International Conference on Computational Intelligence and Emerging Technologies (ICCINET-25)
978-93-344-3140-7

An Exploration of Game-Based Learning and Incidental Learning

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Abstract: *This paper describes a model of game-based learning and makes recommendations about how it can be used for both computer gaming and classroom instruction. The authors highlight students' attitudes and beliefs regarding game design as a career and document the outcomes of a university-level course that was developed as a role-play for creating educational games. They highlight a number of case studies in the fields of health and medicine and imply that educational games can be effectively used to transfer knowledge to fields outside of computer games. This study outlines a game-based learning model and offers suggestions for its application in both computer gaming and classroom education. The authors document the results of a university-level course that was created as a role-play for making educational games and highlight students' attitudes and beliefs regarding game design as a career. In addition to highlighting several case studies in the medical and health domains, they suggest that educational games can be a useful tool for knowledge transfer to domains other than computer games.*

Keywords: learning through games, recursive learning loops, and learning games

1 Overview and introduction to learning through games.

In recent years, a burgeoning trend of games within the realm of e-learning has been noted. Initially, isolated reports on conferences and literature discussing the potential use of digital games for education (Gee, 2003) garnered attention, leading to increasing acceptance among practitioners and researchers, particularly within the e-learning community. In 2006, the prominent European e-learning conference, Online Educa in Berlin, launched a dedicated game track. The two-day session facilitated an open dialogue among academics, educators, and industry professionals, concentrating on the potential of game-based learning in universities and lifelong learning institutions, as well as prospective software solutions.[1]

The discussions primarily concentrate on the advantages and disadvantages of utilizing games for educational purposes, seeking to address the question of why games are not more frequently employed in classrooms. There is frequently an emphasis on the

challenges of locating games that align with curricular topics, the limited acceptance of games within educational settings where they are often regarded as frivolous activities, concerns among some educators regarding the achievement of learning objectives, and potential obstacles related to the lack of technical resources in schools. An additional crucial factor is the quality of educational games, which should possess a clear learning objective and be suitable for use, adaptation, and adoption to enhance and facilitate learning processes (SIG-GLUE).

Kasvi (2000) enumerates the seven criteria proposed by Norman (1993) for an effective learning environment as follows:

1. Ensure a high level of engagement and feedback;
2. Establish clear objectives and defined protocols;
3. Inspire enthusiasm;
4. Ensure a consistent sense of challenge, avoiding extremes of frustration or boredom;
5. Facilitate direct engagement with the task;
6. Supply suitable tools for the task; and
7. Eliminate distractions and disruptions that undermine the subjective experience.

According to Kasvi (2000), computer games "satisfy them better than most other learning mediums" (p.6) and appear to meet all of these criteria. Finding a game with a learning curriculum suitable for various educational levels is extremely challenging, though. Though they only appeal to children aged 8 to 9, well-known games like Vivendi Universal's "Maths Blaster" have captured children's attention. It is unlikely that today's 14-year-old student would play this kind of game, even if it were updated to include a higher level of mathematics.[2][3] However, if you ask the same student to create an educational game from a constructivist perspective, the response will be very different, as section 3 explains.

Video games on computers and consoles have captured the attention of today's students. Humans have always utilized games of all kinds to learn; for example, they have used flight simulators to practice more specialized skills and blocks to practice counting (Pivec, 2006).

Players display the same addictive traits as someone who is motivated to succeed as those required to create one The time required to develop a computer game can range from three months to three years. Developers must remain dedicated to the project throughout the entire process, often performing tedious tasks while constantly learning new and creative ways to do their craft. This includes the original concept, design, coding, testing, and error correction, as well as the artwork, music, packaging, promotion, and distribution.[3] These individuals are typically young adults who have played video games extensively. They learn differently than previous generations, and they are frequently inspired by success and immediate feedback.

