Gamification & Game Mechanics based E-learning

A practical implementation and its effect on user engagement

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Abstract

This thesis presents a practical implementation of Gamification and Game Mechanics based E-Learning. This is an approach to E-Learning that tries to use game design elements and game mechanics, in order to gain some of their motivational properties. Two identical E-Learning systems were developed as web applications, and achievement Badges were implemented to one of them. The systems were evaluated with a class of the Department of Special Education at the University of Thessaly in Greece. The evaluation aimed to provide empirical evidence on whether a gamified E-Learning system can make the educational process more engaging. To give context in this thesis, the growing trend of Gamification is unveiled and explained in detail. The major research achievement was evaluating students' engagement, achievements and perception of the system. It was discovered that the chosen game mechanic made indeed the educational content more attractive and the educational process more engaging. *"Understanding the potential to experience the same things in two ways is the first step to understanding the power of Gamification"*.

Keywords: Game, Education, Gamification, E-Learning, Game Mechanic, Engagement, Motivation, Badges, Empirical Evidence

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Glossary

Game *Is a structured set of rules that creates a decision space, including a system of rewards that aims to make an experience fun.*

Serious Games *Games that are created with a learning objective as the primary goal, and fun and entertainment as secondary.*

Gamification *Is the process of applying elements associated with video games in non-game applications which aims to increase people's engagement and to promote certain behaviors.*

Game Mechanic *An element of a game that is made up of a set of rules and feedback loops used to incentivize the player. CommonGameMechanicsareItems,Levels, and Points.*

Web 2.0 Technology *Technology that facilitates production of content, sharing and collaboration through social networks.*

Learning Management System (LMS) *Administrative E-Learning systems that are commonly used in educational institutions.*

1. Introduction

1.1 Motivation Behind the Project

"*The idea of using games for learning is not new, and maybe nowadays this is probably customary but the view that schools can combine playing and learning used to be at odds to typical thinking"* [1]. But what is typical thinking? For the purposes of this thesis a research was conducted to a sample of 32 students of the Department of Special Education of the University of Thessaly, all born after 1990. The answers gathered showed difficulties for the respondents accepting Video Games, as an equally purposeful and serious tool (for educational purposes) as typical games. Further questions rise regarding the views of those future teachers on subjects such as the changes in Information and Communication Technologies (ICTs). "*Such changes alter society, influencing the way people relate, communicate, work and learn"* [5]. How is this going to affect the interaction between teacher and student? For the latter, and specifically the younger generations designated by some as digital natives [4], all these technologies always existed, and they are used as something that was always part of their lives, providing them highly stimulating experiences, which shape their expectations of education and learning.

Contrary to the experiences of digital natives are the existing E-learning systems that for years have been to a large extent focused on course administration and facilitation. Typical uses have included the teacher publishing messages and documents to the students, and students handing assignments. "*The limitations of E-learning systems, from a pedagogical point of view, are the fact that they cannot transmit emotion or engage the student as a teacher could*" [3]. Such facts formed a challenge, as students might find it increasingly demotivating with old learning processes. This challenge, over the years, led researchers suggesting various theories.

One such theory indicates to integrate play into education, typical or web based, in order to increase student motivation and engagement. The motive behind this particular thesis, is the sense that mundane activities, especially for a longer period of time, are not appealing but by combining those activities with simple games we can create a more effective way to motivate students. Although careful examination is required to either embrace or discard this call, an interesting question which needs further research to be answered has already been formed: *"Is it possible for students to learn from games?"* [Chapter 3.2]

Following the same direction, educational researchers have also pointed out Video Game Based Learning as an attractive complement to typical E-Learning approaches. "*Video games are interactive activities that continually provide challenges and goals to the players, thus involving them into an active learning process to master the game mechanics*" [8]. Still, the development and application of Video Games to real life educational settings (better known as Serious Games) have met several challenges [Chapter 2.1]. Those challenges, and the small adoption into classrooms, have led to a general belief that *"no one has yet broken the code of successfully utilizing games in education*" [3]. But what if we could adopt only some of the elements of games to create gamified applications, in order to further engage and motivate our audiences? "***Serious games are complete games with serious intentions and designed accordingly, whereas in gamified applications only certain elements from games are used"*** [3].

Gamification has been incorporated with commercial success into Web applications, especially social ones, as a way to create narrow relationships between the application and the users, and to drive viral behaviors on them to increase the application's popularity. This success has made some researchers theorize, that it could also be used in education as a tool "*to increase student engagement and to drive desirable learning behaviors on them*" [10]. Furthermore, the

infrastructure of Web applications provides the necessary tools to incorporate different Gamification mechanisms, and measure their usage by students. Since creating games for learning employs costly resources, *"could Gamification be a simpler yet still efficient approach, in order to make educational content more attractive, and engender the desired state for the student?"* And *"which is actually the desired state a student should reach?"* [Chapter 3.2]

1.2 Goal

The main goal of this thesis is to make a contribution to the empirical evidence in the field of Gamification, by designing, implementing and evaluating a gamified learning experience in tertiary education. The research attempts to apply the Gamification theory in practice, and study the design and the consequences of this application in education.

The use of game mechanics to create an E-Learning system, targets to give a new kind of on-line learning experience, as an alternative approach to Serious Games and typical E-Learning. For these purposes, an E-Learning system was created, in order to make typical work including questionnaires, assignments and grades more engaging, by utilizing Badges, a common Gamification element, met in many organizations and Web applications, which is further presented in Chapter 2.4.

The functional aim was to construct two identical Learning Management Systems (LMS) by using Web 2.0 technology. The first one was created typically, without including any Gamification elements or game mechanics. The second one was identical to the first. Additionally, a Gamification element was implemented to it, so as to add extrinsic reward, in order to uplift the students' motivation. The design, as well as the implementation are presented in Chapter 4.2 in

detail. The ultimate goal was to measure the outcome in a methodical way, which is described in Chapter 4.4.

The gamified Learning Management System was tested in a university subject, to gain data on the practical implementation in a real life education setting. Preliminary research has indicated that it would be possible to test the system in the SEAC200 - "*IT Applications in Learning and Special Education*" at SED, UTH. The research goal was to evaluate the students' response to such system, by utilizing a system of interrelated metrics, which is being elaborated in Chapter 4.4.

The work entailed learning and designing the two Learning Management Systems, and implementing the Gamification element to the second one. It also entailed creating and organizing the material of the course, as well as administrating both systems and interacting with various end-users. Finally, collecting the data, measuring and comparing the engagement of the students to each system was required, in order to gain perspective on the effect the conducted experiment had on students. The obtained results are being presented in Chapter 5.

1.3 Methodology

This research was designed according to the model of semi-experimental design with pre-equivalent groups. According to this model, the students were divided into two experimental groups, treatment and control, which were equivalent, and with a high degree of similarity in their composition. In order to achieve the required equivalence, pre-control was conducted in the form of questionnaires. The procedure is being explained in Chapter 4.2.

In order to properly evaluate a developed system in a real-life setting, usability issues have to be uncovered before the actual experiment takes place. However, this particular research was

supported by Moodle, a popular and highly reputed Learning Management System. Therefore, no usability tests nor pilot tests had been conducted, before the actual experiment took place.

Finally, for the purposes of this research, and in order to measure the user engagement to both platforms, a method proposed by Zichermann and Cunningham was followed. According to the mentioned method, "*there is no single metric which can sufficiently measure engagement on the Web technology*".[7] Therefore, a system of interrelated metrics proposed by the two authors was adopted and used, in order to gain perspective on users' engagement.

1.4 Limitations

The scope of this thesis is to evaluate a gamified E-Learning system, and present and discuss the case in this report. Considering that the work also included learning and designing the two Learning Management Systems, setting the educational goals, as well as collecting, creating and organizing the course's material, the scope of this thesis was already extensive. Moreover, selecting a specific course in order to test the two Leaning Management Systems, adds certain limitations regarding the collected data, and consequently the produced results. Therefore, there is a certain range to what this thesis will be able to uncover.

Initially, the evaluation of engagement was performed on a tertiary educational level (the SED at UTH in Greece). Although it might be argued that students at lower educational levels are more responsive to motivating factors, they are not the target group for this case study. The experiment was conducted on a total of 32 graduate students, all female, which participated in the activities designed as the elective laboratory part of the course. The students were divided into two groups: students using the typical E-learning system, and students using the gamified one. The

division was based on questionnaires filled by the students before the beginning of the experiment, which recorded their prior knowledge and attitudes.

Moreover, the development work required for this project, was performed in the same semester as the SED course, which was selected for the evaluation. It follows, that the testing of the systems in the educational setting could not be done from the very start of the semester but only after the development had reached a functional state. The time period decided to give the students to test the system, and provide data for the evaluation was six weeks. Therefore, the content of the course was organized accordingly. Although it is most desired to evaluate a finished system throughout an entire semester, with ample time to integrate it well into the subject course, and get data on its use, this is not considered feasible within the limits of this thesis.

Although it would be interesting to test all game mechanics, or a combination of several of them, it would not be possible to separately measure the influence of each element to the students' engagement. Gaasland in 2010 charted 47 different game mechanics, while Zichermann and Cunningham focused on 7 primary elements, in order to discuss the way they yield a meaningful response from the players. As mentioned before, for the purposes of this thesis, Badges, one of the most popular game mechanics, was selected, so as to isolate and measure the influence of its utilization in learning context.

Finally, E-Learning is an ambiguous term, used to describe a range of different types of systems. Nowadays, some different types of E-Learning systems are CBTs (Computer Based Training), CSCLs (Computer Supported Collaborative Learning) and LMSs (Learning Management Systems). The latter are systems being used as administrative support tools at educational institutions all over the world. Although it would be of great value to construct an E-Learning system, which would combine characteristics from different types of E-Learning systems,

within the limits of this thesis, Moodle was selected, in order to create the gamified learning experience. Moodle is a free software Learning Management System, used in more than 556 institutions all over the world, counting approximately 73,753,000 users [20]. The fact that Moodle is the most popular LMS in the world and it is also highly reputed, in conjunction with the fact that it is open source, and therefore free, led to the particular selection.

2. Background Theory

2.1 Games

Defining Games

In order to understand game mechanics, someone first needs to explore the medium from which they originated: games. Many people have tried to define what a game is.

Salen and Zimmerman in 2004 defined game as *"a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome"* [11]. Such definition may come into collision with the purposes of this thesis, due to the fact that accepting the educational process among different students as engagement in an artificial conflict, can be rather anti-educational.

Some years later, in 2010, Enzo Silva came up with a different definition. He defined game as *"a series of enjoyable yet challenging, meaningful choices, a player makes throughout an experience"* [12]. Although such choices are usually enjoyable, it can be argued that they are always challenging or meaningful.

