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► **To cite this version:**

Arminda Guerra Lopes, Maria Joao Lopes. Human-Computer Interaction – Game-Based Learning. 5th IFIP Working Conference on Human Work Interaction Design (HWID), Aug 2018, Espoo, Finland. pp.140-157, 10.1007/978-3-030-05297-3_10 . hal-02264620

HAL Id: hal-02264620

<https://inria.hal.science/hal-02264620v1>

Submitted on 7 Aug 2019

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Human-Computer Interaction – Game-based Learning

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Abstract. Throughout the past few decades, the use of technology has far exceeded the expectations of all of us. Different users with different profiles and expertise are using technology to help them on daily life tasks. In particular, 21st Century students have grown up using different technology from that which their professors grew up with. The World Wide Web has had a significant effect on the way they think and learn. Against this backdrop, the paper seeks to, through the use of a case study based on polytechnic students learning human-computer interaction fields and their absence of motivation to learn the subject, suggests a game environment to learn; a questionnaire was designed to get student's opinions about learning through games. The results expression proposed the necessity to change the teaching/learning traditional approach.

Keywords: human computer interaction; teaching, learning, games

1 Introduction

The challenges surrounding modern technologies influence every aspect of society, and life worldwide and the way the human interacts. The results of this technology rising use impacts the way the world evolves. Conversely, young people learn to use technological devices sooner in their lives. Summing their experiences with technologies it leads to a normal and natural way to start playing games as an entertainment approach.

The use of games have support people cultivate a mood towards collaboration, problem-solving, communication, experimentation, and exploration of identities, all attributes that promote success in a rapidly-changing, information-based culture [1]. Research into the cognitive and socio-cultural aspects of gaming has exploded in the last decade as people have begun to realize the potential for game-based learning [2], [3].

Since the early 2000s simulation games have gradually become professionalized

[4]. The potential of video games as vectors for learning was recognized from their beginning. Nowadays, there is substantial interest in serious games for formal education, professional training, healthcare, advertising, public policy and social change.

Playing is by its very nature educational. And it should be pleasurable. When the fun goes out of play, most often so does the learning [5]. There is also evidence that games allow students to focus well enough to learn better [6].

This paper presents a summary research concerning the state-of-the-art about the importance of games in teaching/learning process. Departing from a questionnaire answered by students who learn human-computer interaction (HCI) subjects at a polytechnic institution, we concluded that traditional ways of teaching/learning could be changed following a game approach. Students did some suggestions about the way they will like to play a game to learn HCI.

2 Background

Online games have a great impact on undergraduate students. Games have a great potential for students to learn. Some games aim to increase content knowledge by letting the players live the scenario. Games seem to be particularly successful in helping people develop problem-solving and decision-making skills and encouraging innovation [3].

Games are often classified into genres, which means to define games in terms of having a common style or set of characteristics (perspectives, gameplay, interaction, objective, among others):

- Real-time strategy (RTS) games defined a number of goals around resource collection, base and unit construction and engagement in combat with other players.
- Role playing games (RPGs) are characterized in terms of providing the player with flexibility in terms of character development and problem resolution.
- Multiplayer online role-playing games (MMRPGs) normally present a persistent virtual world populated by thousands of other players.
- Racing games place the player behind the wheel and involve competing in a race against other drivers.
- Sports games which are games that simulate the sporting experience – including sports such as football, baseball, golf, boxing, skate boarding, tennis, etc.
- Educational games are designed to teach new skills, which can span from pre-school onwards.

This section presents a summary description of games' example that students are used to play, according to the results of the questionnaires from our research. A reference to serious games and those who apply them for learning is also presented.

2.1 The Games Students Play

The games to be described are: Ages of Empires, League of Legends, Minecraft, HearthStone and Sports games. These games have inspired the researcher, either to study them, or for research-based development and for solving problems.

Ages of Empires – Defined as a Real Time Strategy game, first released in 1997, developed by Ensemble Studios and published by Microsoft Studios. Since then, four series and other spin-off's have been released with great success. This game features real historical events in Europe, Asia and Africa, between the Stone Age and the Classical Period.

The games are demarcated by several goals around resource collection, base and unit construction and engagement in combat with other players or computer opponents who also share similar goals. Emphasis is often placed upon managing logistics, resources and production.

Age of Empires (1997) – This is described as a combination between the games *Civilization* and *Warcraft*. This first sequence, allows the player to choose twelve civilizations from the Stone Age to the Iron Age.

Age of Empires II: The Age of Kings (1999) – Increased the civilization selection to thirteen and is now set in the Middle Ages, specifically from the Dark Ages to the Imperial Age.

Age of Empires III (2005) – Set in the period between 1421-1850, with the introduction of new game mechanics, “home-cities” which helped provide the players with further resources, troops, upgrades, among other.

Age of Empires IV (no release date) – Developed by Relic Entertainment, after twelve years of hibernation, this fourth sequence is expected to collect the historical features from the previous games in a different graphic aesthetic [7].

League of Legends - League of Legends is a multiplayer online battle arena (MOBA) game developed by Riot Games [8] where players participate in teams of five versus five where the goal is to destroy the opposing team's nexus, which will ensure the victory. Each player assumes the role of one of over 120 different characters battling each other to destroy the opposing team's “towers”—structures that fall after suffering enough attacks from characters. The 120 different characters are divided into six different roles:

- **Assassins:** are able to move quickly and dish out lots of damage to single targets. They're best for jumping in, killing high-value targets, and jumping out.
- **Fighters:** dish out and take decent amounts of damage, and are well suited for extended combat. They jump into battle and use their balanced stats to lay down damage.
- **Mages:** excel in ranged combat, and often have area-of-effect (AoE) attacks that damage multiple enemies. They need to keep enemies at bay to survive.
- **Marksmen:** deal damage from a distance. If they're well protected, they can dish out a lot of pain to single enemies, but they are usually vulnerable to attack.

