law aims at teaching specialized knowledge and how to solve hard cases (level 3 knowledge). In contrast, classical academic legal education is usually limited to the transfer of specialized substantive knowledge. Students mainly acquire specialized knowledge of actual regulations but not much of the structure and operation of legal knowledge. We assumed that structural knowledge (the anatomy of law) and procedural knowledge (knowledge of the law in action) can be taught by using a method and means that force students to look at the anatomy of the law (i.e. the structure of regulations and rules) and at the law in action (the construction and application of rules and regulations). In the Law Game project we measured the substantive, the structural and the procedural legal knowledge of our students by an entrance test. Next we saturated all the students with the same substantive knowledge by several digital means. This enabled them to dissect the law in a specific legal domain, to analyze its structure and (inter)actively apply the law, and to introduce new rules in interaction with an expert system (see section 4.3.2). Finally, we measured the students' knowledge again. Comparing the results of the entrance and exit tests answers the research question and enables us to draw some conclusions on the central assumption.

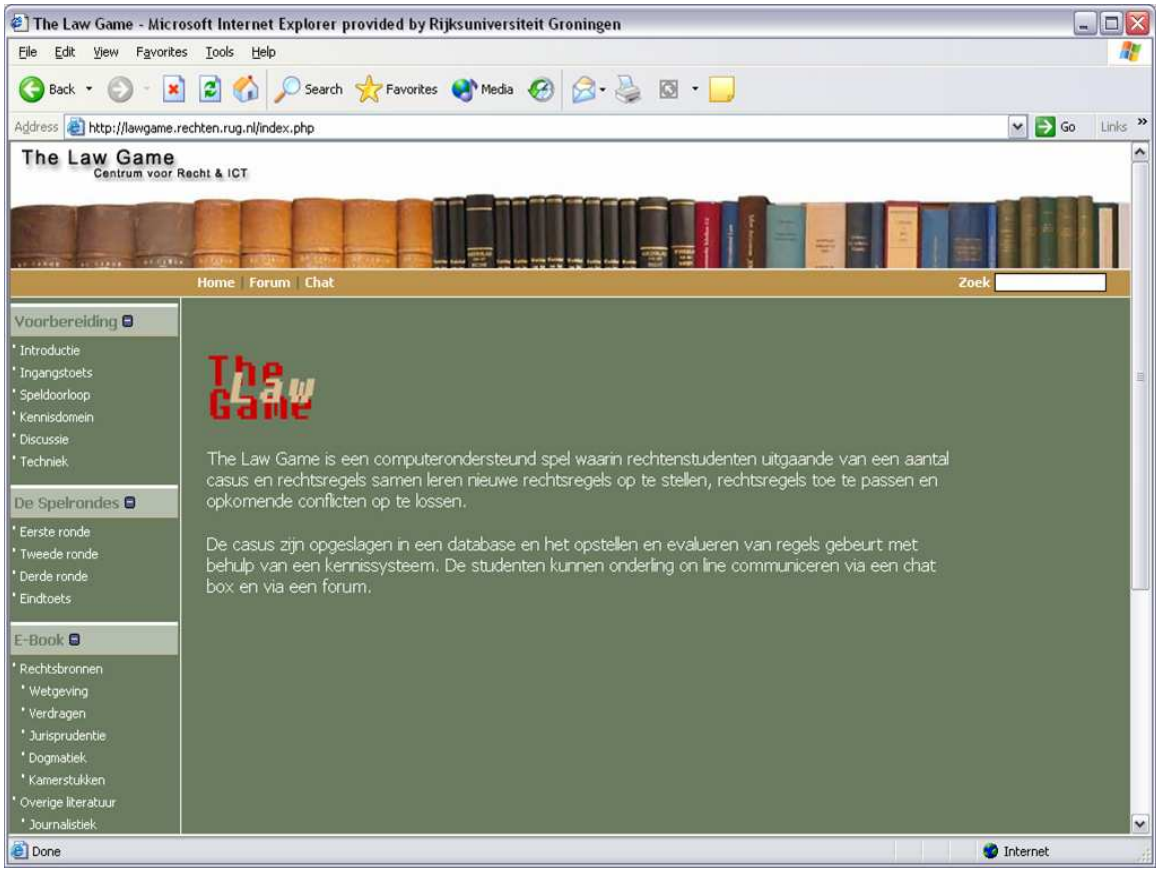

Figure 4.1 – The Law Game

4.3.2 Playing the Law Game

On logging in to the Law Game website, students first get a short introduction to the game as a whole. The aim and outlines are explained. The students are meant to gain substantive, structural and procedural knowledge of a chosen legal sub domain by using various digital legal sources and by constructing and evaluating legal solutions in interaction with a knowledge engineers editor and a legal expert system.

Directly after the introduction all the participating students take an entrance test to establish their individual level of legal and technical knowledge. The results of this entrance test get compared with the results of a similar exit test. After the test the courseof the game is explained in more detail. The students first practice navigating through the site and communicating with the teachers and with each other. Then they acquire knowledge of a chosen legal domain through a number of digital means. They install the client side of the knowledge engineers editor (KEE) and the expert system (ES) on their computers and are trained to use them. Then the three rounds of the actual game start. In each round the students are instructed to construct and evaluate their own decision rules using the KEE and the ES. Subsequently they must publish their own rules and discuss the decision rules of all the students. Finally, they are expected to argue and vote on “the best” decision rule. The teacher scores and publishes the rankings of the decision rules in all three rounds.

The students play different roles in each round. The first round is a simulation of *legislation*. The students are instructed to design a general rule to solve a class of cases according to a political principle. In formulating, discussing and voting for a general rule the students play the role of, for example, members of parliament. The second round is a simulation of *administrative decision-making*. The students are instructed to generate a general rule expressing a general policy or a specific rule expressing the decision criterion for an individual administrative decision. Here the students play the role of the administrators in an administrative body. The third round is a simulation of *jurisdiction*. The students are instructed to create a specific rule solving a specific legal conflict. In this case the students play the role of judges.

Communication amongst teachers and students takes place through The Law Game *Website* (fixed information), *E-mail*, a *Forum*, a *Chat box*, *E-lectures* and an *E-book*. E-mail is used to initiate the course and communicate changes in the game state (new results, new rounds, etc.). The Forum is used to provide instructions (for navigation practice, the acquisition of knowledge on the legal domain and the use of the KEE and ES). In the next phase the Forum is used to publish, discuss and vote on the students' solutions. The Chat box is used in the pre-publishing phase of the three rounds of the game for transitory *online communication* and in combination with the E-lectures. The E-lectures use a webcam and an online connection. This enabled the project leaders to for instance invite a leading expert from another (remote) institution to teach our students from his local office. The students could interact with the lecturer through the Chat box. The E-book can be compared to a portal that provides all the academic knowledge of the chosen legal sub-domain. It includes a textual introduction to the sub-domain, legal sources (statutory law, treaties, parliamentary proceedings, administrative decisions, and jurisprudence), examples of actual cases, links to institutions and other sources and *quizzes* to test the knowledge of the sub-domain in each of the three rounds of the game.

In the game the students are instructed to solve a general (for a class of cases) or specific (for a singular case) legal problem in interaction with the knowledge engineers editor (KEE) and the expert system (ES). The KEE and the ES have access to cases and rules. The facts of the cases are stored in a database and the rules that can be used to solve legal problems are stored in a rule-base. Rules refer to facts in the database by variables (attribute names). The KEE enables the teacher and the students to add new cases, variables and rules to the database and the rule base. The ES applies the rules to the cases using an inference engine and presents the results (the inferred conclusions and the facts and rules used to reach the conclusions) to the user. In the actual game the teachers added one or more cases to be solved to the database as well as all the relevant legally valid rules within the domain to the rule-base. The students were asked to solve a new problem by adding one or more variables and rules to the rule-base.

Those engaging in the Law Game were all arts students. Their capacity to use technically oriented interfaces was therefore limited. We cannot expect arts students to know computer language or even the slightly formalized (quasi natural) language usually found in knowledge engineers editors. So we built an interface that offers the possibility to describe a problem-solving rule in the form of a decision tree (see Figure 4.2). The students can use all the predefined attributes (names of columns in the database) or define new attributes to construct (yellow intermediate) nodes and (blue concluding) leaves of the decision tree. After the decision tree is finished the KEE translates it into a new rule that can be executed by the ES. The inference engine of the ES executes the new rule in combination with the known case data and rules, and then reports and motivates all the inferences that can be made. The ES is equipped with the usual explaining facilities. It can explain *what* a certain legal question or concept means by giving access to web pages containing definitions and short introductions. It can refer and give access to relevant legal sources such as legislation and jurisprudence. It can also explain *how* conclusions were drawn by presenting a step-by-step exposal of the process of making inferences. The student can immediately check the effects of his newly constructed rule on the solution of the cases. If he is satisfied by the shown effects he can publish his rule(s) on the Forum. After that the teacher and the other students can evaluate his rule(s) by feeding them to their local ES. On finishing all three rounds of the game the students take the exit test which measures their final level of knowledge and skills.

