

# Games for Learning and Learning from Games

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This paper details a model of game-based learning and suggests how this can be applied to both the playing of computer games and learning within the classroom environment. The authors document the results from a University level course, created in a role-playing form for designing educational games and highlights the student's attitudes and beliefs regarding game design as a career. They also suggest that educational games can be used successfully for the transfer of knowledge to domains outside the world of computer games and highlights several case studies in the area of health and medicine.

**Key words:** game-based learning, recursive learning loops, games for learning

## Igre za učenje in učenje iz iger

V prispevku je predstavljen model učenja na osnovi iger in možnosti uporabe modela v različnih okoljih: pri igranju iger kakor tudi pri uporabi iger za učenje v razredu. Opisane so izkušnje in rezultati tečaja na univerzitetni ravni, ki je bil zasnovan kot role-play igra, ter mnenja študentov o poklicni karieri na področju koncepcije iger za učenje. Znanje, pridobljeno s pomočjo iger za učenje, je moč uspešno uporabljati in prenesti v različne domene izven računalniških iger, kar je prikazano na primerih in študijah iz zdravstva.

**Ključne besede:** učenje na osnovi iger, rekurzivne zanke učenja, igre za učenje

## 1 Background and Introduction to Game-Based Learning

Over last few years an emerging trend been observed towards games in the area of e-learning. From early isolated reports on conferences and books reflecting on possible application of digital games for learning purposes (Gee, 2003), more and more practitioners and researchers have embraced the idea, including the e-learning community. In 2006 one of the biggest European e-learning conferences, Online Educa in Berlin, introduced a special game track. The two day session hosted an open discussion between academics, teachers and industry practitioners, focusing on the potential of game-based learning in Universities and lifelong learning institutions as well as possible software solutions.

The discussions are primarily focused on the Pros and Cons of applying games for learning and trying to find answers to questions like *Why don't we use games more often in classrooms?* Often, the difficulty of finding games that cover the curricular topics is pointed at, as well as the low tolerance of that environment towards games, where

they are often perceived as an unserious activity, with some lecturers fearing that the learning objectives wouldn't be reached. Others might encounter difficulties with the technical resources that schools are lacking. Another important factor is the quality of the games intended for learning, where games should have an explicit learning purpose and can be used, adapted and adopted for supporting, improving and fostering the learning processes (SIG-GLUE).

Kasvi (2000) lists the seven requirements, suggested by Norman (1993), for an effective learning environment as:

1. Providing a high intensity of interaction and feedback;
2. Having specific goals and established procedures;
3. Be motivational;
4. Provide a continual feeling of challenge - not being so difficult as to be frustrating or so easy as to create boredom;
5. Providing a sense of direct engagement with the task involved;
6. Providing the appropriate tools that fit the task; and

7. Avoiding distractions and disruptions that destroy the subjective experience.

Kasvi (2000) suggests that computer games fulfil all of these requirements and believes that they “satisfy them better than most other learning mediums” (p.6). However, it is very difficult to find a game that includes a learning curriculum that is appropriate for different schooling levels. Popular games such as ‘Maths Blaster’ from Vivendi Universal, has captivated children but only targets ages 8 to 9 years. Even if the game were upgraded to include a higher level of mathematics, it would be doubtful if today’s 14 year old students would play this type of game. But take a constructivists point of view and ask that same student to design an educational game, the response would be quite different, as described in chapter 3.

Today’s students are captivated by computer and console video games. Humans have always used games of all types for learning - from playing with blocks for counting skills through to flight simulators for more specialised skills (Pivec, 2006). Although the skills involved when playing games differ dramatically from those needed to create one, players exhibit the same addictive nature seen in a person who is driven to succeed. A computer game can take anywhere between 3 months and 3 years to create. From the initial concept, design, coding, testing and error correction through to the artwork, music, packaging, promotion and distribution, developers must stay focused and committed to the project throughout this entire time, often doing tedious tasks but always learning new and innovative techniques for their craft. These people are usually young adults and have also been avid game players themselves. They learn in a different way from the earlier generations and are often motivated by instant feedback and rewards for success.

Game-based learning can be applied as an additional option to classroom lecturing. The intention of game-based learning is to address new methods of ICT based instructional design while at the same time providing learners with the possibility of acquiring skills and competencies later required in the business world. By means of digital games, and digital educational games especially, learners should be able to apply factual knowledge, learn on demand, gain experiences in the virtual world that can later shape their behavioural patterns and directly influence their reflection, etc.