Botturi and Loh, during their attempt to explore the idea of playing and learning through a lexical and conceptual analysis within the Western culture, connected the Greek word *paideia* (education) to the word *paignion* (game), based on a forced claim that both words derive from the same source. Actually, *Paideia* derives from the verb *Paidevo* (chasten), while *Paignion* derives from the noun *Pais* (child). Consequently, ***Game could be defined as an autotelic activity (self-aimed activity that has no external end or purpose) a child does*** [1].

The informal definition given by Kim in 2009, describing game as: *"a structured experience with rules and goals that's fun"* [13], in conjunction to Sid Meier's definition: *"a game*

is a series of interesting choices" [14], leads to a more usable definition for the purposes of this thesis: ***Game is a structured set of rules that creates a decision space, including a system of rewards, that aims to make an experience fun.***

- *"Decision space"* refers to the fact that the player can choose between various options at several different points in the game.
- *"Rewards"* means every reinforcement and benefit given to the player, but also indirect rewards stemming from satisfying curiosity through exploring areas of the game for instance [2].

Serious Games & Game Based Learning

At one time, particularly in the 1970s, the term Video Games meant "*games played in a video arcade*" [1]. Nowadays, the term is used broadly to include all digital games playable on a device with video screen, which would include Computers, game consoles, cellular phones and mobile devices. "*The term Serious Games is used to distinguish Video Games that are created for training and instruction, from those developed for entertainment purposes*" [1]. A useful definition of Serious Games can be the following: ***Games that are created with a learning objective as the primary goal, and fun and entertainment as secondary*** [2]. "*Using games, leisure or serious, in schools to enhance and support learning, has become known as Game Based Learning*" [5].

Despite the fact that Simoes et Al stated in 2012 that the use of Video Games as learning tools, has been gaining prominence in recent decades, this statement can be highly argued. It is a fact that the video game industry has grown rapidly and become mainstream entertainment. Currently, video games are the most powerful entertainment industry in economic terms, reaching $936 million in total sales in March 2014, up 9% year-over-year.[15] On the contrary, "*the past 20 years, there have been no major blockbusters in educational software games and since the last*

blockbuster hit in educational games, thousands of educational software companies have attempted and failed to create another sensation".[7]

Video Games application in education is hindered by various issues. Their high production costs results in games being often developed based on general market demand. Therefore, the creation of localized content is often limited. This is even worse in countries like Greece, with a small population (small market), and a curriculum different from the curriculum in the USA (one of the largest markets). Finally, *"the difficulty of getting instructors involved in the development process of Video Games, a required aspect in order to achieve educational value, adds another drawback"* [16].

Games & Motivation

In order to create a gamified system that increases student motivation, it is necessary to focus on the fundamental elements that make games appealing to their players. According to Lee and Hammer in 2011, *"games are motivating because of their impact on the cognitive, emotional and social areas of players"* [10].

In the cognitive area, a game provides a complex system of rules along with series of tasks that guide players through a process to master those rules. These tasks are designed as cycles. A cycle consists of a series of short-term tasks, which players repeatedly try to complete in a try and fail process until the necessary skill level is acquired.

The impact games have on players' emotional area works mainly around the concept of success and failure. On one hand, when players complete tasks they are expected to have positive emotions, by their mere fact of overcoming difficulties. Games try to assure and increase those

feelings with reward systems. On the other hand, when players fail, they are expected to feel anxiety. While some degree of anxiety is acceptable, it is not desirable to transform into frustration.

Finally, when multiple players interact through the game, these interactions have impact on players' social area. Web 2.0 technology offer a wide range of multiplayer interaction mechanisms, which can be integrated to the rules of a gamified system. These mechanisms make it possible for players to cooperate, compete, or just interact socially by talking, flirting, trading or gifting for instance.

2.2 Players

Games are able to get people to take actions that they do not always know they want to take, without the use of force, in a predictable way. But in any system, the player's motivation ultimately drives the outcome. Therefore, *"understanding player motivation is paramount to building a successfully gamified system"* [7].

Flow & Reinforcement

Flow is a cornerstone concept for the success of games. Achieving flow indicates a player's state between anxiety and boredom, where he meets his own motivational level in any given experience. On the other hand, reinforcement is the attempt to convert a reward into a player's action, in the process of guiding him to master the system. Reinforcement is the key to structuring the right reward system, which in combination to a carefully designed interplay can lead the player to achieve flow.

Game balancing is of high complexity. More precisely, players who find the challenge too much will inevitably drop out of the game. To avoid such thing, sequences of tasks should be carefully designed to fit players' skills at any level, and include low penalties on failure to promote

experimentation and task repetition. On the other hand, players who find the challenge too easy are equally probable to drop out of the game. If the difficulty of tasks is correctly balanced, it can drive the players to achieve a flow state which is highly motivating. Such state should be the target of any gamified experience.

Intrinsic & Extrinsic Motivation

Another aspect in understanding player motivations is questioning where motivations come from. *"There are two categories of motivations: intrinsic and extrinsic. Intrinsic motivations are those that derive from our self and are not necessarily based on the world around us. Conversely, extrinsic motivations are driven mostly by the world around us"* [7].

Concern about Gamification and its means has been expressed by its critics. It has been supported that while Gamification is used to provide external motivation, the user's internal motivation decreases. For instance, *"if an organization starts using gamification based upon external rewards and then decides to stop the rewards program, that organization will be worse off than when it started, as users will be less likely to return to the behavior without the external reward"* [18].

Contrariwise, in the book Gamification by Design, the authors claim that this belief in internal motivation over extrinsic rewards is unfounded. They further state that Gamification works better if intrinsic motivations and extrinsic rewards are aligned, and that someone should strive to achieve that, wherever possible. One obvious conclusion of the intrinsic/extrinsic behavioral questions, is that once you start giving someone a reward, you have to keep them in that reward loop forever [7].

Player Types

"The more you know about the motivations of the players playing your game, the easier it is to design an experience that will drive their behavior in the desired way" [7]. There are four main types of players: Explorers, Achievers, Socializers and Killers, according to Bartle's taxonomy in 2004.

Explorers are players who like to wander throughout the system. They take pleasure of exploring the world, and discovering new items so that they can bring them back to their community and proclaim, *"I discovered this thing!"*

Achievers are an integral part of any competitive game. For achievers, losing at the game will likely cause them to lose interest in playing it. On the other hand, developing a system where everyone can win and achieve is of great difficulty.

Socializers are people who play games for the benefit of a social interaction. Games focused on socializers comprise some of the most enduring games throughout history. To further clarify socializers' mentality, it isn't that they do not care about the game or winning, they do. But to them, the game is mainly a backdrop for meaningful long-term social interactions.

Killers consist the smallest population of all the player types. Although they are similar to achievers in their desire to win, unlike achievers, winning for them is not enough. Not only they must win but also someone else must lose.

A player can have characteristics of all four types at the same time. *"For the average person, the breakdown might look something like this: 80% socializer, 50% explorer, 40% achiever and 20% killer. If the scores were mutually exclusive, however, and a player could only*

be one type, the vast majority of people, as much as 75%, are probably socializers. Explorers and achievers each make up about 10% of the population, and killers account for 5%" [7].

2.3 Gamification

Defining Gamification

"*Gamification may be a new term, but the idea of using game-thinking and game mechanics to solve problems and engage audiences isn't exactly new*" [7]. The concept has been initially explored in the marketing and military area, but the potential of its application has been extended to other areas, raising the question of whether it could be applied to education. Furthermore, due to the fact that Gamification started to fully gain traction during the course of 2010, there has been little academic research investigating its merits.

Various attempts have been made to define Gamification. Some researchers generically defined it as *"The use of game design elements and game mechanics in non-game contexts"* [17] or as *"The process of game-thinking and game mechanics to engage users and solve problems"* [7]. For the purposes of this thesis the following definition will be used: ***Gamification is the process of applying elements associated with video games in non-game applications which aims to increase people's engagement and to promote certain behaviors.***

Engagement

The term *"engagement"*, indicates the connection between a consumer and a product or service. There is no single metric on the Web technology that sufficiently measures engagement. Page views or unique viewers can be considered as rather misleading methods to test who is engaging with an application's services. *"Therefore, engagement should be better considered as a series of interrelated metrics that combine to form a whole. These metrics are: Recency, Frequency,*

Duration, Virality and Ratings" [7]. Finally, it is really essential to define the importance of each metric on a given system, as they can vary depending on the type of the application.

System of Rewards

"A system of rewards can be consisted of Status, Access, Power and Stuff, listed in order from the most to the least desired, and the cheapest to the most expensive" [7].

Status can be considered as the relative position of an individual in relation to others, especially in a social group. Status benefits and rewards define a ranking system which does not need to be based on the real world, and most importantly works perfectly in a vaguely constructed environment, such as the environment of a game or a Web application. Some examples of status items include Badges and Leaderboards.

Access can be considered as the reward given to a small group of users, so as to access a certain resource, instead of offering them tangible prizes, such as giveaways or discounts. Some ways to provide access as a reward to the players can include head starts, priority or VIP seating, or the privilege to determine appointments in the most convenient way to them.

The process of awarding power to some players offers a modicum of control over other players in the game. For instance, a good player might be asked to serve as a moderator on a forum. The benefits of such reward can be double, as the player feels standing out from the rest of the group, and at the same time offers his services to the system itself.

Finally, although stuff can be a strong incentive if players are expecting to receive free items, once the item has been given away, the incentive to engage is finished. In other words, stuff is only good until it is redeemed.

2.4 Game Mechanics

Game design is a relatively new, unaccredited discipline with roots in both psychology and systems-thinking. *"When creating a gamified experience, many aspects of game design are leveraged, while focus on the core elements that will produce the greatest impact for the players must be maintained"* [7].

The MDA Framework

One of the most frequently leveraged frameworks of game design is referred to as MDA, which stands for: Mechanics, Dynamics and Aesthetics. *"The MDA framework is a postmortem analysis of the elements of a game. It helps use systems-thinking to describe the interplay of those game elements and apply them outside of games"* [7].

Mechanics make up the functioning components of the game. At their core, they allow a designer ultimate control over the levers of the game, giving him the ability to guide player actions.

Dynamics are the player's interactions with those mechanics. They determine what each player is doing in response to the mechanics of the system, both individually and with other players.

The aesthetics of the system are how the game makes the player feel during interaction. Game aesthetics can be viewed as the composite outcome of the mechanics and dynamics, as they interact with each other and create emotions.

Points

Points are important and they serve a wide range of purposes regardless of whether their accumulation is shared among players, or even between the designer and the player. In gamified applications it is imperative to value and track every move the players make even if those scores

are only visible to the game designer and not to the players. Points are a great tool in service of that purpose.

In Gamification, we can leverage one of five point designs to form the foundation of the experience. Zichermann and Cunningham proposed a points palette which includes the following points options: Experience points, Redeemable points, Skill points, Karma points and Reputation points [7].