- **Support:** characters don't do much on their own, but they can amplify the abilities of their teammates. Some are able to do solid amounts of damage to help other champions control the battlefield.
- **Tanks:** can soak up massive amounts of damage as well as put the hurt on groups of enemies. They generally don't go for lots of kills, but help control the battlefield so other champions can fight with an advantage [9].

Typically, a league of legends gamer will elect a preferred role in the game. Different roles will allow the creation of a diversified and effective team of players.

This MOBA demands great mechanical, analytical and strategic skills from the player. It is a game filled with tactical variety and fictional characters with improvised stories, which bring the game to life. Released in October 2009, League of Legends has successfully caught the attention of 67 million monthly players and numerous international tournaments with professional gamers for a prize in the millions.

Minecraft is a game about breaking and placing blocks [10]. At first, people build structures to protect against nocturnal monsters, but as the game grew players worked together to create wonderful and imaginative things. It can also be about adventuring with friends or watching the sunrise over a blocky ocean. The brave players battle terrible things in The Nether, which is scarier than pretty [11]. The service features huge worlds to explore and a lot of freedom, allowing players to choose how to play the game; The game has several activities including exploration, gathering resources and crafting. Minecraft can be a very realistic game that will almost make players addicted to it, because of all the creative possibilities it contains. With the mob side, turning survival harder to achieve day by day, it will appeal a player to win, to explore, discover different biomes, get more experience, build better houses, castles, bridges, etc. [11].

HearthStone is considered an electronic sports game (e-sports), which has over 50 million players as of April 2016 [12], and is one of the most profitable games for e-sports. HearthStone (HS) is a popular online video game in which players fight one another using virtual playing cards. To defeat their opponent, players have access to a large number of cards that they can use to trigger a variety of offensive or defensive moves. The cards in HS have complex synergies, which are exploited by most experienced players to set up powerful strategies. Over the time, experienced players have accumulated a large body of strategic knowledge about the combinations of cards and how to use them. However, this knowledge remains mostly inaccessible to novice players [13]. Matches in HS involve two players, playing in turns, one at a time. Each turn starts with one player drawing a card from his deck, and then playing a small sequence of actions using the cards in his hand. When the player has performed all the actions that he wants to play, the turn ends, and the other player can start playing. Players are required to build a deck before they can play any match, which is a small set of cards they want to play with. Doux and their colleagues demonstrate how to extract strategic knowledge from gaming data collected among players of the game HearthStone [13]. Taralla develop a modular and extensible clone of the game HearthStone, such that practitioners from all over the world can have a new benchmarking tool to test their algorithms against [14]. Bursztein presents the first algorithm that is able to learn and exploit the structure of card decks to predict with very high accuracy which cards an opponent will play in future turns [15].

2.2 Games based Learning

Game based learning is not a new concept. It dates back to at least 1900s, and paper-based educational games were quite popular in the 1960s and 1970s. But advances in technology have taken game-based learning to a new level. Video games are used to thinking on multiple tracks at once, but have little patience with linear reasoning or delayed gratification [16]. We think that using games for teaching/learning is one way to shift to a more appropriate learning format for the digital generation.

Serious games are games designed for a purpose other than entertainment. Serious games use game environments and techniques to train or educate users or to promote a product or service in an engaging and entertaining way. The "serious" aspect comes from the fact that they are used by industries like: defense, education, scientific exploration, health care, emergency management, city planning, engineering, religion, and politics.

Serious games and gamification share similar traits and even goals. However, there are some differences in the context and elements of both. Gamification is more than a serious game, as it expands game thinking and mechanics into non-game environments, such as the classroom or everyday life [17]. The discussion of this subject is out of the scope of this paper. Serious games apply game thinking and mechanics to "serious" subjects. If gaming elements are compelling and fun, the results we want will be obtained easily. Andrew Hughes explains the concepts of Gamification vs. Game Based Learning [18].

3 Study

The argument that lead us to state that games have impact on undergraduate students is based on a research carried out with students from a Polytechnic institution learning HCI.

Students' profile – the students were first and second year undergraduates' students enrolled in (HCI) and interactive systems design courses.

The study – students were asked to fill a questionnaire and to give their opinions on playing games as an entertainment habit and the challenge of learning HCI through games.

The questionnaire - comprised twelve questions, five of them were closed questions concerning information about time duration they played, if alone or within a team, if they have dependency, if they have pleasure and what types of games they play. The other questions were open questions about personal opinions regarding what they considered they learn with games and what a game for learning should be like.

The questionnaire was available to fill about two weeks on a Moodle platform for the course-registered students. One hundred and thirty eight students answered the questions from the one hundred and fifty registered students.

Data analysis – the data was analyzed following the grounded theory method (GTM). Glaser and Strauss created Grounded Theory Method (GTM) in 1965, while analyzing data for their research [19]. Later, other researchers such as Corbin, Bryant and Charmaz [20] did different interpretations of that approach. GTM allows developing a theoretical account while simultaneously grounding it in observations. Strauss and Corbin [21] proposed three stages in analysis in grounded theory: open coding, axial coding and selective coding. During open coding the researcher reads the text and asks questions to identify codes that are theoretical or analytical. Axial coding is used to relate categories to subcategories. It specifies the properties and dimensions of a category. According to Strauss and Corbin axial coding answers questions such as ‘when, where, why, who, how’ and with what consequences. Selective coding involves the process of selecting and identifying the core category and systematically relating it to other categories [21]. It involves validating the categories’ relationships. The main goal of GTM is a constant comparison. Previously coded text also needs to be checked to see if the new codes created are relevant. Grounded Theory Method was chosen since it gives guidelines and grounding than most approaches.