## 2 Recursive Loops of Game-Based Learning

Based on the example of an educational adventure game, let us consider how and when learning occurs when learners interact - e.g. playing a game. The main characteristic of an educational game is that the instructional content is blurred by game characteristics. The game should be motivating, so that the learner repeats cycles within a game context. While repeating e.g. playing a game, the learner is expected to elicit desirable behaviours based on emotio-

nal or cognitive reactions resulting from interaction with and feedback from the game play.

The purpose of an adventure game is entertainment or edutainment. In adventure games, there are very complex environments - i.e. microworlds - with no deterministic problem representation. An example of a typical edutainment game is Chemicus (by publisher Heureka-Klett; or TIVOLA for the US market), a puzzle-adventure game for the self-directed learning of chemistry. Similar to Chemicus, one can find an entire series of titles e.g. Physicus, Hystorion, Informaticus, etc. from the same publishers and built upon the same game concept.

Adventure games use the intrinsic motivation of the player to explore the game world. Intrinsically motivating games incorporate learning activities in this game world. To increase the immersion of the player, the game offers an extensive story at the start, often related to some murder or mystery. The game characters have to solve the mystery by solving a number of interrelated problems. In each case, the problems are part of the game and the players are motivated to seek the knowledge to provide a solution in order to continue. In this game, enjoyment is strongly related to the learning activity, which can be viewed as a desirable outcome.

Commercial computer games are known for creating social environments and cult followings surrounding the gameplay, character attributes and the player’s abilities, and this is where affective learning occurs (Kearney and Pivec, 2007). Garris et al., (2002) describes affective learning as containing “feelings of confidence, self-efficacy, attitudes, preferences and dispositions” (p.457). Skills-based learning appears to comfortably fit within the micro game cycle (*figure 1*), or the levels within the game. For example, Rosser et al. (2007) found that playing commercial action games improved the surgical skills of laparoscopic physicians and decreased their error rate. There was no documented debriefing session for Rosser’s study and it is assumed that the development of technical or motor skills occurs within the game itself.

Figure 1 also shows how player ability and experience affects the challenge element and the level of learning (the Zone of Proximal Development), and how the level of cognitive challenge can be appropriate for the learner’s current abilities. The model shows the inclusion of instructional design and game characteristics as critical elements of a game, enabling the achievement of the learning outcomes, as well as the additional factor of player ability. Defining learning as the acquisition of knowledge or skills suggests that Game-Based Learning is the vehicle that fosters the acquisition of the learning outcomes. The model includes a time element to allow the player to progress through the game, increasing their knowledge and acquiring new levels of ability. This suggests that knowledge - declarative, procedural and strategic - is acquired over time and that abilities or skills are incremented through experience.

This model can also be applied to role-play within the classroom. As the student’s abilities are supplemented (through tuition or guided instruction), their knowledge