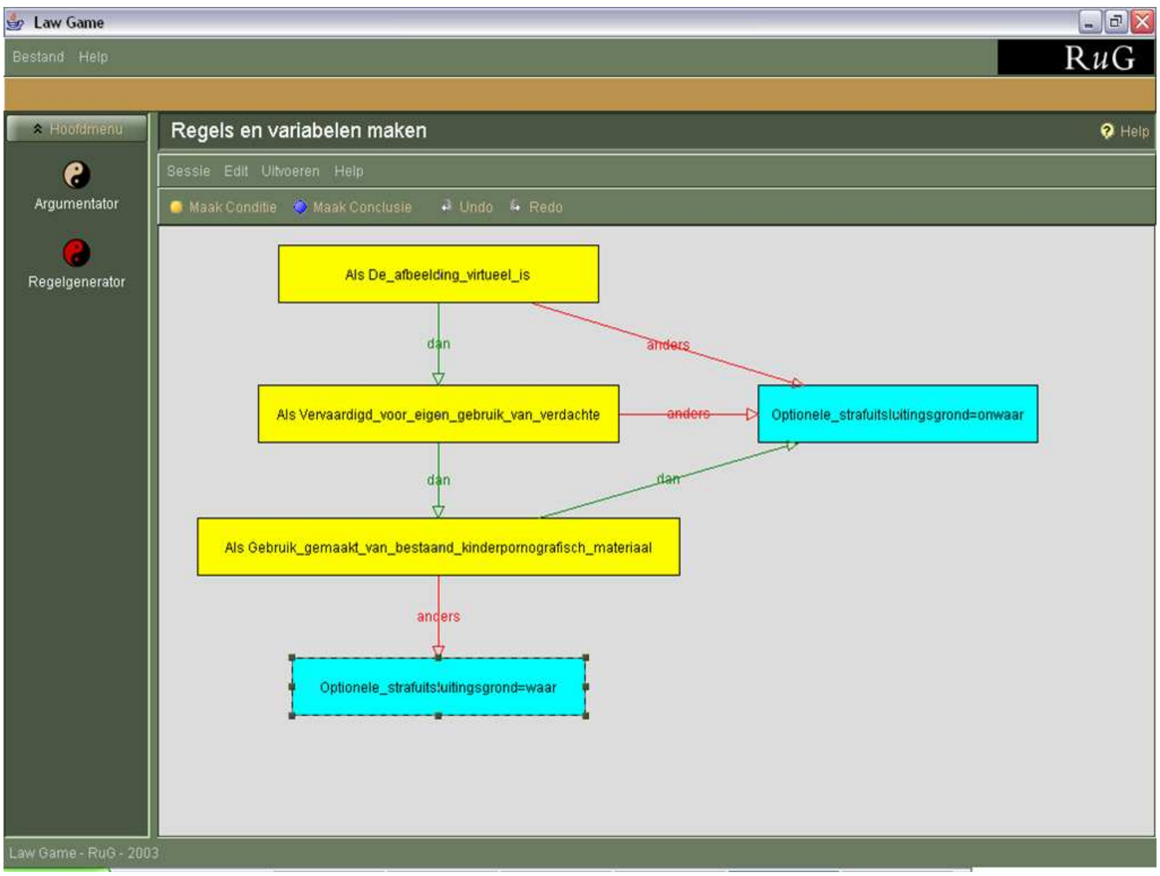

Figure 4.2 – The Law Game (2)

4.3.3 Results of the Law Game project

The Law Game demonstrates the feasibility of a simulation that uses an interactive expert system (ES) and a knowledge engineers editor (KEE) to support teaching the performance of legal tasks at the academic level. That is, both transferring specialized substantive knowledge to solve hard cases and teaching the ability to construct new solutions (i.e. legal rules to solve legal problems). A comparison of the entrance and exit tests shows that playing the Law Game had a strong effect on the amount of the students' specialized substantive knowledge and a substantial effect on the amount of their structural and procedural knowledge. All the students demonstrated an adequate ability to use the technical means provided in the game.

4.4 Cyberdam games, role-playing games for the legal domain

4.4.1 Introducing Cyberdam games and their educational aims

The Institute for Legal Education of the Academy of Amsterdam is a professional law school (as opposed to an academic law school). Professional education emphasizes the teaching of legal skills (level 2 knowledge). Professional lawyers are educated to cooperate in finding and applying the substantive knowledge needed to solve easy cases, in finding and *providing* the substantive knowledge needed to solve hard cases to academic lawyers and in organizing (design and maintain systems for) the finding of substantive knowledge within legal institutions (legal knowledge management). Cyberdam is an environment that typically allows for the development of level 2 simulations (i.e. Cyberdam games) as educational tools. The essence of the application of Cyberdam games is teaching the students to play particular roles in a simulation of legal practice. The transfer of substantive and structural knowledge in Cyberdam games is of secondary importance and is technically limited to textual information provided by web pages. The games concentrate on the roles and tasks of the participants in standard legal interactions and on their mutual communication. The basic idea is that a teacher develops a game to teach his students to play predefined roles in standard legal practice.

The standard educational application uses Cyberdam games mainly to teach the legal skills of finding, applying and providing legal knowledge, but *not* the skill of *organizing* the processes of finding, applying and providing of legal knowledge (legal knowledge management). Therefore I proposed using Cyberdam not only as a means for teachers to develop games for students, but also as an environment for students to develop games for other students. The first (*passive-consumptive*) use teaches students to find, apply and communicate legal knowledge in cooperation, the second (*active-productive*) teaches students to model the process of finding, applying, providing and communicating legal knowledge.

Combining the passive-consumptive and the active-productive uses of Cyberdam allowed us to do research aimed at answering the following questions:

1. Is a Cyberdam game a suitable tool to teach professional-level students the legal skills of cooperatively finding, applying and providing legal knowledge?
2. Is *developing* a Cyberdam game by professional-level students a suitable tool to teach them the legal skill of *organizing* the finding, applying and providing of legal knowledge?

Incidentally, combining the passive and active use has practical advantages:

1. All the professional skills can be trained using the same tool;
2. The games resulting from the active use of Cyberdam can be re-used in passive mode.

4.4.2 Playing and developing four Cyberdam games

Since other chapters of this book deal extensively with the outlines, technical details and evaluation of other projects in the Cyberdam role-playing environment, this chapter only describes the development and properties of the Cyberdam games used in this research. It addresses just the evaluation results relevant to the question of coherence of level of education and level of simulation.

In the first phase of the project a teacher developed a Cyberdam game to be used as part of a regular *first grade* course. The course is aimed at teaching the skill of providing legal counsel in easy rent law cases. The students first need to find and provide the facts of the case, i.e. the substantive knowledge needed to solve the case. Then they need to apply the knowledge to the facts, resulting in a written advice. A small group of students was instructed to solve legal problems both in their usual way and with the Cyberdam simulation. In their usual setting the students were expected to negotiate the division and distribution of the various tasks.

In the Cyberdam game the problem solving process is divided into phases, e.g. the origin and the development of the legal problem, the composition of a letter to the opposite party, the reaction of the opposite party, the request for legal advice, the institution of legal action, the solution of the problem etc. In each phase the students play particular roles, e.g. the injured party, the accused party, the legal advisor, the lawyer, the judge etc. In each role they have to communicate and cooperate in performing certain assigned tasks, specifically collecting, applying, sharing and formatting case data and knowledge for example in the phases of intake of a client, of deliberation with or consultation of a colleague, or of making a consensual decision. The phases and roles are predefined by the teacher, who also provides for the case data and the concrete assignments. The legal knowledge (legislation, jurisprudence, dogma, models etc.) is acquired from textbooks and websites (which can be made available through the virtual library, a part of the Cyberdam environment). So in contrast with the usual setting the student roles are predefined and assigned to them. They have to communicate and cooperate all the way to solve the problem.

The actual game that was developed for this course takes place in the virtual city called Cyberdam (Sieberdam in Dutch), where a Mr. Lijn is subleasing an apartment to Mrs. Wang (see Figure 4.3). Playing the role of mr. Lijn, the teacher starts the game. He gives notice to Mrs. Wang of a rent increase. One or more students play the role of Mrs. Wang, who are provided with the basic facts of the case and are instructed to prepare a request for advice to a general non profit legal advisory office. One or more other students play the role of non profit advisor, who receive Mrs. Wang's request and prepare a preliminary advice. In this case the advice can be to consult a specialized non profit advisory office (about the legal validity of the arguments for the rent increase) or even a lawyer with a combined request for financial and substantive legal aid (i.e. to take legal action). The roles of the advisor from the office or of the lawyer and the possible subsequent roles of the lawyer of the opposite party or eventually of the judge are also assigned to teachers and students. The number of phases, roles and tasks depends on the complexity of the case and the number of teachers and students available. In each phase of the game students play their roles by cooperatively finding and applying legal knowledge and by communicating it orally or through a (formal) document. The experiences of the students were measured by a survey and by individual interviews.

Figure 4.3 – The first Cyberdam Game of the CSI project

In the second part of the project several games were developed by *third grade* students under the supervision of a teacher. The students were instructed to use the production side of the Cyberdam environment to develop their own simulation of thesolution of several legal problems (also involving Mrs. Wang). In this part of the project the students had to define the phases, roles and tasks of the games themselves.
So, in the first phase of the project the students were playing roles in which they learned to cooperate in finding, applying and providing legal knowledge, whereas in the second phase of the project they learned to organize the execution of these tasks by defining the phases, roles and individual tasks of the performers.

The subjects of the games were chosen in such a way that the resulting simulations could be re-used in the regular first grade course of the first phase. The experiences of the students were measured by participating observation of the supervising teacher and by individual interviews.

4.4.3 Results of Cyberdam games project

Evaluation of the first phase of *passive* use of Cyberdam yielded surprising results. The students proved capable of both using the technical means provided and training in the required skills. However, they revolted against the Cyberdam game mainly because it forced them to cooperate and communicate in finding, applying and providing legal knowledge. In the traditional situation the students were quick to allocate the tasks so that each could work on their own as much as possible. They only cooperated at a far later stage, on assembling the final document. Professional practice depends on skillful cooperation and communication in knowledge processing and so teaching these skills is one of the main aims of professional education. Despite this fact the students acted as if they were on an academic education wherein individual expertise (monopolization of knowledge) and individual application of knowledge are paramount to cooperation in finding, applying and providing knowledge. The problem is that the level of knowledge the professional lawyer deals with allows for neither monopolization nor individual application. This is because most of the knowledge is too public to apply individually and there is too much competition from other professionals. So the first research question received both a descriptive and normative answer. A Cyberdam game is technically suitable for teaching professional-level students the legal skill of cooperation in finding, applying and providing legal knowledge, but students first need to be convinced that their level of aspiration is inappropriate and that they actually need to learn cooperative skills. A persistent application of typical level 2 simulations such as Cyberdam games would be effective in this respect, whereas level 3 simulations such as the Law Game would encourage inappropriate levels of aspiration.

Evaluation of the second phase of *active* use of Cyberdam showed that although third grade students could produce new Cyberdam games, they again found it harder to model certain aspects of their profession. As could be expected from the findings in the first phase, students had no problems modeling familiar levels of role playing. The definition of individual roles and individual activities posed no problems in contrast to the definition of game stages. Game stages presuppose an understanding of the (changing) cooperation between the characters playing different roles in each stage. Technically Cyberdam is a suitable tool to teach professional-level students the legal skill of, in this case, *organizing* the finding, applying and providing of legal knowledge, but again the aspiration level of the students prevents them from using the full potential of Cyberdam. So, the evaluation of the second phase of *active* use of Cyberdam also yielded a surprising result. It showed that the production of Cyberdam games can expose fundamental flaws in the educational program, because, even after three years of education, the aspirations of students and the demands of professional legal practice still did not match.