Learning through games can be used as an adjunct to lectures in the classroom. In addition to addressing new approaches to ICT-based instructional design, game-based learning aims to give students the chance to develop the skills and competencies that will eventually be needed in the business world. Learners should be able to apply factual knowledge, learn on demand, and gain experiences in the virtual world through digital games, particularly educational ones, which can directly affect their reflection and later shape their behavioural patterns. Students should be able to apply factual knowledge, learn on demand, and gain experiences in the virtual world through digital games, particularly educational ones, which can directly affect their reflection and later shape their behavioural patterns.[4]

2 Game-Based Learning Recursive Loops.

Using an educational adventure game as an example, let's examine how and when learning happens when students engage with one another, such as while playing a game. The primary attribute of an educational game is the blurring of game features with instructional content. To encourage the learner to repeat cycles within a game context, the game should be engaging. It is anticipated that the learner will elicit desired behaviors during repetition, such as playing a game, based on emotional or cognitive reactions that arise from interaction with and feedback from game play.

Edutainment, or entertainment, is the goal of adventure games. Microworlds are extremely complex environments found in adventure games that do not represent deterministic problems. Chemicus (published by Heureka-Klett; or TIVOLA in the US market) is a puzzle-adventure game for independent chemistry learning that is an example of a typical edutainment game. Physicus, Hystorion, Informaticus, and other titles from the same publishers are all based on the same game concept, much like Chemicus.[5][6]

Adventure games rely on the player's natural desire to explore the game world. Learning activities are incorporated into the game world of intrinsically motivating games. The game starts with a lengthy story, usually involving a murder or mystery, to help the player become more immersed. Characters in the game must solve a series of connected puzzles in order to unravel the mystery.

In each case, the problems are part of the game itself, and players are urged to figure out how to fix them so they can continue to play. Enjoyment is closely related to the educational task in the game as it is described, which could be regarded as a desired outcome.

According to Kearney and Pivec (2007), affective learning takes place in the social environments and cult followings that are created by commercial computer games around the gameplay, character traits, and player abilities. As stated by Garris et al. (2002), "feelings of confidence, self-efficacy, attitudes, preferences, and dispositions" are all part of affective learning (p. 457). The micro game cycle (figure 1) or game levels seem to be a good fit for skill-based learning. For example, Rosser et al. (2007) discovered that playing commercial action games enhanced laparoscopic doctors' surgical abilities and reduced their rate of mistakes. Since Rosser's study lacked a recorded debriefing session, it is presumed that the game itself is where technical or motor skill development takes place.[6]

Figure 1 also demonstrates how player skill and experience impact the challenge component and learning level (Zone of Proximal Development), as well as how the degree of cognitive difficulty can be suitable for the learner's present skill level. The model demonstrates how instructional design and game features are essential components of a game that facilitate the attainment of learning objectives. Additionally, player abilities are taken into consideration. The definition of learning as the process of gaining new information or abilities implies that game-based learning is the means by which learning objectives are acquired. To enable the player to advance through the game, expanding their knowledge and learning new skills, the model incorporates a time component.

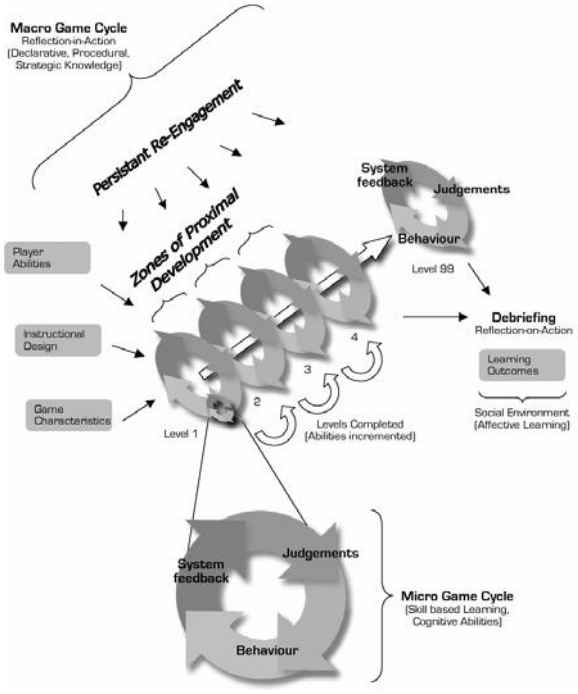

Figure 1: Recursive loops of Game-Based Learning (Kearney & Pivec, 2007).