It is important to string an Experience Points architecture around a gamified system because it informs the designer and the players about which activities are more important. Redeemable Points on the other hand are usable within the system in exchange for things. Skill points are assigned to specific activities within the game and they are a bonus set of points that allow a player to gain reward for activities alongside the core. The purpose of karma is to give points away. Players gain no benefit from keeping their karma points, only from sharing them. Therefore, a behavioral path for altruism and user reward is being created. Finally, Reputation points are complex but often necessary in a system. Many web applications such as Yahoo! Answers and Stack overflow are based on a reputation system in great extent.

Levels

In most games, levels are used to indicate progress. Designers of gamified experiences are not going to use typical levels like those found in Video Games but understanding them can add a powerful tool to the design. In game design, level difficulty is not linear. *"Difficulty increases exponentially through each level and then decreases over time. These complex transitions from one level to the next have proven extremely engaging"* [7].

There are several approaches to the process of designing levels for a gamified system. In some systems, levels might define the difficulty of the game, or else they might serve as a passive marker for players to know where they stand in the gaming experience over time.

Additionally, there are some general guidelines which can be proven quite helpful. *"The best design tips for levels are to make them logical, in order to be easy for the player to understand. Moreover, should be created extensible and flexible, so that new levels could be added as needed. Finally, the levels should be testable and refinable"* [7].

Leaderboards

The purpose of a leaderboard is to make simple comparisons. Unsurprisingly, most people do not need any explanation when they encounter a leaderboard. By default, we see an ordered list with a score beside each name, and we understand that we are looking at a ranking system.

On the contrary, sometimes creating a leaderboard is not as obvious as it seems. In the case that the items being compared are sensitive, leaderboards present a challenge. For instance, the study of Dominguez et Al showed cases in which *"dislike and uneasiness was created by the feeling of competition among students and the process of ranking them on a leaderboard"* [19].

Badges

Badges have existed for a long period of time in our world, and they are a distinctive way of indicating status. Additionally, people desire badges for all kinds of reasons. For many people collecting is a powerful drive. Other players enjoy the sudden rush of surprise or pleasure when an unexpected badge shows up in a gamified system. A well designed, visually valuable badge, can also be compelling for purely aesthetic reasons. Finally, Badges must be visible to other players in the game, otherwise, their meaning and valuation is limited.

There are various successful web and mobile applications that use badges, in order to establish long-term relationships with their users. Foursquare for instance, uses badges to represent players' progress, and to create for them a sense of delight or surprise, due to the fact that *"it doles out those badges with seeming randomness"* [7]. Farmville on the other hand, reveals the challenges more clearly to the player compared to Foursquare. Ribbons serve as the badging system in this particular application but unlike the badges in Foursquare, these ribbons act in close concert with the challenges set by the application.

In regards to education, *"is it feasible to create a reward system based on this particular game mechanic, in order to uplift students' motivation, and engender high levels of engagement?"* More specifically, *"is it possible to combine the two principles behind Foursquare and Farmville, in order to motivate students in completing a course's challenges, while pleasantly surprising them with random trophies, so as to further engage?"* [Chapter 3.2]

3. Related Research

3.1 Previous Work

Gamification and Game Mechanics based E-Learning started to fully gain traction during the course of 2010. While some researches are already in progress, currently there is still little academic work investigating their merits. Some notable works on the field are the following:

"Once Upon a Game"

Botturi and Loh attempted to explore the idea of playing and learning, through a lexical and conceptual analysis of the hidden meaning in usual words, such as "game", "play" and "education". Based on Semiotics and Philosophy, as well as Von Neumann's Game Theory and Mann's Dialogue Macrogame Theory, the authors came up with nine implications which characterize games, and also explained how these characteristics affect education. Although a theoretical background was formed, trying to provide evidence on whether to embrace or discard the call to integrate play into education, a related methodology of how an educational application could be gamified was not included in the study.

"Raising Engagement in E-Learning through Gamification"

Muntean based on Fogg's Behavior Model, made a theoretical analysis of how Gamification could be used as a tool to increase engagement in E-Learning platforms, and also trigger desired behaviors on students. She also stated the difference between Educational Games and Gamification of E-Learning, and provided a list of Gamification elements, explaining how they could be integrated to an E-Learning course. Although Muntean provided a guide of how to

gamify an E-Learning application, no empirical research on the topic was conducted, therefore, more work is required, in order to construct an implementation, and evaluate its effect on students.

"A Social Gamification Framework for a K-6 Learning Platform"

Recently, Simões et Al attempted to incorporate the distinctive elements from Social Games, and apply them to Social Learning Environments. Social Gamification in education, as an alternative approach to Game Based Learning, as well as the validation of such application were the main goals of their work. To accomplish their goals they used schoooools.com, an existent K-6 Social Learning Environment, whose features and tools (private social network, blogs, wikis, etc.) could be naturally integrated to Gamification elements. The authors also presented a scenario, in which they integrated a point-based reward system, in order to demonstrate the extensibility of the framework but no empirical evidence about the effectiveness of this approach was provided.

"Game mechanic based e-learning"

One of the few empirical researches on this subject is the master's thesis "Game mechanic based e-learning" by Gaasland (2011). In his work, Gaasland presented a detailed experiment, in which he developed a web platform using Ruby on Rails, for the purposes of a Gamified E-Learning experience, which was evaluated in a university class. The platform was inspired by web applications such as Yahoo! Answers and StackOverflow, and served as a collaborative database, where students could share knowledge by asking and answering each other's questions, using the platform as an alternative way to study and revise topics. The only Gamification mechanism integrated to the platform was Experience Points, a classic Gamification element used to keep track of players' progression. The major research goal was to evaluate respondents' perception of the system, and create a guide on designing non-game systems, which try to achieve similar

motivational benefits as games. A careful Development methodology was followed, from the designing process till the actual implementation of the platform, and several usability tests were performed throughout the process. This methodology constructed in fact a helpful guide. On the other hand, the results indicating that the platform was "*somewhat motivating*", were totally based on students' responses to questionnaires. Therefore, since such metric does not sufficiently measures engagement on the Web technology, those results are not of great value. Further research is needed, not only on measuring engagement more properly, but on testing other Gamification mechanisms, and their combinations as well.

"Gamifying learning experiences: Practical implications and outcomes"

Another empirical research on this subject is "Gamifying learning experiences: Practical implications and outcomes" by Dominguez et Al (2013). In an attempt to verify the theories indicating that game mechanics can support Web Based Education, the authors designed and built a Gamification plugin for a well-known E-Learning platform. They also conducted an experiment using this plugin in a university course, collecting quantitative and qualitative data in the process. In the cognitive area of the application, they created levels as a hierarchical tree, following the course topics. The platform combined two different Gamification elements, Badges and Leaderboards. Badges were used as a reward system in order to impact the emotional area of the students and motivate them to complete more tasks. Leaderboards on the other hand, were included as a competitive mechanism, related to the social area of the system. Although measuring the effect on motivation, produced by the combination of the two Gamification elements, is of great interest, it remains vague how each one affected the system separately. Finally, their findings suggest, that some common beliefs about the benefits obtained when using games in education can be challenged. Students who completed the gamified experience got better scores in practical

assignments, and in overall score but the same students performed poorly on written assignments and participated less on class activities, despite the fact that their initial motivation was higher.

"Gamification by Design"

"Gamification by Design" is a book written by Gabe Zichermann and Christopher Gunningham, to help demystify some of the cores of game design. The authors indebted to the work of notable game designers, which helped clarify the process of game design, making it a quantifiable science. Good and bad patterns, from both famous and lesser-known case studies were extracted and tested, and as a result a valuable guide was composed, that helps the game designer to align his interests with the intrinsic motivations of the players. An extended theoretical background was provided, which could be separated into two major categories. Firstly, an extended analysis of all the powerful human motivators, and the reasons that engender people to play, introduces the reader to the player's psychology. Secondly, a presentation of a great range of Gamification elements, combined to various examples of their actual use in real life applications, makes a great contribution in understanding how Gamification mechanisms can engender players' behaviors. Moreover, code for the basic game mechanics was provided, as well as a detailed guide for developing a basic Gamification platform. Finally, the concept that describes engagement as a series of interrelated metrics, provided helpful directions in measuring engagement in real life gamified systems.

3.2 Conclusions & Research Questions

The research conducted on previous works done on the specific field, indicates the existence of rich theoretical background, which provides helpful guidelines regarding the determination of the target group an application aims at, the suitability deriving from the characteristics of each

Gamification mechanism, the actual process of gamifying an application, and finally, the process of properly measuring the engagement of the application's users. In contrary, there is little empirical evidence regarding the results of the implication of Gamification theory on a real life educational setting, and there is even fewer evidence regarding the effect of each separate Gamification mechanism on subjects such as the students' engagement and the actual learning process.

Therefore, throughout the research, a series of questions have risen, and they have motivated this particular work. In this thesis an effort was made, in order for those questions to be answered. Those questions can be categorized into two groups: the overall research questions, and the detailed ones.

The research questions are the following:

Overall Research Questions

Question 1: Is it possible for students to learn from games?

Question 2: Could Gamification be a simple yet still efficient approach, in order to make educational content more attractive, and engender the desired state for the student?

Question 3: Which is actually the desired state a student should reach, with respect to his interaction with an on-line experience?

Question 4: How motivating can a simple game mechanic be, when integrated to an E-Learning system?

Technical Research Questions

Question 1: Is it feasible for a reward system, merely based on badges, to uplift students' motivation, and further engender engagement to an E-Learning system?

Question 2: How do students respond to the gamified E-Learning system developed for for the purposes of this research?

Question 3: How usable and helpful do students find the gamified E-Learning system developed for the purposes of this research?

Question 4: To what extent are modern teachers familiar to Information and Communication Technologies used in education? Where do they stand with regard to using such technologies in real life educational settings?

4. Methodology

4.1 Description of the System

The system implemented for the purposes of this research is a web application. Therefore, it would be equally able to run on older computers, as well as new ones, since the computation is performed server-side, and the only requirement is a browser and an internet connection. This approach eliminates several of the problems Serious Games have faced, and creates no special requirement for educational institutes in order to use it. Furthermore, its content is presented on-line and it is not available exclusively for download.

The work presented in this thesis was supported by the Learning Management System Moodle. Moodle disposes a range of features, which are considered typical of an E-Learning platform, as well as a variety of specialized extensions and modules constructed by developers. For the purposes of this research, the following typical features were integrated to the platforms: Resource types, such as document, video and page viewers, file downloaders, assignment submissions and on-line quizzes. Furthermore, specific collaborative modules inspired by social application environments and Web 2.0 technology, such as discussion forums and instant messaging, were also integrated to both platforms.

Finally, the content of the platforms was organized as a hierarchical tree, following the topics of the course. The content was distributed to different containers created to both platforms, which were labeled as weeks for the typical platform, and as levels for the gamified one. The process of organizing the content in both platforms followed the guidelines for learning activities, which were summoned up by Simoes et Al: Repeated experimentation was allowed in order for students to achieve a goal, and rapid feedback cycles were included. Tasks were adapted to the

students' skill level, and their difficulty was increasing as students' skill level was improved. Furthermore, complex tasks were broken into shorter, and different routes to achieving a goal were created. [5] Regarding the gamified platform, recognition and reward were allowed in the form of distributing Badges to the students, every time a set of actions was completed or a goal was achieved.