4.5 Considering the cohesion of levels of performance, education and simulation

Analysis of the tasks performed in legal practice and their clustering into common legal jobs shows that three levels of legal performance can be distinguished: basic support, professional support, and the expert level. These performance levels are in fair correspondence with the actual levels of practical, professional and academic legal education.

An inventory of available methods and techniques for modeling these legal tasks demonstrates that the tasks and their clustering into jobs can all be included in computer simulations at their own level. The feasibility of the application of these methods and techniques was demonstrated in the Law Game project (expert level performance /

academic legal education / academic level simulation) and in the Cyberdam-based CSI project (professional support level of performance / professional education / professional level simulation).

The first aspect of *expert level legal performance* (level 3) is the application of specialized knowledge to solve hard cases. This passive aspect can be simulated by applying the interaction between students and an expert system that can explain its own reasoning process. The second aspect of expert level legal performance is the design of new solutions for legal problems. This active aspect can be simulated by providing the students with a knowledge engineers environment to design new rules, and to extend the associated model of case data and feed these into the expert system for evaluation.

The first aspect of *professional level legal performance* (level 2) is the cooperative finding and *applying* of legal knowledge in easy cases and the cooperative finding and *providing* of legal knowledge in hard cases. This passive aspect can be simulated by incorporating its workflow into a role playing game, in our case a Cyberdam game. The second aspect is the design and maintenance of systems for finding substantive knowledge (*knowledge management*). This active aspect can be simulated by letting students design their own role playing games for the finding and application of substantive knowledge.

These projects proved it was fruitful to use the simulating environments in a consumptive and productive way to simulate the passive and active aspects of legal performance at both the professional and expert level. Indeed, the skills at both levels can be trained using the same tool. In addition, the legal solutions and games that result from the active application of the Law Game and Cyberdam can be re-used to feed the passive side of these simulations.

Apart from showing the feasibility of applying these simulation methods and techniques, both projects show that law students can play the games offered at their educational level. They have no problems understanding the games or dealing with the technical aspects. The results show that students can improve their performance of legal tasks by playing a game adjusted to their expected level of performance.

Playing the Law Game proved to have a strong effect on their amount of specialized substantive knowledge (required for the solution of hard cases) and a substantial effect on their amount of structural and procedural knowledge (required for the construction of new solutions). The latter result confirms the observation that academic education neglects the most creative part of its mission: teaching its students the structural and procedural knowledge required for creating new solutions.

The Cyberdam game proved effective for training in the required skills but also demonstrated a serious shortcoming of the professional educational program in conflict with its educational mission statement. The students found, applied and finally provided legal knowledge at the required level but although they were capable of cooperation they were actually unwilling to do so. The same result was found on the active side of the project where students developed new Cyberdam games. The students had no difficulty modeling the *individual* roles and tasks, but had initial difficulty modeling the *cooperative* game stages.

So the simulations applied in both projects not only served their purpose in teaching required knowledge and skills. They also served as tools for the evaluation of the educational programs. The projects accidentally demonstrated the potential of complete simulations at the correct level of performance to diagnose and mend flaws in both academic and professional educational programs. Application of a simulation on a level other than that of the education will cause (or enforce) inappropriate aspirations (attitudes) in students and leads to knowledge and skills that do not match the level of the legal tasks the students are expected to perform in actual practice.

In conclusion, two assumptions were confirmed by the results of the two projects presented in this chapter. We first assumed and confirmed that the different levels of actual practical performance should be reflected in the actual levels of education. Furthermore, we assumed and confirmed that the level of education and the level of simulation should match. Distinct simulations fitting both academic and professional levels of education not only proved to be methodically and technically feasible, but also proved to be playable by and instructive for students at their particular level of education and job expectancy.

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Chapter 5

Why and how did the games work?
The evaluation of the Cyberdam games from a systems perspective

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5.1 Introduction

5.1.1 The Learning in a Virtual World project

This chapter evaluates the simulation games developed in the “Learning in a Virtual World” project using *Cyberdam* software as the online environment. Cyberdam was first built during the KODOS project, which ran from December 2004 to December 2006. Subsequently, the Learning in a Virtual World project ran from January 2007 to November 2009. During the course of this project, 20 unique simulation games were developed and tested by 12 institutes of higher education, 11 located in the Netherlands and one in Scotland. These institutes developed and tested the following games:

- The Hague University of Applied Sciences: *Gezondheidsplein*
- Hogeschool van Amsterdam, University of Applied Sciences: *Cyborg Services Incorporated - Project Wonen*
- INHolland University of Applied Sciences: *Management Non-Profit*
- Hogeschool Leiden, University of Applied Sciences: *Vergunningen bij de Bouw*
- Rotterdam University of Applied Sciences:
    - *VMBO-docent gevraagd*
    - *Solliciteer ze!*
    - *Border Crossings*
- HU University of Applied Sciences Utrecht:
    - *Safe Areas*
    - *Visie*
    - *Participatietoets*
    - *Broodje Gezond / Privaatrecht*
    - *Dilemma’s in de Outreachende Hulpverlening*
    - *Expertisemarkt Jeugdbeleid*
- Open University of the Netherlands: *Wetgevingsproces*
- Delft University of Technology: *Spoorzone*

- Leiden University:
    - *Legitimate File-Sharing Service*
    - *Legitimate Data-Retention Service*
- University of Strathclyde (Glasgow) and HU University of Applied Sciences Utrecht: *Maternity Leave*
- VU University Amsterdam: *Saving Asia / Information Literacy*
- Willem de Kooning Academy, part of Rotterdam University of Applied Sciences: *Community Art.*

The project entailed continuous development of the Cyberdam online simulation game environment. As mentioned above, the first version of this web-based virtual world was designed in the KODOS project. In the second project we designed version 2.0, which required a total revision of the software code. Over the course of the project, we also developed versions 2.1, 2.2 and 2.3. Most of the simulation games were tested using one or other version of the Cyberdam environment.

Reflecting on each game, two typologies arise that together offer a quick overview of the characteristics of all the games. The first typology concerns *time*, the second typology concerns *domain of learning*. Playing the games took anywhere between 1-15 weeks:

1. Three games were *short*, taking 1-3 weeks to play.
2. Six games were of *medium* length, taking 4-6 weeks to play.
3. Six games were *long*, taking 7 or more weeks to play.

The games all concerned specific issues concerning multiple actors, all dependent on one another. The issues appeared in four domains:

1. Four games concerned *healthcare organization*, where students learned to manage collaborations between various social welfare organizations, youth care or the entire health care chain.
2. Four games concerned *issues of law*, where students learned to manage highly law-determined organizational processes such as applying and dealing with building permits, international differences in labor law, handling a case of private law and the Dutch national law-making process.
3. Five games concerned *governmental, business and public organizations*, where students learned to manage such multi-organizational issues as maintaining district safety, policy-making, lobbying by public organizations and large infrastructure projects.
4. Two games concerned *personal development*, where students learned to handle the job application process or to search for relevant free scientific information on the Internet.

Together the two typologies form the matrix of games[*] laid out in Table 5.1.

These games were all developed and tested at different levels of higher education, that is in various colleges and universities. Given the large scale of this project, we are now able to draw lessons from all the game development and application processes to answer the questions: how and why did the games (not) work? Our analyses reveal that at times the games' degree of success differed considerably. In this report we systematically analyze what determined the success of each game.

[*] The game "Community Art" is omitted.

	Short 1 to 3 weeks	Medium 4 to 6 weeks	Long 7 or more weeks
Healthcare organization		- Dilemma's in de Outreachende Hulpverlening - Expertisemarkt Jeugdbeleid	- Management Non Profit - Gezondheidsplein
Issues of Law	- Vergunningen bij de Bouw - Legitimate File-Sharing Service - Legitimate Data-Retention Service	- Maternity Leave	- Broodje gezond / Privaatrecht - Wetgevingsproces - Cyborg Services Incorporated - Project wonen
Governmental, business and public organizations		- Safe Areas - Visie - Participatietoets	- Spoorzone - Border Crossings
Personal development	- VMBO-docent gevraagd - Saving Asia / Information Literacy		- Solliciteer ze!

Table 5.1 – Typology of developed games

5.1.2 Theory-oriented evaluation

Our main question focuses on the search for the determinants of success for the Cyberdam simulation games. However, before these determinants can be established, it is essential to define success and its indicators. We deem success to be a quest for effectiveness. An effective game is first and foremost able to instantiate a "motivated learner" (Garris, Ahlers, & Driskell, 2002, p. 444). Thus, effectiveness is measured through a student's motivation and sense of learning, that is whether a student was motivated by and learned from playing a game.

We adopted the approach of "theory-oriented evaluation" developed by Kriz and Hense to construct a framework of determinants for success, that is instantiating motivated learners (Kriz & Hense, 2006; Mayer, Stegers-Jager & Bekebrede, 2007, pp. 215-217). The game evaluation project by Kriz and Hense was similar to ours in terms of its large scale and educational focus. They argue that the evaluation method should not focus "solely on outputs and outcomes" but on "processes and mediating factors" as well (Kriz & Hense, 2006, p. 270). They deem their game evaluation method to be theory-oriented, as it emphasizes a "logic model" (Kriz & Hense, 2006, pp. 273-274) that includes the entire game-design, application and debriefing process as well as the game's developers, facilitators and players.

The main structure of Kriz and Hense's logic model is based on Garris's systems conceptualization of simulation gaming that focuses on input, process and outcome (Garris, Ahlers & Driskell, 2002, p. 445). Subsequently, they identify a number of key variables for each of the three main concepts based on their own as well as other extensive literature reviews of simulation game evaluation research (cf. Faria, 2001). We deemed most of the characteristics of input, process and outcome that Kriz and Hense developed as highly relevant to the evaluation of our project.

Input variables

Based on previous research, Kriz and Hense treat several student, teacher and game characteristics as input variables (Kriz & Hense, 2006, pp. 272-273). In previous work Bekebrede and Mayer elaborated on this model to include student input variables about their motivation to use online learning environments as – contrary to the Kriz and Hense project – the games developed in our project were all computer-mediated (Mayer, Stegers-Jager & Bekebrede, 2007, p. 216). With this in mind, the *student input variables* measured in this project are:

- Demographic variables: age and gender;
- Applicability of three types of learning expectancies for the game: learning knowledge, learning social skills and learning relevant future work practices;
- Number of previous experiences with entertainment and simulation games;
- Acceptance of online learning environments.

Kriz and Hense include previous knowledge of the game's subject area as a relevant student input variable. However, the broad scope of this project made it practically impossible to determine beforehand the students' knowledge of each game's specific subject area.