The strategy used using GTM was, first, coding which is the basis for category building and with constant comparison of data, categories emerged. An example of initial coding stage is presented on figure 1 in section 4 of this paper. At this point an analytical pause was made to write analytical notes (memos) as will be explained later in this section. The goal was to explore the researcher’s ideas about the categories and to write about the codes and data and move up to theoretical categories. The codes were analyzed and those that related to a common theme were grouped together. From these data we obtained the main concepts to consider and maintain on the development of the new game for teaching/learning.

4 Results and Discussion

This section presents the research comments about the data gathered on the study. The kinds of skills identified on students playing the games are listed (see table 1). Then, some negative and positive aspects of playing games are stated. Finally, figure 1 presents a summary analysis about the data gathered using GTM approach. This section ends with final important comments that will conduct to the game development.

4.1 Abilities and Skills Worked on Playing Games

There are several skills that a player can obtain by playing games. This section presents some examples collected from the literature about Minecraft and HearthStone games. Then, we describe other skills we consider a gamer has, however some of them were ascertained from the applied questionnaires on the presented study.

Minecraft’s main objective is surviving. There are different skills that the player needs to perfect if they want to go far in the game, such as mining and farming. In

order to understand more of what Minecraft is about, the player needs to have a basic understanding of the extent of the game and the necessary traits and tricks to succeed in it. There is a skill focused around mining stone and ores. A notable perk of this skill is the higher potential yield from each ore, increased even further when using as an active skill. By mining through caves and ravines, the player can find ores like iron, gold, diamond. This skill covers a wide set of activities, from planting flowers to actual farming. For instance, players can make a basic farm with a hoe and a block of water. After building the groundings, players can then plant wheat seeds, carrots, potatoes, pumpkins, melons and many more. Since this is a survival game, one of the most important skills is this one. Either with a block of dirt in the early stages, or with a full enchanted armour, sword and shield, battling down the terrific menace that is the Nether. The player will learn how to battle the threats that lurk in the shadows of the full moon. Some will even build an experience farm, or, in Minecraft terms, an automated mob farm, so they can gather it and gain levels. This is accomplished by creating a creature spawner, an easy fast way of killing an enormous quantity of mobs. The most commonly built ones are skeleton and zombie spawners, in designated rooms for that purpose only [10].

According to students this is an educational game that demonstrates, in a straightforward way, the difficulty of agriculture, farming and building. It can also develop a person's social skills since most people play it in multiplayer servers, where they build true friendships that sometimes are more important than the ones that they gather in their life offline.

HearthStone - Abilities are special effects, powers, or behaviors found on cards. For spell cards, the ability describes the total effect of playing that card, while for minion and weapon cards, abilities are special effects or powers additional to the basic functions of the card. Abilities may be described in the card's text, or granted by enchantments. This game requires a thorough understanding, a great analytical and decision-making sense to be able to gather an effective and powerful deck of cards. Players must study and explore the endless possibilities this game has to offer to reach triumph.

Professional and other skilled gamers are known to have a distinct set of skills, which allow them to reach the higher ranks of the games. Some say that these skills and qualities are necessary to the development of a person who aspires prominence in the gaming community as well as gaming expertise.

- **Dexterity**

To play games motor action is required. To play competently, a swift, smooth and controlled movement of the upper body is required. Special consideration is also given to the agility of the fingers, as they need to press keys rapidly and effectively for the actions in the game to be executed. This motor dexterity is mostly necessary in first and third-person shooter, MOBAS and Sports games.

- **Coordination**

In games where map awareness is required, the gamer must be direct and organized in their movements, to avoid the enemy team from spotting them. Hand-eye coordination allows the gamer to respond quicker. Researchers have discovered that

sensorimotor skills can be improved through video games, which may also develop the motor coordination of people with Autism [22] and in the treatment of amblyopia [23].

- **Communication**

Interaction between team players can assist to solve in-game dilemmas and increase the chances of winning the game. A good communication skill is essential in multiplayer games, and many gamers have been exposed to negative and positive communication. Negative communication in gaming terminology is known as “flaming”. In most online games, if a person insults another or has an inappropriate behavior other players can report them. These reports when accumulated can lead them to being banned from their account in the game.

On the positive side, a study has shown that the collaboration between players in an environment of similar interests and gaming objectives, can lead to the formation of lasting relationships, laying the foundation for a sense of community. Barr demonstrated through his pilot study, that video games have played an important role in development of the communication skill [24].

- **Analytical Skills**

Reputable gamers are known for their thorough understanding of the game, and for their efficient decision-making and problem-solving skills. The mind of a gamer must also be dynamic, ready to reassess itself and the others’ actions whenever possible [25]. Their ability to analyze their actions or circumstances affects the positivity of their outcomes.

The common and necessary traits of a gamer are, in a way, endless. The listed above are essential skills seen in professional gamers, which can be developed through gaming.

Authors consider that these are the basic skills a gamer use when playing an entertainment game or a serious game. These skills will be practiced on HCI game to teach/learn.

4.2 Negative Aspects of Playing Games

According to literature there are some negative aspects that a game can have on a player. The principal aspects are violence and addiction.