4.2 System Design & Development

The course "*IT Applications in Learning and Special Education*" is a course in which students learn how to effectively use ICT tools, and apply their use in learning and special education. The course is aimed at promoting ICT competence at user level for students, and also presenting certain tools, with a view to implement them to the creation of educational material. Syllabus includes video capture and editing software, website building tools, as well as multimedia content creating tools. The course was developed, so as to contain tasks and assignments, designed to improve the skills of the students.

Cognitive Area

Initially, the cognitive area of the experience was designed. In specific, the system of rules in which students would obtain skills was provided by the ICT tools used in the course, while the tasks that would guide the users through the tool mastery process were the assignments integrated to each system. In an attempt to keep the gamified platform, as similar as possible to the typical one, a hierarchical tree was structured. The hierarchical tree was composed of three levels as it is depicted in Figure 4.1. Figure 4.2 depicts the first level of the tree, which matches the course's list of topics, labeled weeks for the typical platform, and levels for the gamified one, as mentioned before.

Moreover, a motif which represented the lower levels of the hierarchy was structured, and was repeated for each week or level. The motif would include the second hierarchy level, consisting of topic-specified forums, topic's material, additional material, quizzes, questionnaires and assignments, as well as the third hierarchy level, consisting of specific pdf and video tutorials, url pages, and assignment descriptions and submissions. Students could freely access any topic and its tasks once it had been introduced in lectures, and although repeated experimentation regarding the topic's material was allowed, assignments', quizzes' and questionnaires' submissions were allowed only once. Figure 4.3 depicts the lower levels of the related hierarchy.

"*In game design, level difficulty is neither linear nor exponential. Applying transitions in the difficulty from one level to the next is how games work, and this is a process that has also proven highly engaging*". [7] Those transitions are essential, in order for the player to balance between anxiety and boredom, and finally to achieve the state of flow. [Chapter 2.2] Motivated by this particular notion, the weeks' or levels' difficulty, in terms of content, throughout the course was designed accordingly, and as shown in Figure 4.4.

Another important element of this area is task evaluation. In order to be able to reward task completion, an evaluation mechanism was required. *An ideal mechanism would be integrated in the E-Learning platform, making it possible for tasks to be auto-evaluated.* Nevertheless, this is not always possible, as in our case, where exercises had to be done using external software. The solution was to use videos as evaluation mechanism. Students would capture and upload videos of their work, and those videos should provide enough information to evaluate if the task was correctly completed or not. The problem with this solution was that immediate feedback on task completion in the form of a reward was not feasible.

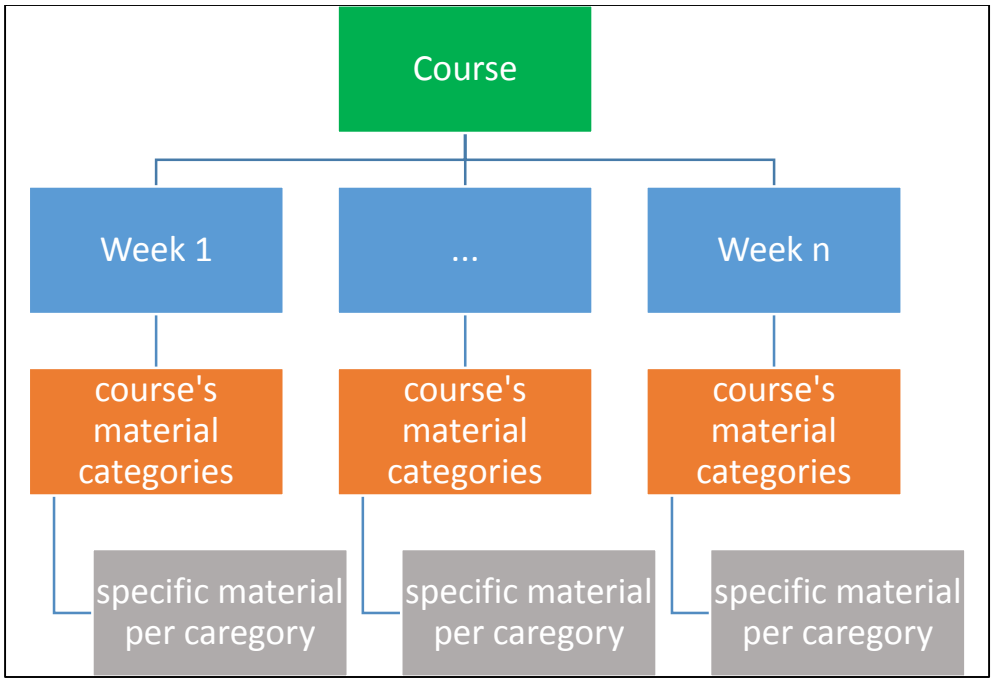


Figure 4.1 [hierarchical tree for the SEAC200 course]

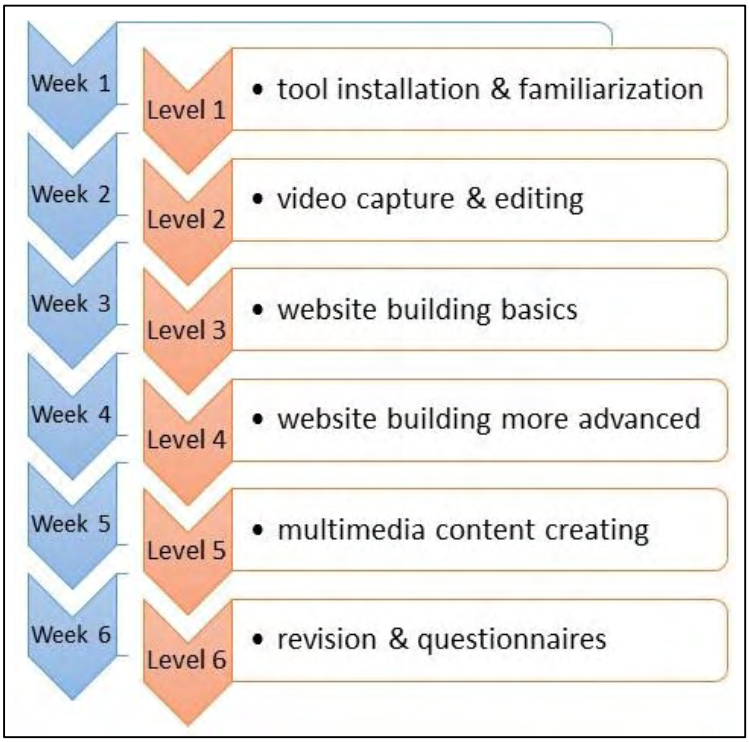


Figure 4.2 [first level of hierarchical tree for the SEAC200 course]

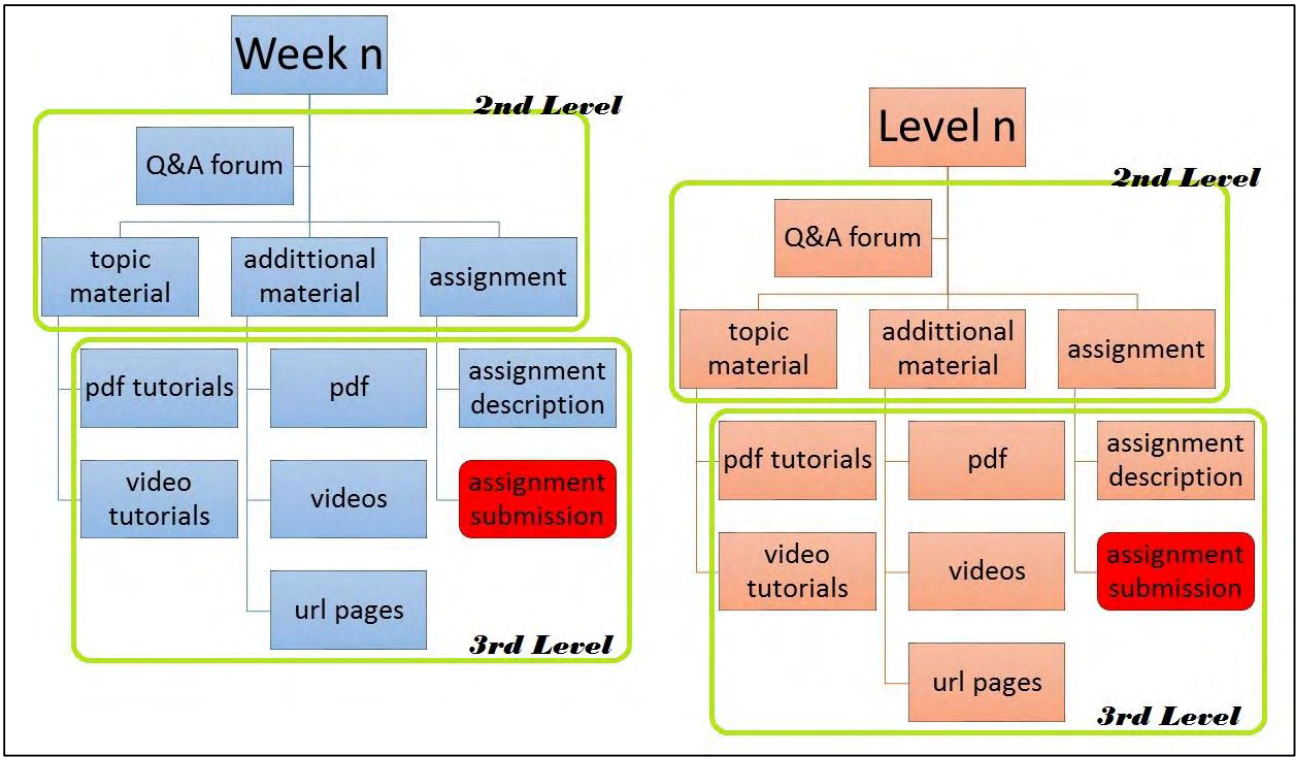


Figure 4.3 [second & third level of hierarchical tree for the SEAC200 course]