In this project we also measured the following *teacher input variables*:

- Experience with developing and using simulation games;
- Preparation for game design and game play.

Kriz and Hense include game design and content quality as game input parameters, but these were excluded from our analysis as it was practically impossible to determine the quality of each game's design and content prior to application. Instead, we included them as process variables by asking students to rate the quality of the game design.

Process variables

Kriz and Hense treat several student-game, student-student and student-teacher interactions as process variables that we deemed relevant to this evaluation as well. Our *process variables* are therefore:

- Student-deemed appropriateness of the game to the curriculum;
- Student-deemed quality of the game design;
- Intensity of student involvement with the game;
- Intensity of student-student interactions, that is team involvement;
- Student-deemed quality of the teacher instructions, support and debriefing.

To develop parameters of game design quality, we used a conceptualization of game design that consists of creating an objective, roles, affordances and rules (Garris, Ahlers & Driskell, 2002, pp. 448-449).

Output variables

The input and process variables mentioned above contribute to the outcome of a game. With respect to output variables, Kriz and Hense distinguish parameters of short-term and long-term outcomes. In this evaluation, we did not set out to measure the long-term outcomes of a simulation game, since we deemed that long-term outcomes as argued by Kriz and Hense are not a determinant of a game's success, that is creating a motivated learner. Instead, they are parameters of additional organizational effects of introducing simulation games as a learning method.

Inspired by Kriz and Hense, when measuring students' short-term learning outcomes we distinguished parameters of learned knowledge, learned social skills and learned work practices. These learning outcomes are identical to student input variables on learning expectancy, and this allowed us to determine whether the students' learning outcomes were congruent with their expectations.

Two more measurements of short-term outcome do not involve learning but are important to this project and simulation games in general. Firstly, the level of perceived fun was an important variable to determine whether the learner was indeed motivated. Secondly, in previous work we argue that it is important to consider the quality of the online environment in which the simulation game is played (Mayer, Stegers-Jager & Bekebrede, 2007, p. 216). This is especially important in this project which is aimed at evaluating the quality of Cyberdam as an online simulation game environment. Therefore the level of acceptance of the Cyberdam environment is also an important output variable.

5.1.3 Hypotheses

Using the above theories in our evaluation of this large-scale simulation gaming project allows us to test several hypotheses, which we contradict or corroborate in this chapter.

Firstly, concerning output, the theory of the motivated learner assumes that a student who is motivated by the perceived fun of game-play will deem the learning effect higher (Garris, Ahlers & Driskell, 2002, p. 444). Thus, our first testable hypothesis is:

> *H1: Players of Cyberdam simulation games who express a high degree of fun express a higher degree of learning.*

Again concerning output, we assume that a student who considers the online environment to be of high quality will consider the learning effect of the game that was played in it higher. This is especially relevant for this project, as all the evaluated games used the Cyberdam game environment. Our second testable hypothesis therefore is:

> *H2: Players of Cyberdam simulation games who express a high degree of Cyberdam quality express a higher degree of learning.*

Concerning input, the theory of game experience assumes that students who have had previous experience with entertainment and simulation games will deem the learning effects of the simulation game higher (Kriz & Hense, 2006, p. 272). To this end, our third testable hypothesis therefore is:

> *H3: Players of Cyberdam simulation games with previous experience in playing entertainment and simulation games prior to playing the Cyberdam simulation game will express a higher degree of learning afterwards.*

Again concerning input, we assume that students who approve of online learning environments will deem the learning effects of the simulation game higher. Our fourth testable hypothesis therefore is:

> *H4: Players of Cyberdam simulation games who express a high approval of online learning environments prior to playing the simulation game will express a higher degree of learning afterwards.*

Concerning process, the theory of game relevance assumes that a student who deems the played simulation game to be highly relevant to his or her education will deem the learning effect higher (Kriz & Hense, 2006, p. 273). Our fifth testable hypothesis therefore is:

> *H5: Players of Cyberdam simulation games who express a high degree of game relevance express a higher degree of learning.*

Again concerning process, the theory of game design assumes that a student who deems the simulation game's design to be of high quality will deem the learning effect higher (Kriz & Hense, 2006, pp. 276-277). Our sixth testable hypothesis therefore is:

H6: Players of Cyberdam simulation games who express a high degree of game design quality express a higher degree of learning.

Finally, concerning process, the theory of game process assumes that a student who deems the process of playing the simulation game to be of high quality will deem the learning effect higher (Kriz & Hense, 2006, p. 273). Our final testable hypothesis therefore is:

H7: Players of Cyberdam simulation games who express a high degree of game-play quality express a higher degree of learning.

This chapter is structured in accordance with the above hypotheses. In Section 5.2, we discuss our methods for testing the seven hypotheses listed above. Section 5.3 discusses what our results tell us about the first two hypotheses on the output variables in our game evaluation framework. In Section 5.4, we discuss the implications of our results on the third and fourth hypotheses on the input variables. Section 5.5 deals with the latter three hypotheses on process variables in our game evaluation framework. Finally, in Section 5.6 we conclude which of our hypotheses were confirmed and which were discredited by our evaluation of the "Learning in a Virtual World" games.

5.2 Methods

To test the hypotheses, we adopted a mixed method approach. We used quantitative research techniques to measure the demographics, actions and opinions of the involved students. We used qualitative research techniques to determine the context of the quantitative parameters, that is how the game's design and application processes went according to the designers and/or leaders.

5.2.1 Procedure and sampling

The unit of analysis of the effectiveness analysis presented in this chapter is the student who played a Cyberdam game. Specifically, we measured the student's demographics, previous experiences, prior expectations, actions during the game and opinions of the played game. The quantitative method of the study entailed approaching all the students who were involved with the game with a pre- and post-game questionnaire. Prior to the start of the game, we contacted the educational institute's project leader to determine the date the game was going to start and the e-mail addresses of the students who were going to play it. We approached the students via e-mail preferably one week before the start of the game to ask them to fill in an online questionnaire.

Most of the games took 5-10 weeks to play. As soon as possible after a game had been finished, we approached all the students via e-mail with an online questionnaire. We asked the project leader and involved teachers to urge the students to fill in both questionnaires. In three cases, the teachers were willing to obligate the students to fill in the questionnaires as a requirement for play. We sent students a reminder e-mail or asked the teachers to remind the students if the questionnaires had low response rates.

After two or three weeks, we assembled the descriptive statistics of all the questions in both surveys into one document. We added a number of chapter propositions to turn the document into a template for an evaluation report concerning the specific game. We then asked the educational institute's project leader to provide their perspective on the game in the evaluation report. This way they could provide the necessary qualitative data concerning the process of game design and application.

After we had received all the game evaluation reports, we determined which of the games could become part of the overall analysis of effectiveness. We upheld the following criteria for determining whether a game's results could become part of the overall analysis:

1. The game involved a group of students who had to play one or more roles within a simulated environment for educational purposes for anywhere between a day and a couple of weeks;
2. The game involved the use of a version of Cyberdam during its entire course;
3. The game was evaluated completely using the explained procedure of standardized pre- and post-game questionnaires.

Of the 20 unique games developed and applied during the project, 6 were excluded from the overall analysis, as they did not meet one of the above criteria.

Since the project was an extension of the previous KODOS project, the four games developed during the KODOS project all met the above criteria. Data from the KODOS project are incorporated into the analyses for the purpose of testing the hypotheses, as their inclusion supports the goal of this report: drawing well-grounded conclusions concerning how and why the Cyberdam games did or did not work.

5.2.2 Participants

Sometimes the measurements from the questionnaires were highly representative, while at other times they were clearly not. Table 5.2 shows the response rate per game. As the table shows, for seven game sessions the response rate for the pre-, post-game or both questionnaires was 60% or higher. However, for eight games the response rate for the pre-, post-game or both questionnaires was between 9% and 40% as a result of organizational problems during the evaluation process, thus rendering these games' data non-representative of the involved students. The problems included bad timing in sending the questionnaires or lack of communication by the teachers as to the importance of filling in the questionnaire. Such problems sometimes resulted in the inability to map post-game results to pre-game results, as both questionnaires had different respondents. Given the complexity of this project, however, such organizational issues were somewhat unavoidable. The overall response rates of the pre- and post-questionnaires of the games included in the effectiveness analysis were 24.7% and 25.4% respectively. In the case of the four KODOS project Cyberdam games, the response rate was very high and the measurements thus representative (Mayer, Stegers-Jager & Bekebrede, 2007, p. 218).

In the pre-game questionnaire, we asked for the respondent's gender and age. Of all respondents 60.3% were male and 39.7% were female. The youngest respondent was 17 years old, while the oldest was 59 years old. The mean age was 21.48 ± 5.34. Teachers did not provide upfront the demographics of all students involved in each game.

Overall, we stress that the results presented here are not representative of all the students who played the games in this project. Instead, the results reflect the students who took part in the evaluation process, either through the pre-game questionnaire, the post-game questionnaire or both. In this effectiveness analysis, there were in total 333 respondents of either the pre-game questionnaire, or post-game questionnaire or both. For the previous KODOS project, this number was 285.

Game	Number of students approached	Response rate pre-game questionnaire	Response rate post-game questionnaire	Number of respondents
Management Non Profit	15	46.7%	66.7%	10
Safe Areas *	23	8.7%	56.5%	14
Visie *	490	8.2%	10.6%	52
- second year	186	10.2%	8.1%	25
Spoorzone	157 pre / 134 post	61.8%	80.6%	116
- second year	39	71.8%	41.0%	30
Participatietoets	6	100%	100%	6
VMBO-docent gevraagd	7	42.9%	57.1%	6
Broodje gezond / Privaatrecht *	8	62.5%	25.0%	5
Dilemma's in de Outreachende Hulpverlening *	44	25.0%	29.6%	18
Vergunningen bij de Bouw *	8	37.5%	25.0%	4
Gezondheidsplein *	17	94.1%	29.4%	16
Cyborg Services Incorporated - Project Wonen	8	50.0%	37.5%	5
Expertisemarkt Jeugdbeleid *	53	15.1%	15.1%	8
Maternity Leave	16	93.8%	62.5%	15
Saving Asia/Information Literacy *	6	50.0%	33.3%	3
Overall	**1083 pre / 1060 post**	**24.7%**	**25.4%**	**333**

* Measurements are deemed not representative

Table 5.2 – Response rates per game

5.2.3 Parameters

To test the hypotheses, we measured the demographics, actions and opinions of the students. In the pre-game questionnaire, we asked the students for their gender and age. We asked how often they played board, role-playing and computer games privately for entertainment, that is weekly, monthly, a number of times per year or never. We also asked how often they had played games for educational purposes before.