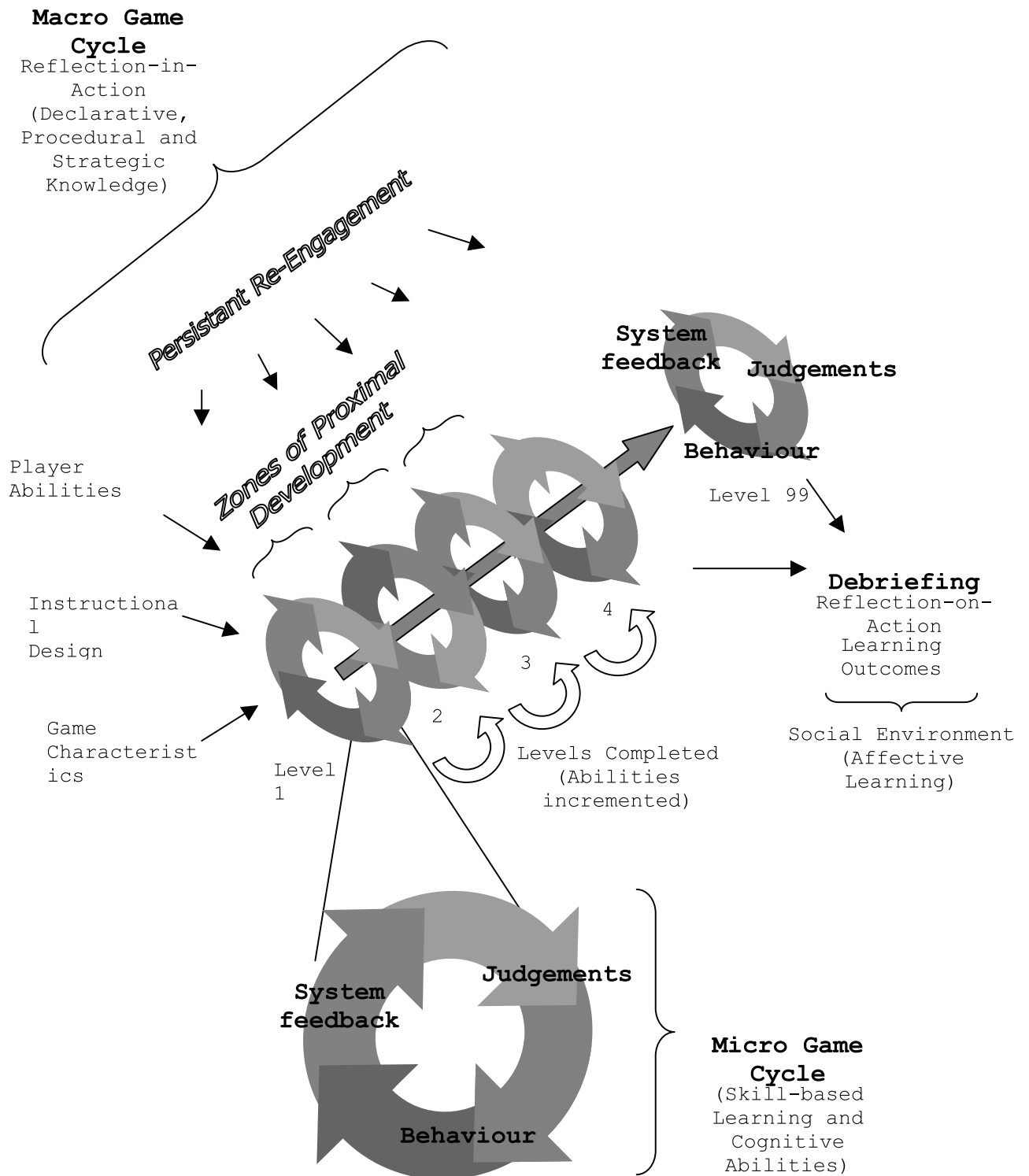


Figure 1: The Recursive loops of Game-Based Learning (Kearney & Pivec, 2007).

and skill level is incremented and they move to the next level or next phase of the project. The role-play course on game design detailed in the next chapter was structured in such a way that the students added to their game design concept as their knowledge and skill increased.

### 3 A Game About Game Design: Role-Play in the Classroom

This chapter documents an educational game design course created by the authors and taught to 75 information design students at the University of Applied Sciences of Joanneum in Austria, where we wanted to introduce this topic to the new generation of potential game designers and make them aware of this new discipline and its specifics. The challenge for students was to create a concept proposal for a publisher of educational games. Based on the course work and results, we analysed how the students perceived the area of educational games for teaching and as a career path.

The class was a role-play game itself i.e. a game about designing a game, where students had to work in teams to create a game design company and take a specific role and responsibilities within the team - e.g. game producer, game developer, programmer, etc. - to contribute to the task accomplishment. The progress of the work and the problems they encountered were documented in the company blogs (as an example, see <http://legalaliengames.blogspot.com/>, the blog of "the best in the show" group)

The course covered topics including the process of commercial game design, taking into consideration the pedagogical design required to achieve the desired learning outcomes. When we design games for learning, both the target audience and the learning outcomes have to be considered in the initial conception of the game. In this way, teachers can easily recognise the value of this resource and the possibilities of including such games in the curriculum. Aspects of educational game design are tackled more in detail in (Pivec, Koubek & Dondi, 2004).

The game concepts range in excellence in areas from the innovative use of technology to their possible market

potential. The class finished with the presentation of the Golden Pineapple awards for concepts (Golden Pineapple Award, 2006). Two of the awarded concepts were focused on medical content (*Figure 2*). Anaphylactic from DUDARY Entertainment is a real time strategy game introducing the principles of the immune system of the human body. Keep Me Alive from Stardust Enterprises is an ICQ game focusing on various infectious diseases and how to prevent and treat them. It also has the potential to include real pharmaceutical products as well as relevant medical advice.

The students were surveyed both before and after completing the course, both on their opinion on games in general and regarding the potential of application of games for learning. We also inquired into the motivational momentum of designing a game in terms - if they were more motivated and achieved better learning results. Based on this survey, we also wanted to assess if they saw educational game development as a possible career path.

On the post survey, 66% of the students agreed that designing educational games was a highly motivational topic and suggested that they now felt competent enough to write a professional educational game concept document. They also agreed that designing educational games could provide future career opportunities, though only 35% of them would consider this for their own career. The majority of the students found the course to be successful, with 70% of the students enjoying the topic despite not considering themselves to be game players. Those who did play computer games, only did so for recreation and had not involved games in any of their schooling. However, upon completion of the course, 60% of the students suggested a preference for using games to learn.