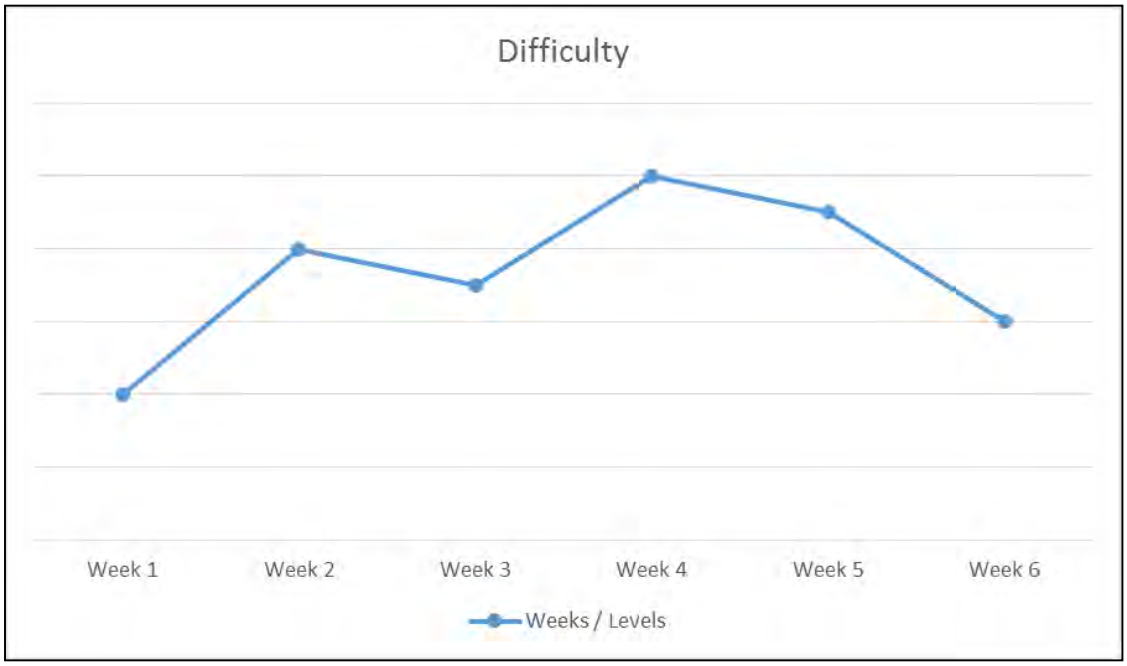


Figure 4.4 [level complexity for the E-Learning platform of the SEAC200 course]

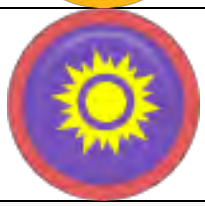
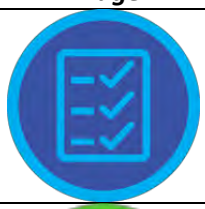
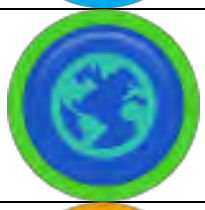
Emotional Area

The next step was to design how to impact on the emotional area of the students. A virtual reward system should be included, so as to create positive emotions on task completion, thus motivating students to complete more tasks. According to Zichermann and Cunningham "*the more you know about who is playing your game, the easier it is to design an experience that will drive their behavior in the desired way.*"[7] Dominguez et Al pointed out cases, where "*dislike and uneasiness was created by the feeling of competition among students."*[19] Furthermore, as mentioned earlier, killers account for a very small proportion of the total population of players, while socializers, explorers and achievers account for 95% of the population. [Chapter 2.2] Therefore, after considering all those factors, and concluding that the particular students who participated in the experiment were more likely to socialize, explore and achieve, rather than compete, it was decided that achievement Badges was the most appropriate form of reward to integrate to the gamified system.

In the particular gamified system developed for the purposes of this research, two major Badges' categories were designed, with a view to impact the emotional area of the students. The first category, inspired by Farmville, [Chapter 2.4] consisted of Badges designed to act in close concert with the challenges set by the E-Learning system. Such Badges, would be awarded to students on assignment, quiz or questionnaire completion, in order to create positive emotions, and would also serve students keeping track of their progress. The second category, inspired by Foursquare, [Chapter 2.4] consisted of Badges designed to be awarded on students' participation, and after they had taken combinatorial actions. Those Badges would be awarded with apparent randomness, in order to create for the students a sense of delight and surprise.

The mentioned categories, the Badges of each category, and the criteria that should be satisfied in order for a Badge to be awarded are depicted in Figure 4.5. Moreover, in an attempt to increase the engagement of the students, the more they progressed in the system, the more the difficulty with which they would earn a Badge should increase. This particular notion is depicted in Figure 4.6.

Badges awarded for assignment, quiz or questionnaire completion			
Level	***Image***	***Name***	***Criteria***
Level 1		*Love U*	*Awarded by manager (Complete all three questionnaires)*
Level 1		*Riddler's 1st Quiz*	*Awarded by manager (Complete quiz)*
Level 2		*You Are a Star!*	*Awarded by manager (Complete video capture and editing)*
Level 2		*Youtube Hero*	*Complete: "Assign - Create a Youtube account"*
Level 3		*You Are a Web Star!*	*Awarded by manager (Complete website part 1/2)*
Level 4		*Web Site Developer Certification*	*Awarded by manager (Complete website part 2/2)*

Level 5		*Multimedia Content Gold Cup*	*Awarded by manager (Complete multimedia content)*
Level 6		*Have a nice summer!*	*Awarded by manager (Complete final questionnaire)*
Badges awarded for participation and combinatorial actions			
Level	***Image***	***Name***	***Criteria***
Level 1		*Platforms Master*	*Complete ALL of: "PDF – expression encoder", "PDF - web expression", "PDF - Multimedia builder"*
Level 1		*World Wide Web Master*	*Complete: "URL - Client server model"*
Level 2		*Embedded Content Master*	*Complete: "PDF - Embedded content"*
Level 2		*Top Class Director*	*Complete ALL of: "PDF - Creating a video", "VIDEO - Creating a video"*
Level 3		*Web Site Blue Award*	*Complete ALL of: "PDF - Creating a website 1/2", "VIDEO - Creating a website part 1", "VIDEO - Creating a website part 2"*
Level 4		*Web Site Yellow Award*	*Complete ALL of: "PDF - Creating a website 2/2", "VIDEO - Creating a website part 3", "VIDEO - Creating a website part 4"*

Level 5		*Multimedia Content Red Award*	*Complete ALL of: "PDF - MMB troubleshooting", "PDF - Creating multimedia", "VIDEO - Creating multimedia content part 1", "VIDEO - Creating multimedia content part 2"*

Figure 4.5 [Badges designed to impact the emotional area]

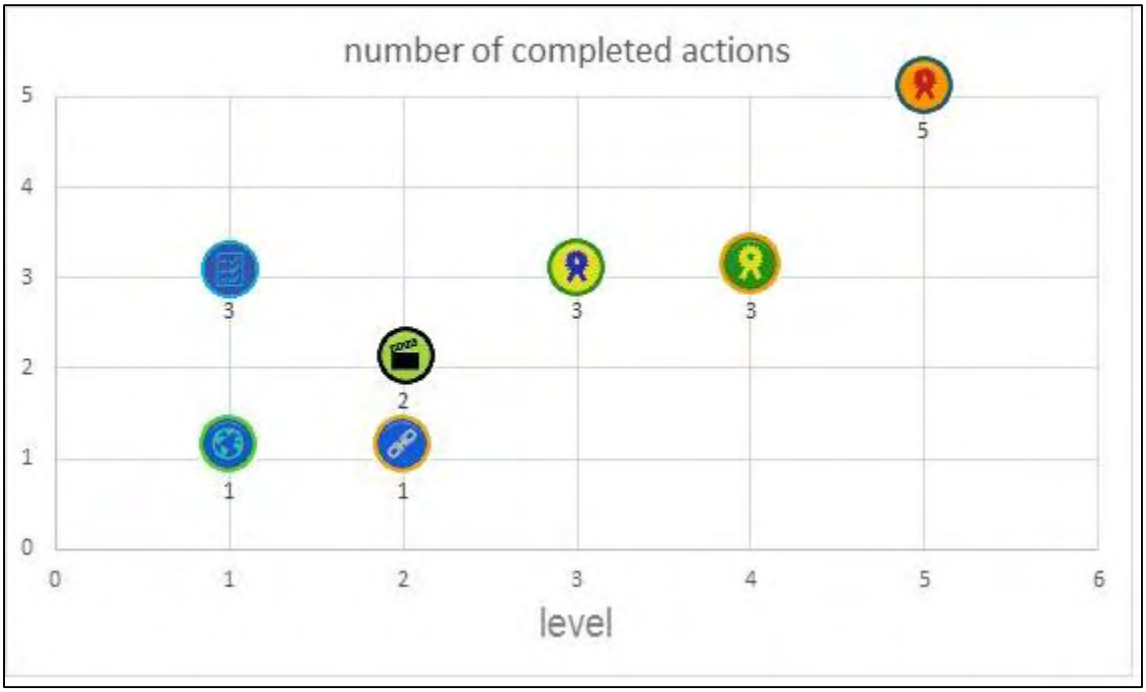


Figure 4.6 [difficulty in earning hidden Badges]

Social Area

The final design step was related to the social area of the system. As previously mentioned, there are different ways of student interaction: cooperative, competitive and social. Although the course tasks had been designed for individuals, it was decided to combine cooperative mechanisms to the social modules that had already been utilized, in order to motivate students' collaboration, and avoid the negative impact of competitive mechanisms. [19]

Moodle includes a range of social modules. Moreover, in the initial design of the E-Learning systems, modules such as chat rooms, general forums and questions & answers forums had already been integrated. [Figure 4.3] Therefore, it was decided to encourage students' social interaction and collaboration, by awarding Badges for actions such as instant messaging, posting questions and answering to classmates' questions, or other minor actions such as profile updating and photo uploading, which indicate commitment to the system. The third Badge category, consisting of social Badges, the Badges included, and the criteria that should be satisfied in order for those Badges to be awarded are depicted in Figure 4.7.

Badges awarded for social interaction and collaboration			
Level	***Image***	***Name***	***Criteria***
System		*Welcome in!*	*Complete: "Update profile"*
Complementary module		*Chit Chater*	*Complete: " Chat room"*
Complementary module		*Socializer*	*Complete: "General forum"*
Level 1		*Savior*	*Complete: "Q&A forum"*
Level 2		*I like to help!*	*Complete: "Q&A forum"*

Level 3		*Hot Tips*	*Complete: "Q&A forum"*
Level 4		*Share the Idea!*	*Complete: "Q&A forum"*
Level 5		*Lifesaver*	*Complete: "Q&A forum"*

Figure 4.7 [Badges designed to impact the social area]

4.3 Experimental Subjects

This research was designed according to the model of semi-experimental design with pre-equivalent groups. According to this model, the students are divided into groups of physically equivalent, with a high degree of similarity in their composition. The degree of similarity in the composition of the students was ensured by the fact that they were all students of the same age and the same sex, and they also had the common element that they had consciously chosen to attend the Department of Special Education at University of Thessaly. Moreover, none of the students had previous experience with the system.

For the purposes of this project two groups were used: control and treatment group. In order for the groups to be formed, pre-control was conducted by distributing questionnaires, which were answered by the initial sample. Pre-control was also divided in two phases, with the questionnaires being distributed respectively to each phase. In phase one, questions were related to the sample's prior knowledge on the subject of the course, as well as the familiarity and the

usability rates of personal computers, mobile devices and the Internet. The outcome of the first phase was the classification of the sample into four groups depending on their answers, as it is depicted in Figure 4.8.