Subsequently, we asked a number of questions or posed a number of statements that students could answer or respond to using a 5-point Likert measurement scale (*strongly disagree – disagree – neutral – agree – strongly agree*). We asked whether they liked and were comfortable using the computer to try out and learn new applications as well as e-learning environments such as Blackboard, WebCT or Moodle. We asked whether they preferred their educational environment to include lectures, literature studies, individual projects and group projects. Finally, we asked whether they favored using games in their education and what kind of an educational environment they expected the upcoming game to offer. The questions and statements provided us with data with which we could confront hypotheses three and four.

In the post-game questionnaire, we asked the students how much fun they had had using the Cyberdam environment as well as playing the specific game. We also asked whether they generally felt that the simulation game had improved their learning. The questions and statements provided us with data with which we could confront hypotheses one and two.

We also asked the students to rate the relevance of the game as a whole to their education. Furthermore, we asked the students to rate the game's design in terms of the clarity and attractiveness of the objectives, the rules of the game, the role they had to play and the assignments they were given. We then asked the students to rate the course of the game in terms of the instructors' effort (if relevant) and their as well as other students' attitude and effort. Finally, we asked the students to rate the Cyberdam as a digital environment in terms of its performance and ease of use generally as well as specific to the different elements of the software. The questions and statements provided us with data with which we could confront hypotheses five, six and seven.

5.3 Main parameters for learning and success

5.3.1 Parameters for learning

To measure the amount of learning, we posed 13 statements in the post-game questionnaire and asked the respondents to respond to them on a 5-point Likert scale. We first posed a general statement of learning: "It improves my learning to work on this simulation game (this role play)." Subsequently, we posed 12 statements about specific forms of learning, that is learning knowledge, learning social skills and learning relevant future work practices, in the following order:

1. The theory from formal lectures and books has become more understandable.
2. I have learned to work better with other students in a team.
3. I have learned to communicate better.
4. I have learned to discuss and reason better.
5. I have learned to negotiate better.
6. I have gained content-related (subject) knowledge.
7. I have gained (theoretical) knowledge.
8. I have learned to think beyond disciplinary boundaries.
9. I have learned to see the relations between different subject areas.
10. I have been able to practice in a safe environment.
11. I have prepared myself for later professional practice (in an internship, traineeship, work, etc.).
12. I have improved relevant (professional) skills.

In the pre-game questionnaire, we posed the same statements formulated in the future tense. This way we were able to determine what the respondents expected to learn from playing the game. A factor and reliability analysis of pre-game learning expectation statements revealed that the respondents generally upheld the same theoretical construct of three types of learning outcomes as we did. The first, sixth, seventh, eighth and ninth statements above could be grouped to form a reliable theoretical construct, as Cronbach's alpha was more than 0.7 (0.746). Cronbach's alpha indicates how well several variables together measure an underlying latent construct. In other words, the higher the alpha value, the more reliable the theoretical construct is. A Cronbach's alpha of higher than 0.70 can be considered acceptable (Nunnally, 1978). We thus constructed this factor and named it "expect knowledge." Furthermore, the second, third, fourth and fifth statements above could also be grouped to form a reliable theoretical construct, as Cronbach's alpha was 0.832. We constructed this factor and named it "expect social skills." The final tenth, eleventh and twelfth statements above could be grouped to form a reliable theoretical construct, as Cronbach's alpha was 0.740. We constructed this factor and named it "expect practice."

Interestingly, from the data of the post-game questionnaire, we were not able to construct the same three factors. The post-game measurements of learning outcome could only be grouped to form a single theoretical construct. Thus, the factor analysis of the post-game questionnaire's learning outcome variables did not lead to the same distinction of three types of learning. It would seem that the respondents instead rated all 12 statements of learning more similarly than in the pre-game questionnaire. The 12 statements that together measured learning outcome in the post-game questionnaire can be grouped to form a reliable theoretical construct, as Cronbach's alpha was 0.896. Thus, we grouped these post-game statements to form the factor "learning."

Together, the learning factor and the general statement of learning offer interesting insights into the learning effects of each game. The learning factor correlated significantly and quite well with the general statement of learning (0.555; n = 455). This supports the conclusion that this factor can indeed be seen as a second general measure for learning outcome which can be used to test the hypotheses more rigorously. Together, the general statement of learning outcome and learning factor are therefore deemed reliable measures of whether the respondent deemed to have learned from playing the simulation game.

Comparing both the results of the general statement of learning and the learning factor of each game, we conclude that the game "Saving Asia" scored the highest learning outcome, although the number of respondents was low (n = 3). The game that scored second highest on learning outcome was a tie between "Participatietoets" (n = 6) and "Maternity Leave" (n = 10). Collectively, the personal development games scored the highest learning outcome. The healthcare games scored the lowest learning outcome.

5.3.2 The importance of fun

As any game tends to connote, players expect it to be fun upfront. More than two thirds (67.6%) of the respondents (strongly) agree that it is fun to take part in simulation games in general, while even more respondents (71.6%) (strongly) agree that the particular game they are about to play sounds like fun (n = 466).

The game with the highest expectation of fun was "Broodje Gezond," the law game (n = 5). Moreover, the game type with the highest expectation of fun were the law games. The game with the lowest expectation of fun was "Vergunningen bij de Bouw" (n = 4). Furthermore, the game type with the lowest expectation of fun were the personal development games.

Interestingly, from the analysis of the post-game data we conclude that in the end the personal development game "Saving Asia" scored the highest sense of fun of all games (4.50 ± 0.707; n = 3). Two games scored the second highest sense of fun: the law game “Broodje Gezond” (4.00 ± 0.0; n = 2) and the organizational game “Participatietoets” (4.00 ± 0.632; n = 6).

According to hypothesis 1, we could expect higher degrees of learning in games and cases where the most fun was experienced. We found a strong correlation between the statements “I had fun working on this simulation game” and “It improves my learning to work on this simulation game (this role play),” as Table 5.3 shows. Thus, it seems hypothesis 1 is confirmed. As this table also shows, we found a weaker correlation between the pre-game statement “Taking part in this simulation game sounds like fun” and the post-game statement “I had fun working on this simulation game.” Moreover, we found a weak correlation between the statements “Taking part in this simulation game sounds like fun” and “It improves my learning to work on this simulation game (this role play)” as well as the post-game learning factor. Thus, hypothesis 1 is mediated by the fact that if our respondents expected a game to be fun upfront, there was already a chance that they would deem it fun afterwards and a slight chance they would score its learning outcome highly afterwards as well.

		It improves my learning to work on this game (this role play).	Post-game “learning effect” factor	Taking part in this simulation game sounds like fun.	I had fun working on this game.
It improves my learning to work on this game (this role play).	Pearson Correlation	1	.555**	.188**	.604**
	Sig. (2-tailed)		.000	.001	.000
	N	455	392	333	452
Post-game “learning effect” factor	Pearson Correlation	.555**	1	.389**	.490**
	Sig. (2-tailed)	.000		.000	.000
	N	392	392	295	391
Taking part in this game sounds like fun.	Pearson Correlation	.188**	.389**	1	.362**
	Sig. (2-tailed)	.001	.000		.000
	N	333	295	466	331
I had fun working on this game.	Pearson Correlation	.604**	.490**	.362**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	452	391	331	452

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.3 – Correlations between expecting fun, experiencing fun and learning outcome

5.3.3 The importance of Cyberdam quality

All evaluated games used the Cyberdam online environment that encompasses specific features. It is web-based, built in Java, and conceptually based on a fictional Dutch city, although other maps could be developed and used from version 2.1 onwards. A game that uses the Cyberdam environment can be based on rounds or phases. In addition, it can make use of a directory of actors that inhabit the fictional city, an internal e-mailing system and role-specific activities. All these elements can be defined or customized by the game designers.

Given the fact that all the evaluated games used Cyberdam, it is important to consider it an intrinsic part of the game itself and therefore the game's evaluation. Overall, the respondents deemed Cyberdam versions 2.0 and higher to be somewhat easy to use (mean: 3.38 ± 1.07; n = 219), fun (mean: 3.25 ± 0.95; n = 199) and valuable (mean: 3.38 ± 1.02; n = 200).

Disappointingly, the development of versions 2.0 and 2.1 did not lead to higher scores on the statement most important to this project: "The use of Cyberdam in education is valuable." The scores remained just above the neutral score of 3, that is from a mean of 3.1 (version 2.0; n = 17) to 3.4 (version 2.1; n = 46).

Nevertheless, according to hypothesis 2 a positive score of Cyberdam's quality leads to a higher degree of learning. Deeming the general statement of "The use of Cyberdam in education is valuable" as a measure of Cyberdam quality, we analyzed the correlation between this statement and the statement "It improves my learning to work on this simulation game (this role play)." We also analyzed the correlations between the other general statements about Cyberdam and the two parameters for learning effect as well. The results are shown in Table 5.4. As the table shows, finding Cyberdam easy to use, fun and valuable is correlated with learning outcome. This analysis supports hypothesis 2 in general terms.

		It improves my learning to work on this game (this role play).	Post-game "learning effect" factor	The Cyberdam environment was easy to use.	I had fun using Cyberdam.	The use of Cyberdam in education is valuable.
It improves my learning to work on this game (this role play).	Pearson Correlation	1	,555**	,322**	,411**	,511**
	Sig. (2-tailed)		,000	,000	,000	,000
	N	455	392	412	412	412
Post-game "learning effect" factor	Pearson Correlation	.555**	1	.411**	.497**	.541**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	392	392	361	361	362
The Cyberdam environment was easy to use.	Pearson Correlation	.322**	.411**	1	.432**	.340**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	412	361	432	411	411
I had fun using Cyberdam.	Pearson Correlation	.411**	.497**	.432**	1	.595**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	412	361	411	412	411

The use of Cyberdam in education is valuable.	Pearson Correlation	.511**	.541**	.340**	.595**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	412	362	411	411	412

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.4 – Correlations between Cyberdam quality and learning outcome

To be more specific about *what* makes Cyberdam valuable and possibly leads to positive learning outcome, we formulated nine statements about the quality of the elements of the online environment or virtual world and the functionalities of the system. The elements that instantiate the virtual world include a map of sorts (most often of a fictional Dutch city), a directory of actors who have a place on that map and websites detailing information on each actor. The functionalities of the system entail logging in to and out of a specific role, e-mailing with other roles in the game, a portfolio of documents, and the ability to both upload and download documents.