This implies that abilities or skills are developed via experience, and declarative, procedural, and strategic knowledge is gained over time.[7]

It is also possible to use this model for role-playing in the classroom. Students advance to the next level, or the next stage of the project, as their knowledge and skill level increase as a result of tuition or guided instruction. The next section describes a role-playing course on game design that was scaffolded so that students could add to their game design concept as their knowledge and proficiency grew.

3 Role-playing in the classroom is a game about game design.

We wanted to introduce this topic to the next generation of potential game designers and make them aware of this new discipline along with its specifics, so we created an educational game design course that was taught to 75 information design students at the University of Applied Sciences Joanneum in Austria. This section details the course that the authors created. Students were given the task of coming up with a concept proposal for an educational game publisher. We examined how students viewed the field of educational games for use in instruction and as a career path based on the course work and results.

Students had to work in groups, establish a game design company, and assume specific roles and responsibilities within the team—such as game producer, game developer, programmer, etc.[8][9]—in order to contribute to the task completion. The class was a role-play, or game about designing a game. The work's progress and the issues they encountered were recorded on the company blogs (for instance, the blog of "the best in show" group at http://legalaliengames.blogspot.com/).

The process of designing commercial games while taking into account the pedagogical design necessary to attain the intended learning outcomes was one of the topics covered in the course. The target audience and the learning objectives must be taken into account from the very beginning when creating educational games. Teachers will be able to recognize the resource's worth and the potential for incorporating these games into the curriculum with ease. More information on various facets of educational game design can be found in (Pivec, Koubek & Dondi, 2004).

Figure 2: Student Designs

From the creative use of technology to their potential market potential, the game concepts vary in quality. The presentation of the Golden Pineapple Award-winning concepts (Golden Pineapple Award, 2006) concluded the class. Two of the concepts that were awarded had a medical theme (Figure 2 & 3).[10] Dudary Entertainment's real-time strategy game Anaphylactic teaches the fundamentals of the human immune system. The ICQ game Keep Me Alive from Stardust Enterprises focuses on different infectious diseases and how to treat and prevent them. Along with pertinent medical advice, it may also contain actual pharmaceutical products.

Students' opinions about games in general and the potential for using games for learning were surveyed both before and after the course ended. In order to determine whether they were more motivated and produced better learning outcomes, we also asked about the motivational momentum of game design. We also aimed to determine whether they considered educational game development as a potential career path based on the results of this survey.

Figure 3: Student Designs

According to the post-survey, 66% of the students said they now felt competent enough to write a professional educational game concept document and agreed that creating educational games was a highly motivating topic. Only 35% of them would think about this for their own careers, despite the fact that they agreed that creating educational gems could lead to future employment opportunities. Even though 70% of the students did not consider themselves game players, they still thought the course was successful. Those who did play computer games did so purely for fun and had no connection to their academic studies. At the end of the course, though, 60% of the students indicated that they preferred learning through games.

4 Using game-based learning.

In an effort to highlight the potential uses of games in the field of medicine (as a serious discipline as opposed to computer games, which are frequently viewed as merely a pastime or even a waste of time),

A few well-known and recorded instances of game-based learning being used to target different user groups are shown. Examples range from educational games designed for interdisciplinary learning to context-based settings that help medical and veterinary students apply discrete knowledge, as well as the use of commercial off-the-shelf games (cots) to enhance laparoscopic performance that are incorporated into the curricula.[11]

Canadians Suzanne de Castell and Jennifer Jenson developed the role-playing adventure game Contagion, which is aimed at kids between the ages of 10 and 15 and promotes interdisciplinary learning (de Castell and Jenson, 2006). Traditional school subjects as well as related fields like technology, biology, and medical sciences, as well as human and social sciences, are the basis for the game. The game has two objectives.