In phase two, questions were related to the sample's prior attitudes regarding the usefulness and the purposefulness of E-Learning systems and Video Games as educational tools. The outcome of the second phase was the further classification of the resulting four groups of the previous phase into two subgroups. The first one was composed of those students who felt positively, while the second one was composed of the students who felt negatively on the related subject. The specific classification is depicted in Figure 4.0.9.

Eventually, students were selected, in order to form the control and treatment groups, in such a way as to contain equal proportions from each of the categories formed in phases one and two. Figure 4.0.10 depicts control and treatment groups, which were formed to be equivalent. The first group would test the typical platform, while the second would test the gamified one.

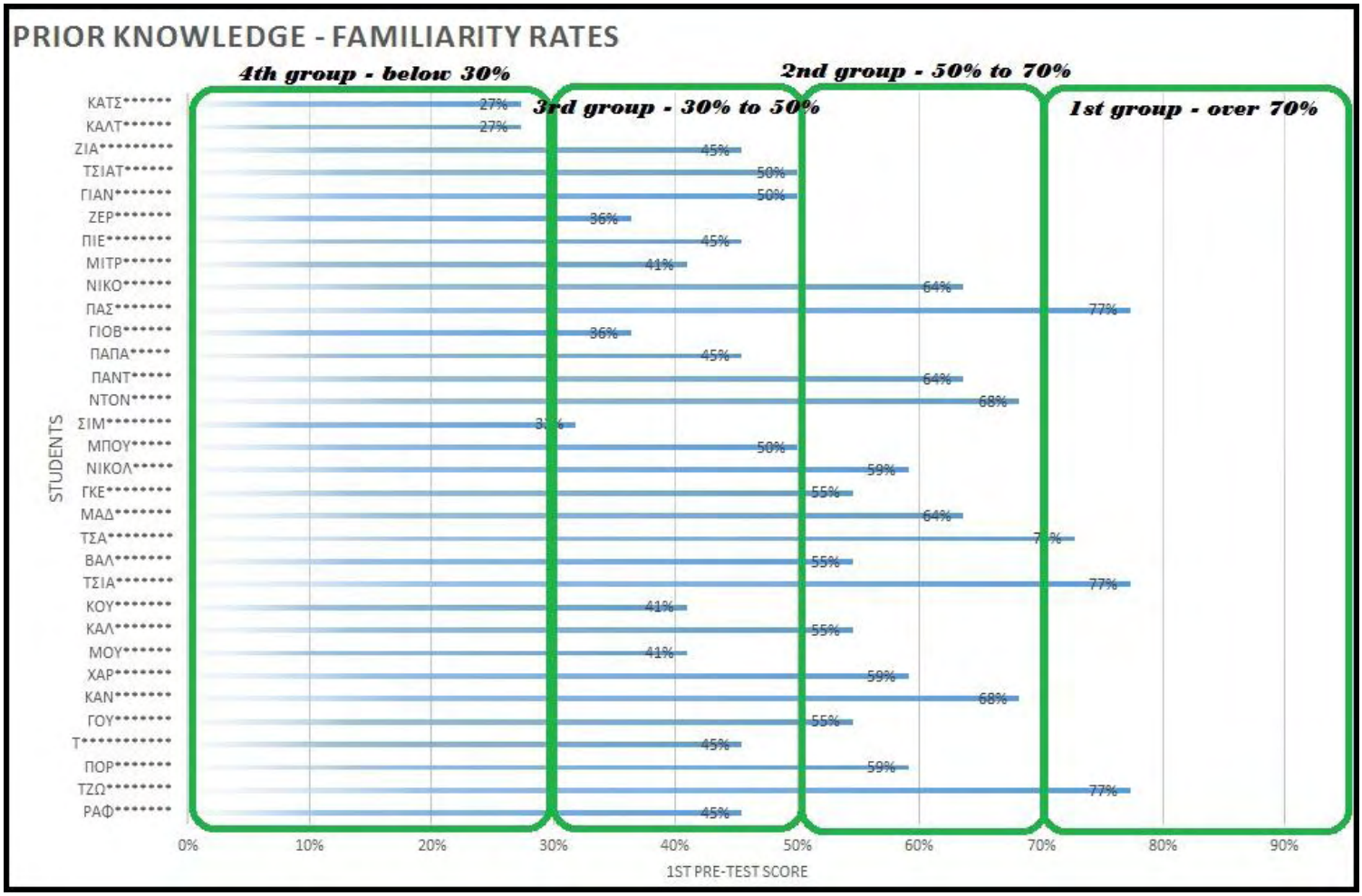


Figure 4.8 [subjects division into equivalent groups based on pre-control – phase1]

STUDENTS	***GROUPS***	***ATTITUDES***
ΠΑΣΧ***	1ST GROUP	✗
ΤΖΙ****	1ST GROUP	✗
ΤΣΑΚΑ***	1ST GROUP	✗
ΤΣΙΑΚΥ****	1ST GROUP	✓
ΒΑΛ*****	2ND GROUP	✗
ΓΚΕ***	2ND GROUP	✗
ΓΟΥΡ****	2ND GROUP	✗
ΚΑΛ****	2ND GROUP	✓
ΚΑΝΤ****	2ND GROUP	✗
ΜΑΔΕ****	2ND GROUP	✓
ΝΙΚΟΛΟ****	2ND GROUP	✗
ΝΙΚΟ****	2ND GROUP	✗
ΝΤΟΝ****	2ND GROUP	✗

ΠΑΝ***	2ND GROUP	✗
ΠΟΡΤ****	2ND GROUP	✓
ΧΑΡΑ****	2ND GROUP	✗
ΓΙΑΝ****	3RD GROUP	✓
ΓΙΟΒ****	3RD GROUP	✗
ΖΕΡΒ****	3RD GROUP	✗
ΖΙΑ***	3RD GROUP	✗
ΚΟΥΤ****	3RD GROUP	✗
ΜΙΤΡ****	3RD GROUP	✗
ΜΟΥΣ****	3RD GROUP	✗
ΜΠΟΥΡ****	3RD GROUP	✗
ΠΑΠΑΔ****	3RD GROUP	✓
ΠΙΕΡ****	3RD GROUP	✗
ΣΙΜ****	3RD GROUP	✓
Τ*****	3RD GROUP	✗
ΤΣΙΑ*****	3RD GROUP	✗
ΚΑΛΤ****	4TH GROUP	✗
ΚΑΤΣ*****	4TH GROUP	✗

Figure 4.0.9 [subjects division into equivalent groups based on pre-control – phase2]

STUDENTS	*FINAL GROUPS*	*PHASE 1 GROUPS*	*ATTITUDES*
ΠΑΣΧ****	CONTROL	1ST GROUP	✗
ΤΣΑΚ****	CONTROL	1ST GROUP	✗
ΓΟΥΡ****	CONTROL	2ND GROUP	✗
ΚΑΝΤ****	CONTROL	2ND GROUP	✗
ΝΤΟΝ****	CONTROL	2ND GROUP	✗
ΠΟΡΤ****	CONTROL	2ND GROUP	✓
ΧΑΡΑ****	CONTROL	2ND GROUP	✗
ΓΙΟΒ*****	CONTROL	3RD GROUP	✗
ΜΠΟΥ****	CONTROL	3RD GROUP	✗
ΠΙΕΡ****	CONTROL	3RD GROUP	✗
ΓΙΑΝ****	CONTROL	3RD GROUP	✓
ΚΟΥΤΣ****	CONTROL	3RD GROUP	✗
ΜΙΤΡ****	CONTROL	3RD GROUP	✗
ΠΑΠΑΔ****	CONTROL	3RD GROUP	✓
ΚΑΛΤ****	CONTROL	4TH GROUP	✗
ΚΑΛΑ****	CONTROL	2ND GROUP	✓
ΒΑΛ****	TREATMENT	2ND GROUP	✗
ΤΣΙΑΚΥ****	TREATMENT	1ST GROUP	✓

ΤΖΙΩ****	TREATMENT	1ST GROUP	✗
ΓΚΕ****	TREATMENT	2ND GROUP	✗
ΝΙΚΟΛΟ****	TREATMENT	2ND GROUP	✗
ΝΙΚΟΥ****	TREATMENT	2ND GROUP	✗
ΜΑΔΕ****	TREATMENT	2ND GROUP	✓
ΠΑΝ****	TREATMENT	2ND GROUP	✗
ΖΙΑ****	TREATMENT	3RD GROUP	✗
Τ****	TREATMENT	3RD GROUP	✗
ΤΣΙΑ****	TREATMENT	3RD GROUP	✗
ΖΕΡ****	TREATMENT	3RD GROUP	✗
ΜΟΥΣ****	TREATMENT	3RD GROUP	✗
ΣΙΜ****	TREATMENT	3RD GROUP	✓
ΚΑΤΣ***	TREATMENT	4TH GROUP	✗

Figure 4.0.10 [control and treatment equivalent groups]

4.4 Evaluation & Data Collection

Engagement

As mentioned before, and for the purposes of this thesis, engagement is considered as being comprised of a series of interrelated metrics that combine to form a whole. These metrics are: Recency, Frequency, Duration, Virality and Ratings. However, it is mandatory to realize, that the relative proportion, or importance, of each of these metrics will vary depending on the type of the application.

For the purposes of this research, the proportions which considered appropriate in the context of an E-Learning system are the following: 40% Recency, 40% Frequency, 20% Duration, 0% Virality and 0% Ratings. In an attempt to explain the choice regarding the proportions of each metric, the reasoning that led to the specific percentages is being elaborated.

Duration, also called time on site, is one way of measuring visit quality. If users spend long time visiting a website, it is probable to be interacting extensively with it. However, time on site

can be misleading, due to the fact that users often leave browser windows open while they are not actually viewing or using the site. Therefore, it was considered appropriate to assign to Duration half the proportion assigned to Frequency and Recency respectively.

Moreover, although Ratings is a popular mechanism, used by many successful web applications, and although it can also be combined to gamification elements in order to uplift motivation, such mechanism was not integrated to the E-Learning systems presented by this thesis. Therefore, Ratings was a metric excluded from the proportions used to measure engagement.

Finally, Virality is an ambiguous term. It is widely used to describe social distribution, or more commonly, how many additional new users a system will get, given one new user. Therefore, since the number of the enrolled users of our system was predefined, and the system was confined, there was not any point in measuring Virality.

Although it is really important to extract the proportions of engagement in the context of a system, it is also of great importance to properly measure each and every one of the metrics used to form the proportions. In order to achieve this, Google Analytics' definitions of those metrics were adopted as part of this research, so as to calculate statistics per unique user.

Frequency measures how frequently users return to a website within a time frame, while Recency measures how many days go by before users return to a website. The time frame selected in this particular research, so as to measure Frequency and Recency was one week, due to the fact that the content of the course was organized respectively. Duration is calculated as the average session length of all users. Session length is the sum of the average time spent on site's page, for all web pages. The time frame selected in order to measure Duration was the same as the one selected before.