		It improves my learning to work on this game (this role play).	Post-game "learning effect" factor	Post-game "quality of virtual environment" factor	Post-game "quality of system functionalities" factor
It improves my learning to work on this game (this role play).	Pearson Correlation	1	.555**	.252**	.272**
	Sig. (2-tailed)		.000	.000	.000
	N	455	392	423	422
Post-game "learning effect" factor	Pearson Correlation	.555**	1	.285**	.285**
	Sig. (2-tailed)	.000		.000	.000
	N	392	392	379	377
Post-game "quality of virtual environment" factor	Pearson Correlation	.252**	.285**	1	.405**
	Sig. (2-tailed)	.000	.000		.000
	N	423	379	423	416
Post-game "quality of system functionalities" factor	Pearson Correlation	.272**	.285**	.405**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	422	377	416	422

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.5 – Correlations between Cyberdam environment, functionalities and learning outcome

We asked respondents to mark each element or functionality of Cyberdam on a scale of 1 to 10, with 10 the best and 1 the worst mark. Following factor and reliability analysis, three statements we deemed upfront to be about the virtual world could be grouped into one theoretical construct as Cronbach's alpha scored 0.786. This meant that grouped together the three statements would be a reliable indicator for quality of the virtual world. Another six statements we deemed upfront to be about the quality of the system's functionalities could indeed be grouped into one theoretical construct as Cronbach's alpha scored 0.877.

With these reliable factors we were able to reduce our data and again examine the correlation between them and the parameters of learning effect. Table 5.5 shows these correlations. Interestingly, the correlations between the Cyberdam factors and learning parameters are also significant, but slightly weaker than the general statements about Cyberdam and the learning parameters. This analysis again confirms hypothesis 2.

5.3.4 Parameters for success

We confirmed hypothesis 2 using two separate techniques of statistical analysis. We also confirmed hypothesis 1 in section 5.3.2. These two confirmations lead us to the conclusion that a sense of fun in game-play and deeming the Cyberdam environment valuable have together a high chance of leading to a high score for learning outcome. A sense of fun in game-play, deeming the Cyberdam environment valuable and a high general learning outcome are related. Confirmative factor analysis revealed that the three statements "I had fun working on this simulation game," "The use of Cyberdam in education is valuable" and "It improves my learning to work on this simulation game (this role play)" can indeed be grouped to form a theoretical construct with high reliability (Cronbach's alpha: 0.766). We thus constructed the factor "Game Success," involving these three statements. We use this factor throughout the remaining part of this report as a reliable measure of a game's success. Figure 5.1 shows the distribution of success among all the evaluated games. Also, Figure 5.2 shows the means of success per individual game and Figure 5.3 shows the means of success per game type.

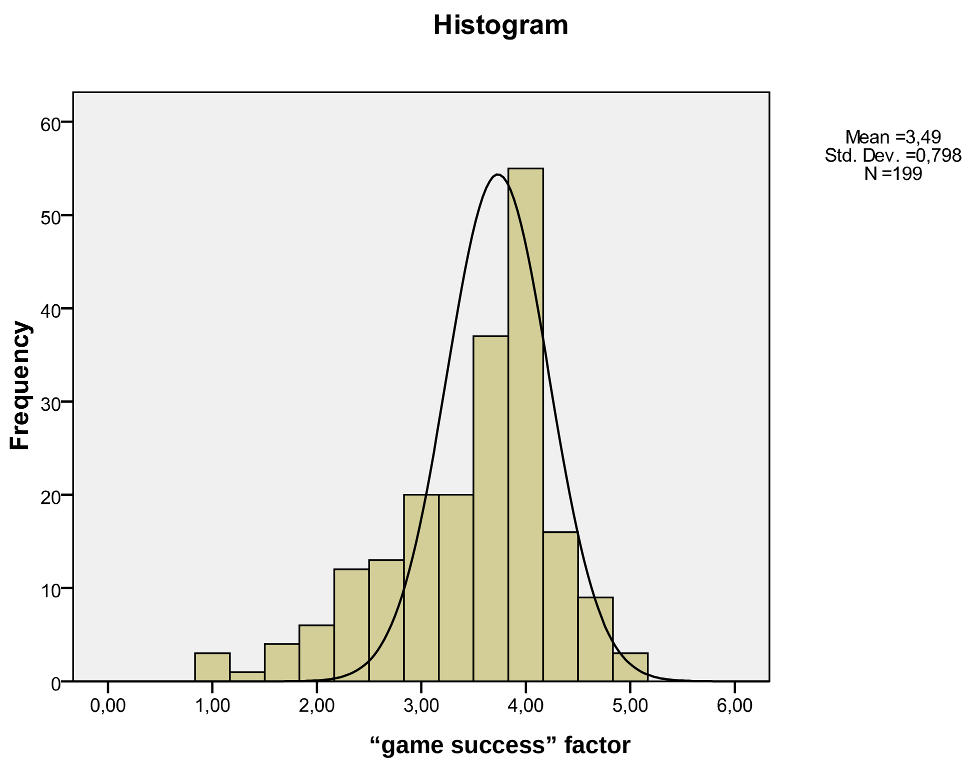

Figure 5.1 – Distribution of the success factor

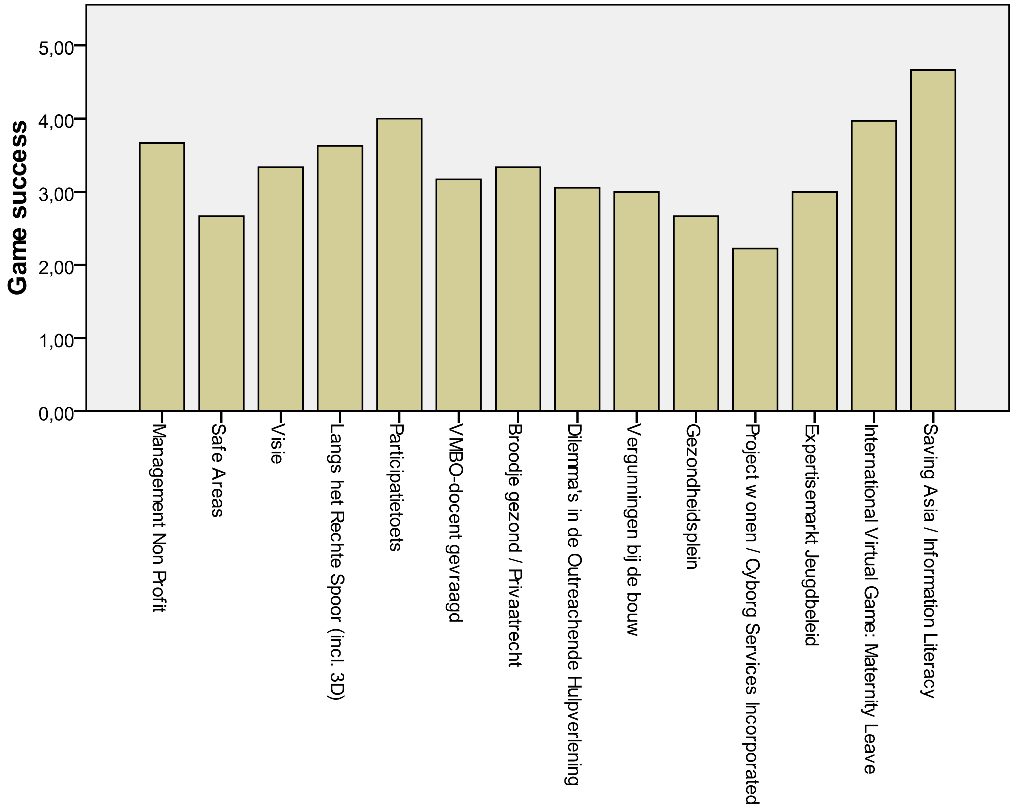

Figure 5.2 – Means of the success factor per game

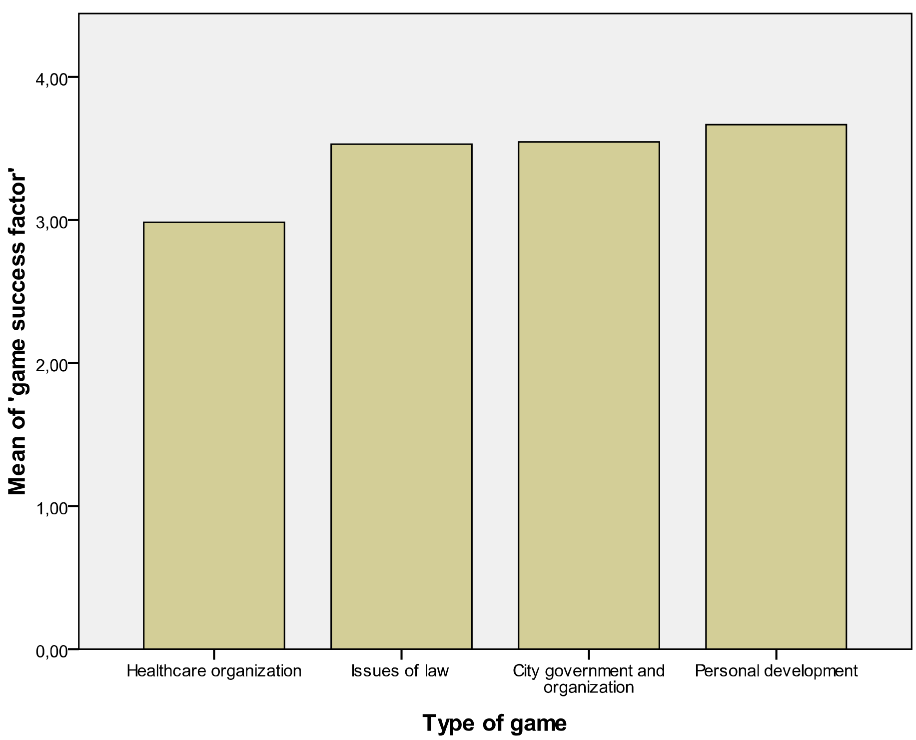

Figure 5.3 – Means of the success factor per game type

5.4 Input variables

5.4.1 The importance of prior experience with games

On average, the respondents of both this project and the KODOS project state that they typically play entertainment board or role-playing games more than a couple of times per year, but less than monthly (n = 476). The respondents of this project (n = 221) state they play slightly more entertainment board or role-playing games than the respondents of the KODOS project (n = 255). The respondents of both projects state that they play computer games more often than board or role-playing games; on average almost monthly. Concerning computer games, there are no differences between the respondents of the KODOS project and this one. Our results indicate that most respondents have played hardly any simulation games in their education or work. On average, respondents have played simulation games slightly less than once or twice. Interestingly, respondents of this project (n = 206) have generally played simulation games slightly more often than the respondents of the previous KODOS project (n = 255).