Violence - A significant amount of research suggests that playing violent video games negatively influences players’ behavior in a variety of ways. Meta-analytic reviews [26], [27], [28] discovered that playing video games increases children’s aggressive cognitions [29], [30]; aggressive emotions [31], aggressive actions [32], and physiological arousal [33]. McLean conducted a study to determine if there was a connection between gaming violence and concern victims and culpable victims, and the results indicated that a direct correlation was evident [34].

The American Psychological Association [35], in a research review, found that people who played violent video games were very slightly more likely to engage in aggressive behavior (actions like playing a loud sound that people they were

competing against could hear over an audio system). However, the APA said playing games was not enough to cause aggression.

Ferguson as a researcher who has studied violent video games for almost 15 years, states that there is no evidence to support these claims that violent media and real-world violence are connected [36]. You, according to a study's results indicated that violent video games have a significant direct effect on aggressive behaviors, and a significant indirect effect on pro social behaviors. Specifically, empathy and behavioral self-control were found to mediate the relation between playing violent video games and pro social behaviors [37].

One of the questionnaire respondents stated that "a game about cooking does not make a professional cooker and a book about advocacy does not make a lawyer... it depends on each one personality and behavior".

Addiction - Technology and gaming addiction have become a concern in recent years as technology use has become ubiquitous. The World Health Organization considers a gaming disorder on its list of mental health conditions. Gaming behavior could be a disorder if it meets three characteristics: if a person loses control over their gaming habits, if they start to prioritize gaming over many other interests or activities, and if they continue playing despite clear negative consequences [38].

The psychological effects of video games might vary depending on how much people play and how they consider games in their way of living.

4.3 Positive Aspects of Playing Games

The main positive aspects, according to literature are stated. Playing games improve people's ability to pay attention and process visual information, and it can also be a way to relax and de-stress. Researchers have found that video-game players can outperform non-gamers on visual tasks, and several studies have shown that video games can 'train' visual processing skills in ways that translate to other activities. Action games can improve visual acuity and ability to find objects in a distracting setting. Video-game players appear to outperform non-game players on several different visual tasks [39, 40, 41, 42, 43, 44]. Kids who played sport video games were more involved in sports. The games provided knowledge of the sport, which gave the children confidence to get more connected in the real life [46]. Video games could also improve problem – solving capacities and change the way people learn [16].

People who played shooter games were better able to filter out distractions while engaged in attention-demanding tasks. The players were less distracted by other visual information [45].

Gamers are exposed to a creative process [47]. Creativity is presented, for example, on players' ability to find new, and/or different solutions when facing with problems and situations. Also, sometimes, rules can be managed in very different ways.

Games can elicit a range of emotions, positive and negative. Gamers play video games to relax, feel better and trigger positive emotional responses [48]. This can help to regulate emotions, to learn to cope with situations, and challenge themselves.

4.4 Methodological Approach Analysis

The data obtained from the questionnaires was organized on a table structure. Table 1 presents a short sample. The selection represents differences among the answers and they were randomly chosen.

Table 1 – Example of questionnaire’ answers

Frequency	Type of Games	Addiction	Play alone	Play in teams? Why?	Results	Violence influences	Serious Games	Learning/Outputs
5 hours/day	Call of Duty, Battlefield	Yes	Yes	Yes	Mission accomplishment, skills development, reaction time, competition	No	Educational games, knowledge acquisition	Historical evidences, skills training
1 to 3 hours/day	Survival, strategy, cars, building	No	Yes	Yes	Entertainment, to find nice people	Too much violence, give up	Learning, entertainment	World War history, Ancient ways of living, Strategy, Creativity, Logic
4 to 5 hours/day	Strategy	Yes	Yes	Yes	To be with friends, to distract from everything	No	Real evidence based	Knowledge acquisition
1 to 2 hours/day	NBA, K18, Sports	No	Yes	No	Fight with difficulties	Yes	Educational content	Knowledge acquisition
2 hours/day	Competitive (Sport)	No	No	Yes	Entertainment, living together	No	Competitive games	Relax
More than 3 hours/day	Strategy	No	Yes	Yes	To win	No	To learn	English language
2 hours/day	Multiplayer	No	Yes	Yes	To win, to play with friends	No	Challenge the player	Entertainment
30 minutes/day	Offline games	No	Yes	No	Distraction	No	Entertainment	Entertainment
3 hours/day	Fifa and open-world	No	Yes	Yes	To be challenged	No	Work	Observe challenges and ways to overcome them
Sometimes	Offline games	No	Yes	No	---	No	Challenging	Nothing
1 to 2 hours/day	Offline games: GTA, FIFA and Watch Dogs	No	Yes	No	To do impossible things	No	No opinion	War facts, historical events, English Language
2 hours	Mobile: Candy Crush, Last Day of June, Life is Strange	No	Yes	No	Like single player games	No	Educational games	Abilities exercises, strategic thinking
2 hours	Offline games: Sports and Cars	Yes	Yes	No	Achieve objectives, entertainment	No	---	Survival techniques, knowledge acquisition
2 to 3 hours/day	Fortnite and Counter Strike Global Offensive	No	No	Yes	Distract with friends	No	Educational games	Overcoming challenges, thinking fast
2 hours	RPGs and MMORPGs	No	Yes	Yes	Win, sort problems	No	Simulation games to learn	Mythologies
2 to 3 hours/day	League of Legends, Multiplayer online	No	Yes	Yes	Friendships, communication	No	Serious Games, Educational	Collaborative work, leadership, control, communication