Attitudes & Student Achievement

To answer the research questions and further evaluate the system, statistical information which resulted from Moodle's report tools was gathered and evaluated, and an additional survey including on-line questionnaires was conducted.

Initially, the data collected from Moodle's report tools included general course participation, as well as specific activity participation and activity completion. Statistical information regarding students' performance in tests was also included, as well as information related to the users' general interaction with the system. The information gathered from Moodle's report tools was evaluated complementary to the users' engagement.

Moreover, the additional survey was performed in the form of questionnaires, served as a post test, which aimed to investigate potential changes on students' attitudes, and to determine the extent they had broadened their knowledge. The survey also targeted to uncover facts, such as the system's usefulness in the context of the specific course, the manner in which the system was used, and the most desired functionality for future implementation.

5. Experimental Results

The experiment was conducted on the class of SEAC200 during the 2013/2014 spring semester. Outcome data collected from the typical and the gamified E-Learning platforms, as well as additional data, that resulted from the survey conducted in the form of questionnaires, are being presented in this section.

5.1 Engagement.

Frequency

Figure 5.1 depicts the average Frequency per group, for each week of the experiment. As shown, initially the two groups have similar Frequency rates. More precisely, an average of 1.333 and 1.375 log-ins per week are noted for the users of the typical, and the users of the gamified platform respectively. Equal initial rates were expected, since the two groups had been selected to be equivalent, as explained in Chapter 4.2.

Moreover, although during the second week the Frequency rates of the treatment group decreased for unknown reasons, it seems that by the third week and on they constantly rise, in contrast to the control group, whose Frequency rates range indistinctly. This fact is particularly encouraging, since the users of the gamified platform tend to return more often to the system over time. By the fifth week, the Frequency rates have been formed to an average of 1.333 and 2.583 log-ins per week for the users of the typical, and the users of the gamified platform respectively. The slight decrease in the Frequency rates for the users of both platforms during the last week is justified, due to the fact that the specific topic's material that was uploaded to both platforms had been designed limited, and therefore, the work that the students had to make during this particular week was less.

Finally, Figure 5.2 depicts the total average of the Frequency rates for the users of each platform, throughout the entire experiment. As shown, an average of 1.407 and 1.516 log-ins are noted for the users of the typical, and the users of the gamified platform respectively. It is indicated a greater Frequency rate up to 7.2% on average, for the users of the gamified platform.

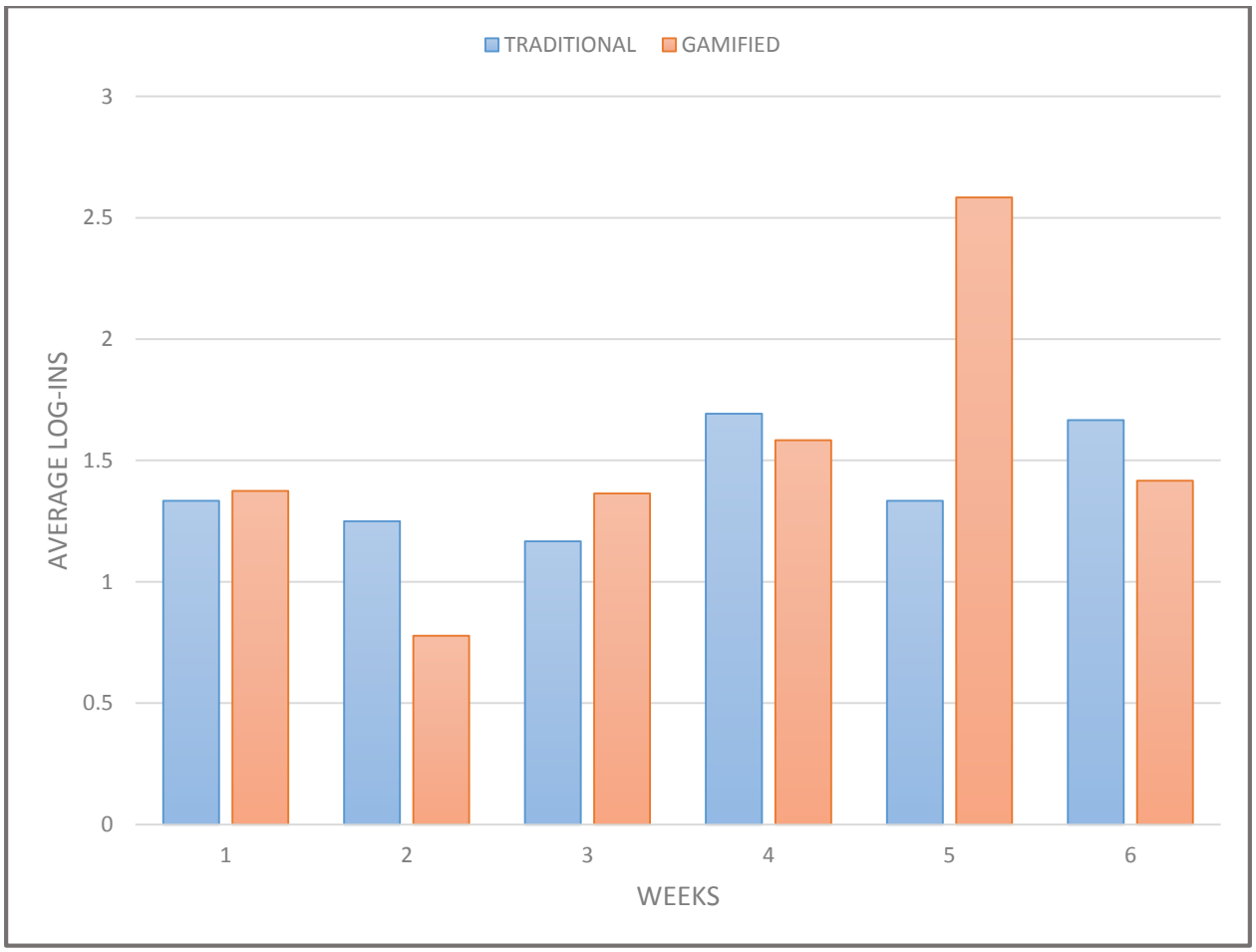


Figure 5.1 [average Frequency per group for each week of the experiment]

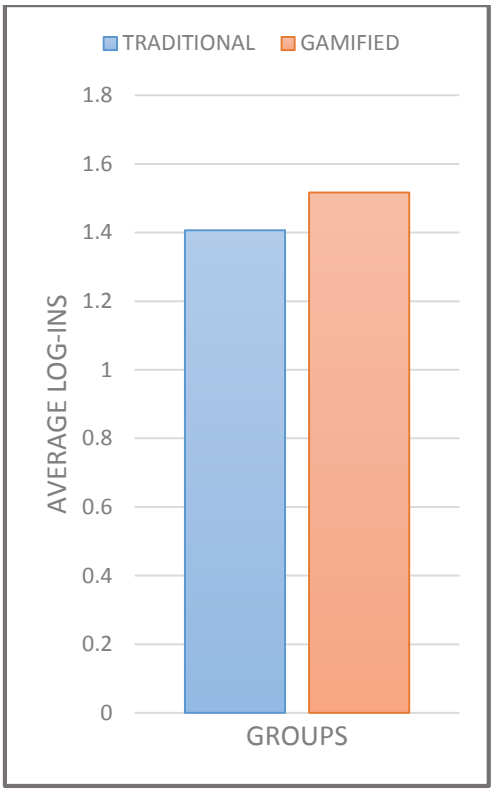


Figure 5.2 [average Frequency per group throughout the entire experiment]

Recency

Recency for the typical platform is shown in Figure 5.3, while the same magnitude for the gamified platform is shown in Figure 5.4. In specific, Figure 5.3 depicts the average number of days passed before a student returned to the system, for all the students of the control group, during the six weeks that the experiment lasted. Figure 5.4 depicts the average number of days passed before a student returned to the system, for all the students of the treatment group.

In an attempt to generalize the amount of time that had gone by before a student returned to each system, is being reported that for the typical platform, the students would return to the system every 7.896 days on average, while for the gamified one they would return every 6.461 days on average. The period of time is sorter up to 18.2% for the students of the gamified platform, compared to the students of the typical one, as it is depicted in Figure 5.5.

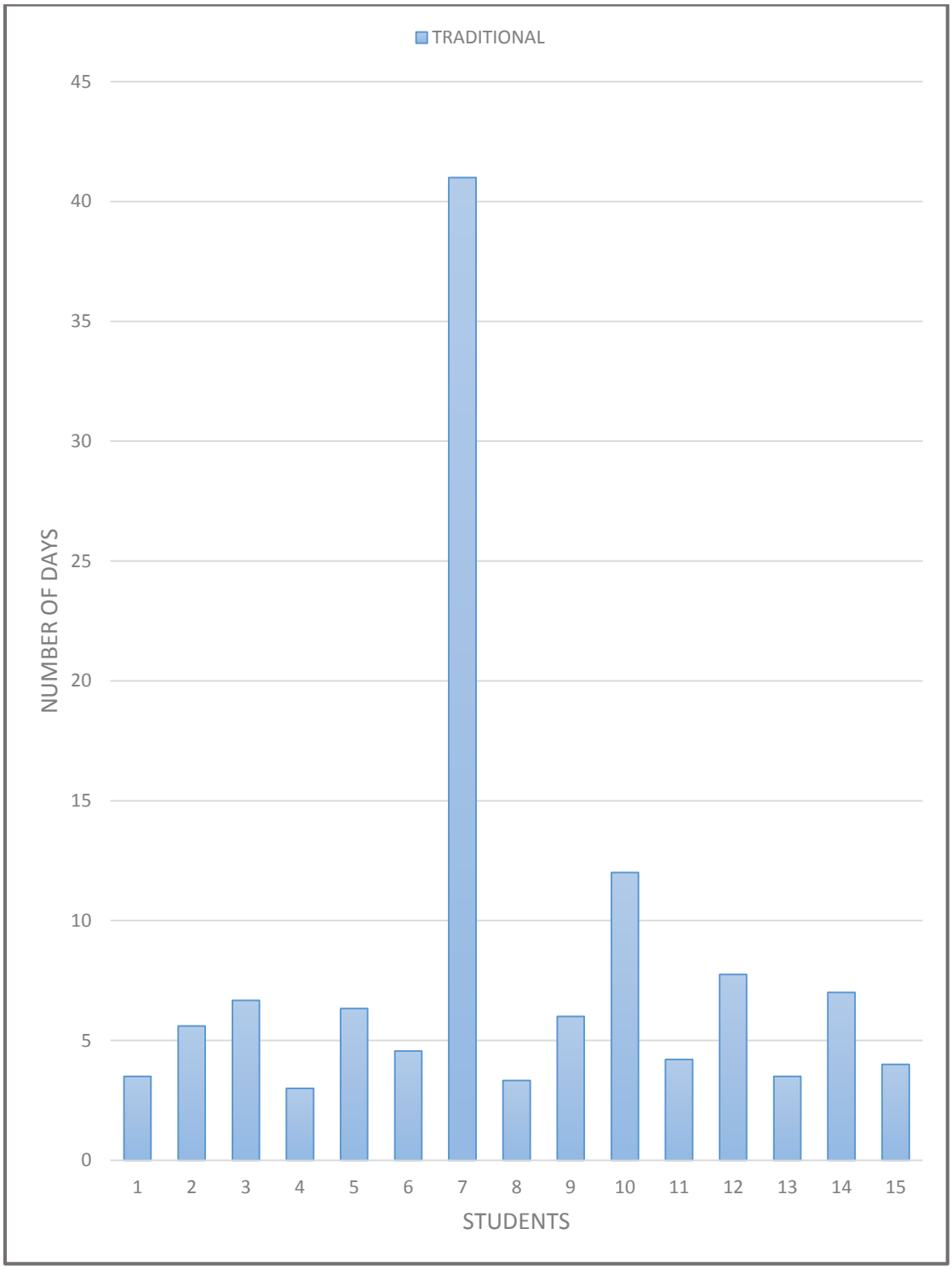


Figure 5.3 [average Recency for each student throughout the experiment]