		Post-game "game success" factor	Post-game "learning effect" factor	Frequency of playing regular games privately	Frequency of playing computer games privately	Participation in simulation games
Post-game "game success" factor	Pearson Correlation	1	.643**	.114*	.076	.059
	Sig. (2-tailed)		.000	.039	.166	.286
	N	411	361	328	332	331
Post-game "learning effect" factor	Pearson Correlation	.643**	1	.025	-.040	.077
	Sig. (2-tailed)	.000		.672	.491	.188
	N	361	392	290	294	294
Frequency of playing regular games in private	Pearson Correlation	.114*	.025	1	.299**	.101*
	Sig. (2-tailed)	.039	.672		.000	.032
	N	328	290	476	476	454
Frequency of playing computer games in private	Pearson Correlation	.076	-.040	.299**	1	-.059
	Sig. (2-tailed)	.166	.491	.000		.211
	N	332	294	476	481	458
Participation in simulation games	Pearson Correlation	.059	.077	.101*	-.059	1
	Sig. (2-tailed)	.286	.188	.032	.211	
	N	331	294	454	458	461

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 5.6 – Correlations between prior experience with entertainment and simulation games and the success factor or the learning factor

According to hypothesis 3, we would expect correlations between statements concerning the frequency of entertainment or simulation games played and statements concerning the simulation game's success. As Table 5.6 shows, there is only a minor correlation with medium significance between the frequency of having played regular games privately, that is entertainment board and role-playing games, and the success factor. There is no correlation whatsoever between frequency of playing computer games or even simulation games and the success factor or the learning effect factor. These results lead us to discredit hypothesis 3. Instead, it seems that prior experiences need not determine a Cyberdam game's success. To test the rigor of this conclusion, we also checked the correlations between game experience and the three individual statements that underlie success factor. The results indicate that there is only a weak but significant correlation between frequency of having played simulation games and finding Cyberdam valuable (0.156; n = 332). This single minor correlation does not warrant confirmation of the third hypothesis.

5.4.2 The importance of prior experience with online learning environments

In the pre-game questionnaire, we posed five statements on the degree of experience with and approval of online learning environments such as WebCT, Blackboard or Moodle. In general, the respondents indicated that they were reasonably comfortable with using online learning environments (mean: 3.82 ± 1.0; n = 522) and that they deemed them to be valuable to education (mean: 4.08 ± 0.922; n = 520). The respondents also indicated that they were somewhat comfortable with trying out new uses and applications for computers (mean: 3.61 ± 0.961; n = 474).

We posed five statements to not only measure general opinions concerning online learning environments, but also to measure the opinions of respondents concerning the specific use of online learning environments, that is whether they could enhance group cooperation or help students work whenever and wherever they want. Together these statements were meant to measure the level of approval of online learning environments in a respondent's education. Factor analysis showed that these statements could indeed be grouped to form a theoretical construct with high reliability, as Cronbach's alpha was 0.821. Thus, we constructed a factor named "online learning environment approval." The mean of this factor is 3.71 ± 0.73 (n = 504), thus indicating that respondents moderately approved online learning environments.

According to hypothesis 4, we can expect correlations between online learning environment approval and both game success and learning effect. As Table 5.7 shows, there is only a minor correlation with medium significance between the online learning environment approval factor and the game success factor. Thus it seems hypothesis 4 cannot be confirmed. To test the rigor of this conclusion, we also checked the correlations between online learning environment approval and the three individual statements that underlie success. Furthermore, we checked whether level of comfort with trying out new uses and applications for computers correlated with online learning environment approval as well as the three individual statements underlying game success. We found a correlation between the level of comfort with trying out new uses and applications and online learning environment approval (0.400; n = 454). Moreover, we found a minor but significant correlation between online learning environment approval and having had fun playing the game (0.210; n = 360). Thus, it would seem that there is a medium chance that respondents who indicate that they enjoy trying out new uses and applications also approve of online learning environments, and vice versa. This mediates the correlation between online learning environment approval and having had fun. These results indicate further that hypothesis 4 can indeed be discredited.

		Post-game "game success" factor	Post-game "learning effect" factor	Pre-game "online learning environment approval" factor
Post-game "game success" factor	Pearson Correlation	1	.643**	.121*
	Sig. (2-tailed)		.000	.029
	N	411	361	323
Post-game "learning effect" factor	Pearson Correlation	.643**	1	.127*
	Sig. (2-tailed)	.000		.023
	N	361	392	316
Pre-game "online learning environment approval" factor	Pearson Correlation	.121*	.127*	1
	Sig. (2-tailed)	.029	.023	
	N	323	316	504

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 5.7 – Correlation between online learning environment approval and game success

5.5 Process variables

5.5.1 The importance of perceived game relevance

In the post-game questionnaire we posed two statements that measured the relevance of the game's objectives and topic to the respondent's course of study. On average the respondents agreed moderately that the topic was relevant (mean: 3.78 ± 0.85; n = 455) and that the objective was relevant (mean: 3.55 ± 0.94; n = 449). Interestingly, five games scored highest on relevance to the game's objective. The law game "Cyborg Services Incorporated - Project Wonen" scored lowest on relevance on the game's objective. Both the law game "Broodje Gezond" (n = 2) and the personal development game "Saving Asia" (n = 2) scored highest on relevance to the game's topic, although in both cases the response was low. The organizations game "Cyborg Services Incorporated - Project Wonen" (n = 2) again scored the lowest on relevance to the game's topic. Overall, the law games scored highest on objective relevance. The organizations games scored lowest on topic relevance, while the personal development games scored lowest on objective relevance. In contrast, the personal development games scored highest on topic relevance. The difference can be explained; in a way the two personal development games "VMBO docent gevraagd" and "Saving Asia" are *indirectly* relevant to the student's education, as can be expected.

According to hypothesis 5, we can expect correlations between perceived game relevance and game success. As Table 5.8 shows, both statements concerning perceived game relevance are correlated. Moreover, there are correlations between both statements concerning perceived game relevance and game success, with a slightly higher correlation between perceived relevance of the game's topic and game success. There are also significant correlations between the two statements of game relevance and the learning effect factor. Thus the data confirms hypothesis 5.

		Post-game "game success" factor	Post-game "learning effect" factor	The objectives of the simulation game are relevant to my course of study	The topic of the simulation game is relevant to my course of study
Post-game "game success" factor	Pearson Correlation	1	.643**	.399**	.413**
	Sig. (2-tailed)		.000	.000	.000
	N	411	361	393	398
Post-game "learning effect" factor	Pearson Correlation	.643**	1	.397**	.387**
	Sig. (2-tailed)	.000		.000	.000
	N	361	392	382	389
The objectives of the simulation game are relevant to my course of study	Pearson Correlation	.399**	.397**	1	.631**
	Sig. (2-tailed)	.000	.000		.000
	N	393	382	449	446
The topic of the simulation game is relevant to my course of study	Pearson Correlation	.413**	.387**	.631**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	398	389	446	455

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.8 – Correlations between perceived game relevance and game success

5.5.2 The importance of perceived game design quality

In the post-game questionnaire we posed six statements that measured the respondent's opinion of the quality of game design. The first was a general statement on game design, that is "The simulation game was built up in an interesting and motivating way." We then posed four statements on the clarity of the design:

1. The objective of the simulation game was clear.
2. The roles we played in the simulation game were understandable and clearly described.
3. The assignments (tasks) in the simulation game were understandable and clearly described.
4. The rules of the game were clear and understandable.

All four statements correlated significantly with one another. This led us to consider analyzing whether these more specific parameters of game design could be grouped into a factor. Indeed, factor analysis allowed us to group these four parameters into one theoretical construct, as Cronbach's alpha was 0.722. We therefore constructed the factor "game concept quality." The game concept quality factor and general game design quality statement correlated significantly (0.329; n = 433). We therefore deem both parameters reliable for determining the respondent's perception of game design quality.

		Post-game "game success" factor	Post-game "learning effect" factor	Post-game "game concept quality" factor	Post-game "quality of virtual environment" factor	Post-game "quality of system functionalities" factor
Post-game "game success" factor	Pearson Correlation	1	.643**	.349**	.347**	.340**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	411	361	400	388	388
Post-game "learning effect" factor	Pearson Correlation	.643**	1	.328**	.285**	.285**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	361	392	389	379	377
Post-game "game concept quality" factor	Pearson Correlation	.349**	.328**	1	.281**	.405**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	400	389	436	417	416
Post-game "quality of virtual environment" factor	Pearson Correlation	.347**	.285**	.281**	1	.405**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	388	379	417	423	416
Post-game "quality of system functionalities" factor	Pearson Correlation	.340**	.285**	.405**	.405**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	388	377	416	416	422

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.9 – Correlations between perceived game concept quality, Cyberdam virtual environment quality, Cyberdam system functionality quality and game success

Analyzing the results of the general game design quality statement and game concept quality factor per game, we conclude that the game "Saving Asia" (n = 2) scored highest on perceived game design quality. The two games "Broodje Gezond" (n = 2) and "Participatietoets" (n = 6) scored second highest. Interestingly, both these games were developed from scratch by a teacher with no previous experience in game design. However, in both cases the teacher asked for help from several colleagues and members of the Cyberdam project team. Collectively the organizational games scored highest on game concept quality, while the personal development games scored highest on the generic measure for game design quality. “Gezondheidsplein” (n = 5) scored lowest on perceived game design quality. From the evaluation report, we conclude that this game’s design was not at a very advanced stage at the time. Collectively the healthcare games scored lowest on perceived game design quality.

According to hypothesis 6, we can expect the perceived game design quality to correlate with game success. Indeed, Table 5.9 shows correlations between game concept and game success as well as the learning effect factor. This correlation confirms hypothesis 6. Moreover, there is a correlation between perceived quality of the Cyberdam functionalities and perceived quality of the game concept. This indicates that for some respondents the Cyberdam functionalities and the game concept depend on each other.