The table contains the information about the frequency that each student spends playing, which is 2 or 3 hours/day in media, the type of games that they play, the information about addiction and playing alone or in teams. Students do not consider themselves addicted. They play either alone or in teams. We were also interested to know if violent games influenced student’s behaviors: all of the answers, to this question, were negative. Concerning serious games, students had different opinions about it. Some of them considered that an entertainment game could also be an educational game. They learn while they play. Games are somehow related with real life situations, which challenge the gamer to act as

such. Finally, questions approaching results and outputs permitted to understand some of the positive aspects of playing. The goal was to get information about students' opinions and feelings concerning the importance that playing a game had in their lives. We obtained different answers, for example: knowledge acquisition in different domains; learning survival techniques; communication and collaborative work, and development of different personal skills (handling techniques, thinking fast, solving problems...)

4.5 Final Comments

The information registered on the table structure was then analyzed using GTM approach. Several steps were followed and figure 1 presents a summary of the data analysis-using GTM.

From the data interpretation and data comparison processes a list of terms was created, as well as, explanatory texts. On the coding procedure, a category is located at the center and a network of relationships is developed around it. For example, the category "analytical skills" has relationship with "goals" and "ends". These categories were selected from those a gamer uses when playing a game; these are the decisions, priorities of tasks and activities organizations that the gamer needs to execute.

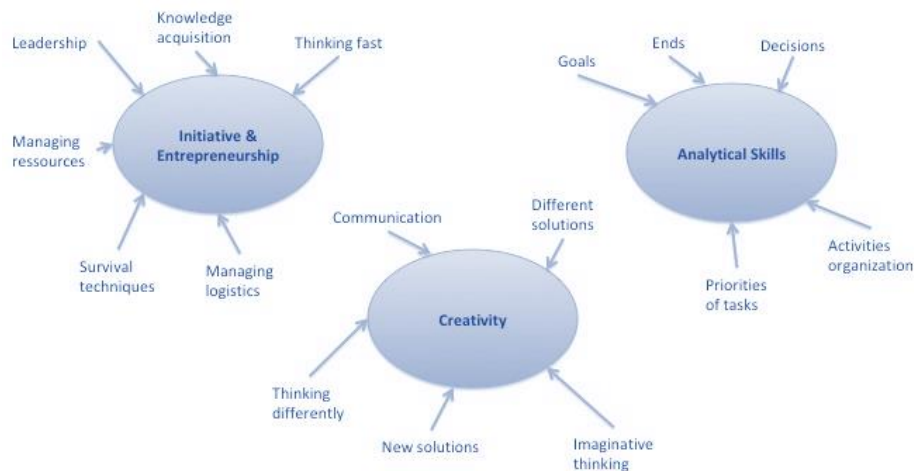


Figure 1 - Initial coding stage with GTM

From the final data analysis, on the theory generation phase, we concluded that students agree that learning HCI and similar subjects would be interesting through a game approach. The justification for this argument was based on the answer to the question: "Do you think that a game methodology would be accepted to learn HCI discipline?" Ninety percent of the respondents answered 'Yes'. The others had no opinion. Another reason for the argument gained value from the abilities and skills

found from the questionnaires results analysis: Students who play videogames tend to be more creative, make increasing use of their analytical skills and demonstrate higher levels of initiative and entrepreneurship. These outputs are some of the necessary traits for achievement when learning a subject. The game will be designed either for a purpose (to learn) or to entertain. It will be a game environment with techniques and rules to be followed. The results of playing a game will give students the opportunity to learn HCI materials and to pass the course.

4.6 How it would be?

Playing games accentuate several students/teachers abilities, such as those referred in this section. To learn a subject as HCI, which is a multidisciplinary field, a game can be an interesting and motivating tool. Before presenting the idea of the game we investigated about a common HCI curricula (table 2).

Table 2 - HCI living curriculum [49]

SUBJECTS IN HCI	
Very important	Interaction design
Important	Cognitive science, communication, computer science (general), design (general), digital media, information science, psychology (general), sociology, statistics
TOPICS IN HCI	
Very important	Experience design
Important	Accessibility, group dynamics/teamwork, HCI for development, history of HCI, information architecture, social computing, ubiquitous computing, universal design
INTERFACES AND DISPLAYS	
Very important	Desktop, mobile, tablet
Important	Embodied, large displays, shared displays
INPUT MODALITIES	
Very important	Gesture, keyboard, sensor, touch
Important	Haptic, location, voice
DESIGN PARADIGMS	
Very important	Agile/iterative design, experience design, interaction design, participatory design
Important	RIP (rapid iteration and testing), value-centered design
DESIGN METHODS	
Very important	Brainstorming, field study/ethnography, interactive/high fidelity prototyping, interviews, observations, paper/low-fidelity prototyping, prototyping (general), scenarios and storytelling, surveys, think aloud methodologies, usability testing, wire-framing
Important	Affinity diagram analysis, cognitive walkthrough, contextual inquiry, discount usability testing, focus groups, heuristic analysis, mental models, persona development, remote usability testing
EMPIRICAL METHODS	
Very important	Principles for empirical research, qualitative research methods, quantitative research methods, experimental methods, problem formation and research design, data analysis, analyzing and applying research
Important	Current research topics, critical evaluation of theory, statistics

Churchill and colleagues stated that HCI students and scholars learn about basic human characteristics and develop the necessary skills to study people’s activities with and around technologies. Students need to develop investigative, analytical, technical, communication, and advocacy skills to help them shape interactive technologies that augment people’s abilities, enhance their creativity, connect them to others, and protect their interests [49].