### 4 The Application of Game-Based Learning

With the intention of outlining the potentials of applying games in the area of medicine (as a serious discipline in contrast to the computer games that are often seen simply as a leisure activity or even as a waste of time), some



Figure 2: Student Designs

known and documented cases of the application of game-based learning targeting various user groups are presented. The cases vary from an educational game created for interdisciplinary learning to context based environments supporting the application of specific knowledge for medical and veterinarian students and the application of commercial-off-the-shelf games (cots) to improve the laparoscopic performance, embedded in the curricula.

Suzanne de Castell and Jennifer Jenson from Canada created *Contagion*, a role-playing adventure game fostering interdisciplinary learning and targeted at children aged 10-15 (de Castell and Jenson, 2006). The game is based on traditional school subjects and related fields such as technology, biology and medical sciences, as well as human and social sciences. The goal of the game is twofold. On one hand, the game should introduce health related topics and educate players through “serious play” about diseases such as Severe Acute Respiratory Syndrome (SARS), West Nile Virus (WNV), Avian Flu and Acquired Immune Deficiency Syndrome (AIDS), as well as possible preventive behaviours. On the other hand, the game also provides a career preparation environment; where players can learn about and role-play various occupations of interest e.g. community health officer, physician or medical researcher. The player entering the game world chooses one of these roles, which effects the development of the game play and the point of view on the situation throughout the game. In the game, the player is confronted with the situation of a medical and humanitarian crisis and acts out the situation differently based on the respective role. The majority of the learning is based on active exploration.

At the University of Edinburgh, students interact with virtual patients from their first year of study through to completion. The virtual patients are related to various curricular topics enlivened with narrative elements, thus creating a realistic context (Begg et al., 2006). Each student interacts with the same virtual patients - e.g. George - several times throughout their study. His condition gets more complicated as they progress in their studies. The aim of George is to provide an opportunity to apply concepts learned in isolation - e.g. the social and cultural factors of health and communication skills. By interacting with these virtual patients, students are role playing as a “doctor” until the end of their education, when they actually become doctors. *Labyrinth* is a similar application based on the virtual patients and realistic scenarios that were created for the College of Medicine and Veterinary Medicine’s Learning Technology Section at the University of Edinburgh. The scenarios are focused on decision-making, i.e. the students’ decisions and courses of action influence further development of the scenario. At the start, the student is placed in the role of being in charge of an admissions unit at the start of the night shift. The student is confronted with a situation based on a short descriptive text and asked what to do next. They are offered a set of choices, some of which are more appropriate than others. Based on the development of the scenario, they get feedback on their reflection and choices made. With

technology - i.e. virtual scenarios - one has the advantage of being able to restart the session and repeatedly try out “what if” reflections.

Newly published research suggests that video games may be a teaching tool for training laparoscopic skills (Rosser et al., 2007). The study involved thirty three male and female surgeons with various specialities and was centred at the Rosser Top Gun Laparoscopic Skills and Suturing Program, where the goal is to build skill sets that enable surgeons to function effectively in the video-endoscopic surgical environment. One part of the study included playing three cots video games. At the end of the study the results of laparoscopic performance were grouped in categories based on gaming experience - i.e. past players and current players - and demonstrated skills in the games as a part of the study before comparing them to the laparoscopic results of the non-players. The published results showed that current video game players made 32% fewer errors ( $P=0.04$ ), performed 24% faster ( $P=0.04$ ) and scored 26% better overall (time and errors) ( $P=0.005$ ) compared with their non-paying colleagues (Rosser et al., 2007). Based on the research carried out, Rosser argues that video games “may help reduce the technical interface between surgeons and screen-mediated applications”, thus contributing to improved performance in laparoscopic surgery in terms of faster completion and fewer errors.

## 5 Conclusions

In many cases, the application of serious games and simulations for learning purposes provides an opportunity for learners to apply acquired knowledge and to experiment and get feedback in form of consequences, thus getting experiences in a “safe virtual world”. There are specific educational domains where game-based learning concepts and approaches have a high learning value. These domains are interdisciplinary topics where skills such as critical thinking, group communication, debate and decision making are of high importance. Such subjects, if learned in isolation, often cannot be applied in real-world contexts.

Games can provide the motivation to learn, increasing the likelihood that the desired learning outcomes will be achieved. Learning is defined as the acquisition of knowledge or skills through experience or practice, and what better way to learn than through a game.

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