5.5.3 The importance of perceived game-play quality

In the post-game questionnaire, we posed nine statements that measured the student’s perception of game-play quality. First we defined game-play quality as involving both students’ and teachers’ efforts. We posed a number of statements to measure student and student-deemed teacher effort. Factor analysis confirmed that the nine statements about student effort (a respondent’s own effort as well as the other students’ efforts) could be grouped to form a theoretical construct with high reliability, as Cronbach’s alpha was 0.806. We thus constructed the factor “student effort” that measures the effort of the students involved in the game.

“Expertisemarkt Jeugdbeleid” (n = 1) scored highest for student effort. The game with the second highest score was “Participatietoets” (n = 6). Collectively the law games scored highest for student effort. “VMBO docent gevraagd” (n = 4) scored lowest for student effort. Collectively the personal development games scored lowest for student effort, primarily because “Saving Asia” was a single-player game.

The parameters for perceived teacher effort consisted of the following statements:

1. The instructions and explanations provided by the instructors at the start of the simulation game were clear.
2. The simulation game was well-led by the instructor(s).
3. Good feedback was provided during and immediately after the game.

Contrary to the statements on student effort, the statements about perceived teacher effort could not be grouped into a reliable factor. Thus, we use the three statements separately to analyze teacher effort per game.

On the latter two parameters, “Saving Asia” (n = 2) scored highest. On the first measure, “Saving Asia” (n = 2) and “Vergunningen bij de Bouw” (n = 1) scored equally high. On all three parameters, the personal development games scored highest. On the latter two parameters, “Broodje Gezond” (n =2) scored lowest. On the first measure, the game “Gezondheidsplein” (n = 5) scored lowest. On the first two parameters, the healthcare games collectively scored lowest. On the last parameter, the law games collectively scored lowest.

According to hypothesis 7, we can expect student effort and the three parameters of perceived teacher effort to correlate with the factors for game success and learning effect. Tables 5.10 and 5.11 show that these variables indeed correlate significantly, although the clarity of instructions and explanations upfront correlates the least with game success. In Table 5.12, the low yet significant correlations between the different parameters of perceived teacher effort and student effort show that good teacher effort can to a limited extent lead to better student effort, especially if the teacher provides clear instructions and explanations upfront. Combined, these results confirm hypothesis 7.

		Post-game "game success" factor	Post-game "learning effect" factor	Post-game "student effort" factor
Post-game "game success" factor	Pearson Correlation	1	.643**	.384**
	Sig. (2-tailed)		.000	.000
	N	411	361	356
Post-game "learning effect" factor	Pearson Correlation	.643**	1	.425**
	Sig. (2-tailed)	.000		.000
	N	361	392	345
Post-game "student effort" factor	Pearson Correlation	.384**	.425**	1
	Sig. (2-tailed)	.000	.000	
	N	356	345	387

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.10 – Correlations between student effort and the game success or learning factor

		Post-game "game success" factor	Post-game "learning effect" factor	The instructions and explanations provided by the instructors at the start of the simulation game were clear.	The simulation game was well-led by the instructor(s).	Good feedback was provided during and immediately after the game.
Post-game "game success" factor	Pearson Correlation	1	.643**	.252**	.362**	.307**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	411	361	402	400	395
Post-game "learning effect" factor	Pearson Correlation	.643**	1	.247**	.300**	.255**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	361	392	389	388	382
The instructions and explanations provided by the instructors at the start of the simulation game were clear.	Pearson Correlation	.252**	.247**	1	.394**	.245**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	402	389	438	433	425
The simulation game was well-led by the instructor(s).	Pearson Correlation	.362**	.300**	.394**	1	.525**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	400	388	433	457	425

Good feedback was provided during and immediately after the game.	Pearson Correlation	.307**	.255**	.245**	.525**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	395	382	425	425	429

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.11 – Correlations between teacher effort and the game success or learning factor

		Post-game "student effort" factor	The instructions and explanations provided by the instructors at the start of the simulation game were clear.	The simulation game was well-led by the instructor(s).	Good feedback was provided during and immediately after the game.
Post-game "student effort" factor	Pearson Correlation	1	.238**	.194**	.134**
	Sig. (2-tailed)		.000	.000	.009
	N	387	383	383	380
The instructions and explanations provided by the instructors at the start of the simulation game were clear.	Pearson Correlation	.238**	1	.394**	.245**
	Sig. (2-tailed)	.000		.000	.000
	N	383	438	433	425
The simulation game was well-led by the instructor(s).	Pearson Correlation	.194**	.394**	1	.525**
	Sig. (2-tailed)	.000	.000		.000
	N	383	433	457	425
Good feedback was provided during and immediately after the game.	Pearson Correlation	.134**	.245**	.525**	1
	Sig. (2-tailed)	.009	.000	.000	
	N	380	425	425	429

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.12 – Correlations between student effort and teacher effort

5.6 Conclusion

We set out to test seven different hypotheses that together offer insights into how and why the Cyberdam games did or did not work. The hypotheses concerned the impact of certain factors on the effectiveness of the Cyberdam games, which were all played by students as learning experiences in higher education settings. The first hypothesis concerned the effect of fun on learning. Our analysis confirmed this hypothesis. The second hypothesis concerned the effects of Cyberdam quality on learning. Again, we were able to confirm this hypothesis. We discredited both the third hypothesis, which concerned the effects of prior game experiences on learning, and the fourth hypothesis, which concerned the effects of online learning environment approval on learning. We were able to confirm the remaining hypotheses: the fifth concerned the effects of perceived game relevance on learning; the sixth concerned the effects of perceived game design quality on learning; and, finally, the seventh concerned perceived game-play quality on learning.

Game, with score for Learning††	Score for Fun *	Score for Cyberdam †	Score for Relevance ‡	Score for Game design§	Score for Game-play **
"Management Non-profit" 4.00 (n = 1)	3.00	4.00	4.00 4.00	2.00	2.00
"Safe Areas" 2.67 ± 1.30 (n = 12)	2.58 ± 1.08	2.75 ± 1.14	2.75 ± 1.49 2.83 ± 1.40	2.85 ± 1.03	2.71 ± 0.90 3.58 ± 1.38
"Visie" 3.34 ± 1.04 (n = 53)	3.15 ± 1.09	3.50 ± 0.80	3.28 ± 1.03 3.78 ± 0.76	3.16 ± 0.73	3.22 ± 0.64 3.36 ± 1.05
"Spoorzone" 3.85 ± 0.67 (n = 126)	3.63 ± 0.81	3.39 ± 0.93	3.53 ± 0.84 3.72 ± 0.77	3.49 ± 0.59	3.35 ± 0.59 3.74 ± 0.71
"Participatietoets" **4.00 ± 0.63 (n = 6)**	**4.00 ± 0.63**	**4.00 ± 0.0**	3.40 ± 0.89 3.60 ± 0.89	3.42 ± 0.52	**3.74 ± 0.41** **3.83 ± 0.41**
"VMBO-docent gevraagd" 2.75 ± 0.96 (n = 4)	3.50 ± 1.0	3.25 ± 0.96	3.50 ± 1.0 4.00 ± 1.0	2.88 ± 0.66	2.44 ± 0.97 3.50 ± 1.29
"Broodje Gezond "/ "Privaatrecht" 3.00 ± 1.41 (n = 2)	**4.00 ± 0.0**	3.00 ± 1.41	4.00 ± 0.0 **4.50 ± 0.71**	**3.63 ± 0.18**	2.00 ± 1.41
"Dilemma's in de Outreachende Hulpverlening" 2.92 ± 0.90 (n = 12)	3.17 ± 0.94	3.08 ± 1.38	3.91 ± 0.83 4.09 ± 0.30	3.45 ± 0.58	3.13 ± 0.50 2.91 ± 0.70
"Vergunningen bij de Bouw" 3.00 (n = 1)	3.00	3.00	4.00 4.00	2.50	3.33 **4.00**
"Gezondheidsplein" 2.60 ± 1.14 (n = 5)	2.20 ± 0.84	3.20 ± 0.84	3.80 ± 1.30 **4.40 ± 0.55**	1.80 ± 0.48	3.04 ± 0.85 2.60 ± 1.14
"Cyborg Services Incorporated □ Project Wonen" 2.33 ± 1.53 (n = 3)	2.33 ± 0.58	2.00 ± 1.73	2.67 ± 0.58 2.67 ± 1.53	2.33 ± 1.04	3.11 ± 0.48 2.67 ± 1.16
"Expertisemarkt Jeugdbeleid" 3.25 ± 1.50 (n = 4)	3.25 ± 1.50	3.00 ± 1.73	**4.00 ± 0.0** 3.67 ± 0.58	**3.50 ± 0.25**	**3.78** 3.00 ± 2.00
"Maternity Leave" **4.00 ± 0.63 (n = 11)**	3.73 ± 1.19	**4.18 ± 0.87**	**4.00 ± 0.54** 4.00 ± 0.50	3.25 ± 0.89	**3.68 ± 0.52** 3.30 ± 1.16
"Saving Asia" /" Information Literacy" **4.50 ± 0.71** (n = 2)	**4.50 ± 0.71**	**5.0 ± 0.0**	3.00 ± 0.0 **4.50 ± 0.71**	**4.00 ± 0.71**	3.67 **4.50 ± 0.71**

†† Mean ± SD for learning factor and "It improves my learning to work on this simulation game (this role play)."
* Mean ± SD for "I had fun working on this simulation game."
† Mean ± SD for "The use of Cyberdam in education is valuable."
‡ Mean ± SD for "The objectives of the simulation game are relevant to my course of study" and "The topic of the simulation game is relevant to my course of study."
§ Mean ± SD for the game concept quality factor.
** Mean ± SD for student effort factor and "The simulation game was well-led by the instructor(s)."

Table 5.13 – Scores for the five main parameters for each of the confirmed hypotheses per game with the top three scores per parameter set in bold

Given these results, comparing the main parameters of the confirmed hypotheses reveals why some Cyberdam games worked, and others did not. In Table 5.13 we compare each game in this manner. The table shows that the most effective games scored highest on at least three of the five main parameters. Interestingly, it also shows that games that scored low on learning sometimes scored highly on relevance or game play. Thus even the less effective games had positive characteristics. All in all, this structured evaluation of the Cyberdam simulation games allowed us to extensively test prevalent theories of simulation game design and application in the educational setting. More importantly, it allowed us to uncover the most important factors a designer and applier of simulation games in higher education must consider to ensure the effectiveness of the game.

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