According to Churchill et al. study, they presented important survey items across time frames and across populations. They suggest a valuable starting point for articulating a unified vision of HCI education [49].

These authors considered that clear regional and contextual differences became evident, raising concerns about the relevance of a single HCI curriculum that would

be globally applicable. This makes sense, and invites an HCI curriculum that acknowledges geographic and cultural differences in terms of user “need” and that offers locally relevant content [49].

From the overall analysis, answers to questionnaires, games content description and literature review, the following outcomes abilities gave us motivation to develop a game for HCI teaching and learning: innovation, initiative and entrepreneurship, problem-solving, risk-taking, continuous improvement, value of effort, disciplinary skills improvement, analytical skills, foreign language improvement, capability of planning and organization, strategy skills, technological competence, independent learning, creativity, responsibility, resource management, among others.

The positive aspects of playing games, as presented on section 4.3 will be considered on the game to study HCI subjects, namely the provision of theories and practices knowledge. The game will require a through understanding, a great analytical and decision-making sense allowing students to be able to gather as much as possible information to digest and apply.

The game will be a learning tool, taking into account the students profile and the field to study in our proposal, not forgetting that suitable tutoring must monitor it.

Our proposal is to create a game play with pleasurable activities, such as learning. The structure of the game will be characterizes by rules: the rules that define how the game works but also defines the goal of the game.

The interface of the game is expanded. The first is the interface of the computer and an additional interface is a narrative, which teaches the students how to use the game features and how to proceed to achieve the different goals. The narrative provides also an explanation and meaning of the change of rules.

The main goal is that the game to teach/learn HCI will be a game based on some of the characteristics of HearthStone – a cards’ approach and the game of Empires – a strategy game. Students will face several challenges such as: playing a strategy game with several levels of difficulties, with problem solving situations. They collaborate with other players; they will have fixed rules to accomplish and feedback for mistakes. Figure 2 presents a draft of the content structure.

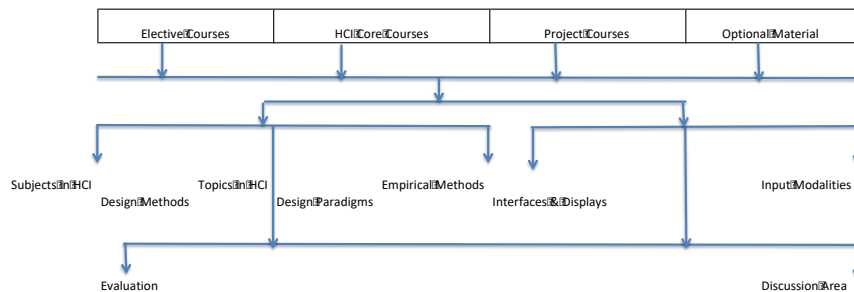


Figure 2 - Game content structure

The context information for the HCI game design is:

- The game should be based on concrete and well defined course aims;
- Objectives must be straightforward settled because it is easier to plan the lessons or modules. Objectives will be broken down into challenges;
- The game will have two options: to be played individually and/or to be played in teams. These options will not be optative, which means there are compulsory tasks to be done by each student and other tasks will be done in collaboration.
- Games could allow students to assess their knowledge for themselves giving them a chance to see where they are having difficulties before a test. The success could be rewarded with immediate admission to the next level, for example.
- The game should include prizes for completing or winning a game. These prizes will be attributed before the final prize (the grade).
- Grades can tell students if they failed to learn something, but for a variety of reasons, students may not make good use of the feedback, but this is another focus.

4.7 Learning through Games in other Subjects

This section serves to highlight our proposal, learning through games. Educational games help build a better connection between student teacher and student learning. Games can build an interactive bridge between the participants in education and the motivation of these to complete their tasks. The use of technology is not decreasing any time soon, and we must reap the benefits it has brought us by diversifying it and including it in spaces that rarely see the use of it for other purposes. According to Statista the number of active video gamers worldwide is expected to reach 2.37

billion by 2021 [50]. Therefore, we can assume that a high percentage of students in classrooms are involved in some form or other in video games.

Many education sectors face the increasing need of maintaining the motivation and continuous work of students for the taught subject. The nature of games and education are similar as they both present: goals, objectives, achievements and rewards [51]. For instance, in Music Education we can see a number of game applications designed to increase the participation of all students and facilitate the task of the teacher when conveying ideas to a large number of students. Solfeg.io is an online platform, which provides many activities and games, which aid music teachers in classroom activities. Guitar Hero is a popular music game for 1-2 players available on many gaming platforms such as Playstation, Xbox and Nintendo. This is a rhythm based game utilizes a simulator shaped like a musical instrument. On the screen, a number of colored notes glide down and the player must press these on the simulator at the correct time to achieve the maximum points. This game can develop the rhythmical and coordination abilities of the player. The number of video games directed to music education and other areas is rising. Gower and McDowall agree that video games are a valuable addition to education, and are also impactful to the learning and teaching of important fundamentals in Music [52].

Hargreaves and North state that music education should teach children to not just learn but also love music [53]. This belief should be transported through all areas of education. Gower and McDowall further state that much importance needs to be given to the potential of interactive video games in the classroom, and that these also act as a breath of fresh-air to the demands of educators and intensive curricula [52].

There is undeniable proof of the benefits video games can bring to the learning and motivation of students. As we approach this digital age, we must also reshape and rejuvenate the present education models to guarantee the preparation and development of our future generations.