On the one hand, the game ought to discuss health-related subjects and teach players through "serious play" about illnesses like AIDS, West Nile Virus, Avian Flu, and severe acute respiratory syndrome (SARS), as well as potential preventive measures. The game, however, also offers a career preparation environment where players can learn about and role-play different occupations of interest, such as medical researcher, doctor, or community health officer. Upon entering the game world, the player selects one of these roles, which influences how the game progresses and how they perceive the situation throughout the game. A medical and humanitarian crisis is presented to the player in the game, and depending on their role, they act out the scenario in a different way. Active exploration forms the basis for most of the learning.

From their first year of study until they graduate, students at the University of Edinburgh engage with virtual patients. In order to create a realistic context, the virtual patients are connected to a variety of curriculum topics that are blurred with narrative elements (Begg et al., 2006). Throughout their studies, each student engages with the same virtual patients—for example, George—multiple times. As they advance in their studies, his condition becomes more complex. George aims to give students the chance to apply concepts they have learned in isolation, such as communication skills and social and cultural aspects of health.[12]

Through their interactions with these virtual patients, students are rehearsing "to be a doctor" until they graduate and become medical professionals. A comparable application called Labyrinth was developed for the University of Edinburgh's College of Medicine and Veterinary Medicine's Learning Technology Section. It is based on realistic scenarios and virtual patients. The scenarios are centered around decision-making, meaning that the choices and actions made by the students impact how the scenario develops further. When the night shift begins, the student is initially assigned to oversee an admissions unit. After reading a brief description of the situation, the student is presented with it and asked what to do next. Students practice "to be a doctor" until they graduate and enter the medical field by interacting with these virtual patients. For the Learning Technology Section of the College of Medicine and Veterinary Medicine at the University of Edinburgh, a similar application named Labyrinth was created. It is predicated on virtual patients and realistic scenarios. Because the scenarios revolve around decision-making, the students'

decisions and actions have an effect on how the scenario plays out. The student is first tasked with managing an admissions unit when the night shift starts. The student is given the scenario and asked what to do next after reading a brief explanation of it.

A variety of options are presented to them, some of which are more suitable than others. Considering the evolution of the scenario, they receive input on their decisions and reflections. One benefit of technology, such as virtual scenarios, is that it allows you to restart the session and try out the "what if" reflections more than once.

According to recently released research, video games could be used as a teaching tool to help students practice laparoscopic techniques (Rosser et al., 2007). The study, which focused on the Rosser Top Gun Laparoscopic Skills and Suturing Program, which aims to develop skill sets that allow surgeons to operate efficiently in the video-endoscopic surgical environment, involved thirty- three male and female surgeons from a variety of specialties. Playing the video game Three Cots was one aspect of the study. At the conclusion of the study, the laparoscopic performance results were categorized and compared to the laparoscopic results of non-players based on the gaming experience, i.e., past and present players and demonstrated skills in the study's games.

Compared to their colleagues who did not pay, current video game players made 32% fewer mistakes (P=0.04), performed 24% faster (P=0.04), and scored 26% higher overall (time and errors) (P=0.005), according to the published results (Rosser et al., 2007). Rosser contends that video games "may help thin the technical interface between surgeons and screen-mediated applications," which would improve laparoscopic surgery performance in terms of quicker completion and fewer errors, based on the conducted research.

5 Conclusions.

When serious games and simulations are used for educational purposes, they frequently give students the chance to apply what they have learned, try new things, and receive feedback in the form of consequences—all while experiencing a "safe virtual world." Concepts and methods of game-based learning have a high learning value in certain educational domains. These fields are multidisciplinary and heavily rely on abilities like debate, group communication, critical thinking, and decision- making. When learned in isolation, these subjects are frequently inapplicable in real-world situations.

Games have the power to inspire learning, which raises the possibility that the intended learning objectives will be met. Learning is the process of gaining knowledge or skills via practice or experience, and there's no better way to learn than by playing a game.

Acknowledgments.

The students of Maharshi Karve Model College for Women's Department of Computer Science and the Group of Institutions of the Navsahyadri Education Society are greatly appreciated for their work during the courses and for their willingness to participate in the pre and post surveys.

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