Conclusion

This study does not contribute too much for research. However, several positive aspects were experienced. The opportunity for asking students about their opinions and suggestions to develop a game approach to teach/learn HCI; the research about games that students play and about studies that other researchers already did concerning this subject gave us important knowledge and cues to replicate or adapt games to use for an educational approach different from the traditional.

Authors consider that the basic skills to play a game are the same of those to play an HCI game: dexterity, coordination, communication, and analytical skills. There are other complementary skills for playing the game, which are referred on the positive aspects of playing a game' section: concentration, visual processing, acuity, engagement, and problem-solving capacity.

The HCI game will improve students' acquisition knowledge in an entertainment scenario approach. It will be a strategic game – with a number of goals around HCI

resource collection tools, allowing the opportunity to construct challenges and to engage with other colleagues.

The future work will be the development of a game, which already started, based on the results obtained from this study. The design process is made and the structure to follow is settled.

Acknowledgements

We want to thank the students that participated in the study.

References

- [1] Johnson, L., Smith, R., Willis, H., Levine, A., and Haywood, K., (2011). *The 2011 Horizon Report*. Austin, Texas: The New Media Consortium.
- [2] Gee, J.P., 2003. What video games have to teach us about learning and literacy. Macmillan, pp. 225.
- [3] Salen, K. ed. 2008. *The ecology of games: Connecting youth, games, and learning*. MIT Press, pp. 278.
- [4] D'Angelo, C., Rutstein, D., Harris, C., Bernard, R., Borokhovski, E., Haertel, G. (2013). *Simulations for STEM Learning: Systematic Review and Meta-Analysis (Executive Summary)*. Menlo Park, CA: SRI International.
- [5] Oppenheim, J., & Bank Street College of Education. (1984). *Kids and play*. New York: Ballantine Books.
- [6] Lepper, M. R., & Cordova, D. I. (1992). A desire to be taught: Instructional consequences of intrinsic motivation. *Motivation and Emotion*, 16(3), 187-208.
- [7] Godwin, Jennifer. (2017) Available at: <https://www.ageofempires.com/news/history-of-age-of-empires/> [Accessed 23 April 2018]
- [8] Riot Games, Inc., "Riot Games API," 2014. [Online]. Available: <https://developer.riotgames.com/> [Accessed 25 April 2018]
- [9] Albright, D. (2017). What is League of Legends?. *MUO (Make Use of)*. [online] Available at: <https://www.makeuseof.com/tag/what-is-league-of-legends/> [Accessed 11th June 2018]
- [10] MineCraft (2018). Available at: <https://minecraft.net/en-us/> [Accessed 24 April 2018]
- [11] Blizzard Entertainment. *Hearthstone: Heroes of warcraft*. Available at: <http://us.battle.net/hearthstone/en/>, March 2018.
- [12] Polygon. *Hearthstone now has 50 million players*. Available at: <http://www.polygon.com/2016/4/26/11511890/hearthstone-50-million-players-2016>, April 2018.
- [13] Doux, Boris, Gautrais, Clement, and Negrevergne, Benjamim (2016) *Detecting strategic moves in HearthStone*.
- [14] Taralla (2015) *Learning Artificial Intelligence in Large-Scale Video Games – A first case study with Hearthstone: Heros of WarCraft*. Master thesis submitted for the degree of MSc in Computing Science & Engineering, University of Liege.
- [15] Bursztein, Elie. (2016). I am a legend: hacking Hearthstone using statistical learning methods. Conference: 2016 IEEE Conference on Computational Intelligence and Games (CIG)
- [16] Prensky, M. (2012). *From digital natives to digital wisdom: Hopeful essays for 21st century learning*. Thousand Oaks, CA: Corwin Press.

- [17] Dubbels, Brock (2013). Gamification, Serious Games, Ludic Simulation, and Other Contentious Categories. *International Journal of Gaming and Computer-Mediated Simulations* 5(2):1-19
- [18] Hughes, Andrew. () Gamification vs. Game Based Learning. *Designing Digitally, Inc.* Available at: <http://www.designingdigitally.com/blog/2013/08/gamification-or-serious-game-whats-difference#ixzz4g7yv60gK>
- [19] Glaser BG, Strauss AL., (1967), *The discovery of grounded theory: Strategies for qualitative research*, New York: Aldine de Gruyter
- [20] Charmaz K, (2006). *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis*, London, Sage Publications
- [21] Strauss A, Corbin J., (1990), *Basics of qualitative research Grounded theory procedures and techniques*, Newbury Oark; Sage Publications
- [22] iLS. (2018). Action Video Games May Improve Hand-Eye Coordination [online] Available at: <http://integratedlistening.com.au/blog/2014/10/21/action-video-games-may-improve-hand-eye-coordination/> [Accessed 11th June 2018]
- [23] Gray, P. (2015). Cognitive Benefits of Playing Video Games. *Psychology Today*. [online] Available at: <https://www.psychologytoday.com/us/blog/freedom-learn/201502/cognitive-benefits-playing-video-games> [Accessed 11th June 2018]
- [24] Barr, M. (2016). Using Video Games to Develop Communication Skills in Higher Education In: *Proceedings of the Irish Conference on Game-Based Learning*, Trinity College Dublin, Ireland
- [25] Frommer, J. (2016). Common Traits of Gamers in: *Geeks.Media* [online] Available at: <https://geeks.media/common-traits-of-gamers> [Accessed 11th June 2018]
- [26] Anderson, C.A., Berkowitz, L., Donnerstein, E., Huesmann, L.R., Johnson, J., Linz, D., Malamuth, N., & Wartella, E. (2003). The influence of media violence on youth. *Psychological Science in the Public Interest*, Vol. 4, pp. 81-110.
- [27] Anderson, C. A. & Bushman, B. J. (2001). Effects of violent games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science*, Vol. 12, pp. 353-359.
- [28] Huesmann, L.R. (2007). The impact of electronic media violence: scientific theory and research. *Journal of Adolescent Health*, 41, S6- S13.
- [29] Heidi Brummert Lennings and Robert P. Franks, (2017). Does Modifying Media Reduce Aggression and Violence? *Implementation Science and Community-Wide Media Interventions*, The Wiley Handbook of Violence and Aggression, (1-12).
- [30] Gentile, D. A., Lynch, P. J., Linder, J. R., & Walsh, D. A. (2004). The effects of violent video game habits on adolescent aggressive attitudes and behaviors. *Journal of Adolescence*, Vol. 27, pp. 5-22.
- [31] Griffiths, M. D., & Hunt, N. (1995). Computer games playing adolescence: prevalence and demographic indicators. *Journal of Community and Applied Social Psychology*, 5, 189–193.
- [32] Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behavior in the laboratory and in life. *Journal of Personality and Social Psychology*, 78(4), 772–790.
- [33] Lynch, P. J. (1999). Hostility, Type A behavior, and stress hormones at rest and after playing violent video games in teenagers. *Psychosomatic Medicine*, 61, 113.
- [34] McLean, Lavinia and Griffiths, Mark D. (2014) "Violent video games and attitudes towards victims of crime: An empirical study among youth," *The ITB Journal*: Vol. 15: Iss. 1, Article 6. Available at: <https://arrow.dit.ie/itbj/vol15/iss1/6>
- [35] American Psychological Association. (2015). APA Task Force on Violent Media. Technical Report on the Review of the Violent Video Game Literature. Available online at: <http://www.apa.org/pi/families/violent-media.aspx>.
- [36] Ferguson, Christopher. (2018). Retrieved from: <https://theconversation.com/its-time-to-end-the-debate-about-video-games-and-violence-91607>
- [37] Sukkyung You, Euikyung Kim, Unkyung No. (2014). Impact of violent video games on the social behaviors of adolescents: The mediating role of emotional competence. *School Psychology International*, vol. 36, 1: pp. 94-111.
- [38] Health Organization. Retrieved from: <https://icd.who.int/dev11/l-m/en/#/http%3a%2f%2fid.who.int%2ficd%2fentity%2f1448597234>

- [39] Castel AD, Pratt J, Drummond E. (2005). The effects of action video game experience on the time course of inhibition of return and the efficiency of visual search. *Acta Psychol (Amst)*. 119(2):217-30.
- [40] Gopher D, Weil M, Bareket T. Transfer of skill from a computer game trainer to flight. *Human Factors*. 1994;36:387- 405.
- [41] Green CS, Bavelier D. (2003). Action video game modifies visual selective attention. *Nature*. 423(6939):534-7.
- [42] Green CS, Bavelier D. (2006). The cognitive neuroscience of video games. In: Humphreys L, Messaris P, editors. *Digital media: Transformations in human communication*. New York: Peter Lang; pp. 211–223.
- [43] Green CS, Bavelier D. (2006). Enumeration versus multiple object tracking: the case of action video game players. *Cognition*. 101(1):217-45.
- [44] Trick LM, Jaspers-Fayer F, Sethi N. (2005). Multiple-object tracking in children: The “Catch the Spies” task. *Cognitive Development*. 20:373–387.
- [45] Hubert-Wallander B, Green CS, Bavelier D. Stretching the limits of visual attention: the case of action video games.
- [46] Adachi, P. J. C., & Willoughby, T. (2015). From the couch to the sports field: The longitudinal associations between sports video game play, self-esteem, and involvement in sports. *Psychology of Popular Media Culture*, 4(4), 329-341.
- [47] Steinkuehler, Constance; Duncan, Sean. (2008). Scientific Habits of Mind in Virtual Worlds. *Journal of Science Education and Technology*, v17 n6 p530-543.
- [48] Russoniello, C. V., O'Brien, K., & Parks, J. M. (2009). EEG, HRV and psychological correlates while playing *Bejeweled II*: A randomized controlled study. In B. K. Wiederhold & G. Riva (Eds.), *Annual review of cybertherapy and telemedicine 2009: Advance technologies in the behavioral, social and neurosciences* (Vol. 7, pp. 189–192). Amsterdam, The Netherlands: Interactive Media Institute and IOS Press.
- [49] Elizabeth F. Churchill, Anne Bowser, and Jennifer Preece. (2016). The future of HCI education: a flexible, global, living curriculum. *interactions* 23, 2 70-73.
- [50] Statista. (2018). The Statistic Portal. Number of active video gamers worldwide from 2014 to 2021 (in millions). [online] Available at: <https://www.statista.com/statistics/748044/number-video-gamers-world/> [Accessed on 20th June 2018]
- [51] Laughlin, M. (2015) Video Game Music: The Great Teaching Experiment. National Association for Music Education. [online] Available at: <https://nafme.org/video-game-music-the-great-teaching-experiment/> [Accessed on 20th June 2018]
- [52] Gower, L., and McDowall, J. (2012). Interactive music video games and children's musical development. *British Journal of Music Education*, 29, pp 91-105
- [53] North, A. C. and Hargreaves, D. J. (1997). Music and consumer behaviour. in D. J. Hargreaves and A. C. North (Eds.), *The social psychology of music*. Oxford: Oxford University Press.