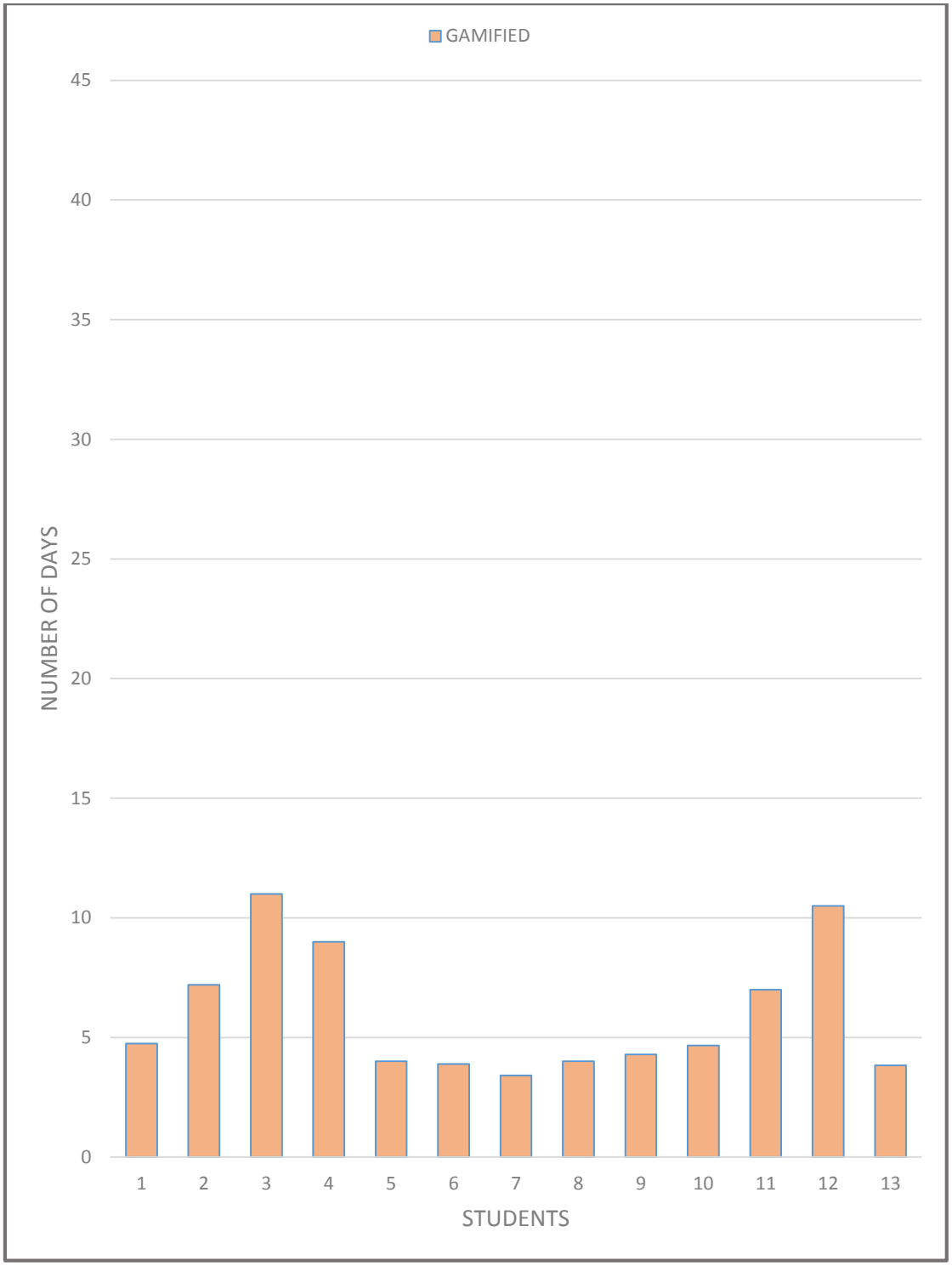


Figure 5.4 [average Recency for each student throughout the experiment]

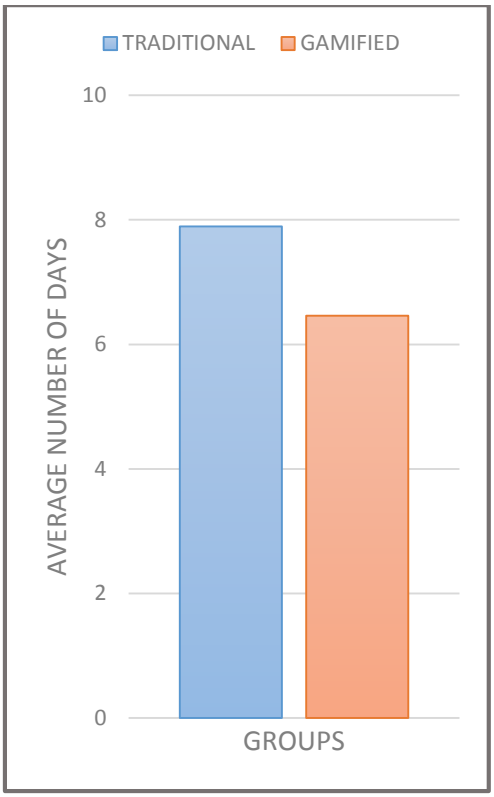


Figure 5.5 [average Recency per group throughout the entire experiment]

Duration

Figure 5.6 and Figure 5.7 depict the sum of the time spent for each student on each platform, during the six weeks that the experiment lasted. Although the amount of time devoted by a student to an educational activity does not necessarily enclose pedagogical value, the fact that the students of the gamified platform obviously spent more time on it, compared to the students of the typical platform, is particularly encouraging in respect to the purposes of this research.

More precisely, students of the treatment group, spent an average of 6 hours and 11 minutes on the gamified platform throughout the entire experiment, which is up to 123.5% higher, compared to the average of 2 hours and 46 minutes that the students of the control group spent on the typical platform, as it is depicted in Figure 5.8.

Finally, as it is shown in Figure 5.9, the Duration that the treatment group interacts with the gamified E-learning system constantly rises throughout the experiment, except for the last week for the same reasons that were explained before. Contrariwise, the Duration that the control group interacts with the typical E-Learning system, ranges indistinctly, as Frequency did. This particular fact, captures as well the increasing user engagement to the gamified platform.

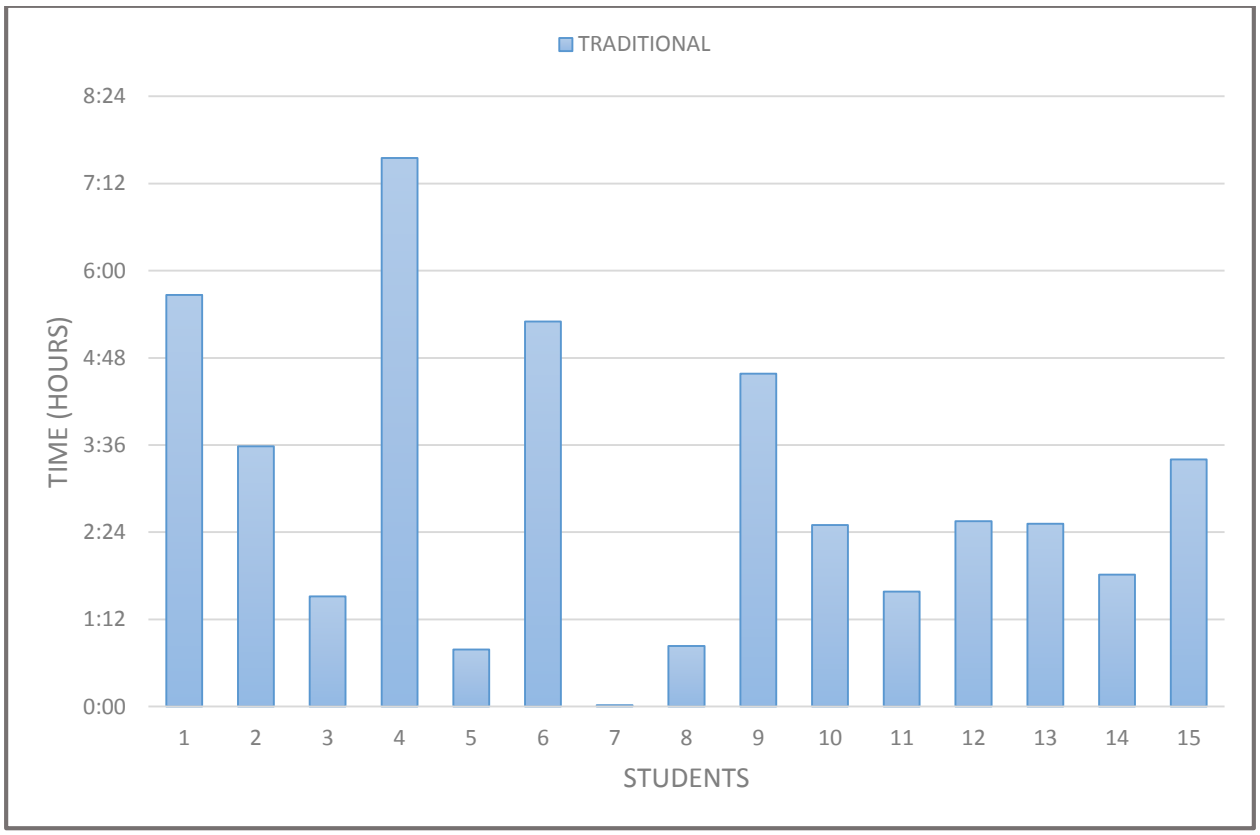


Figure 5.6 [total Duration for each student throughout the entire experiment]

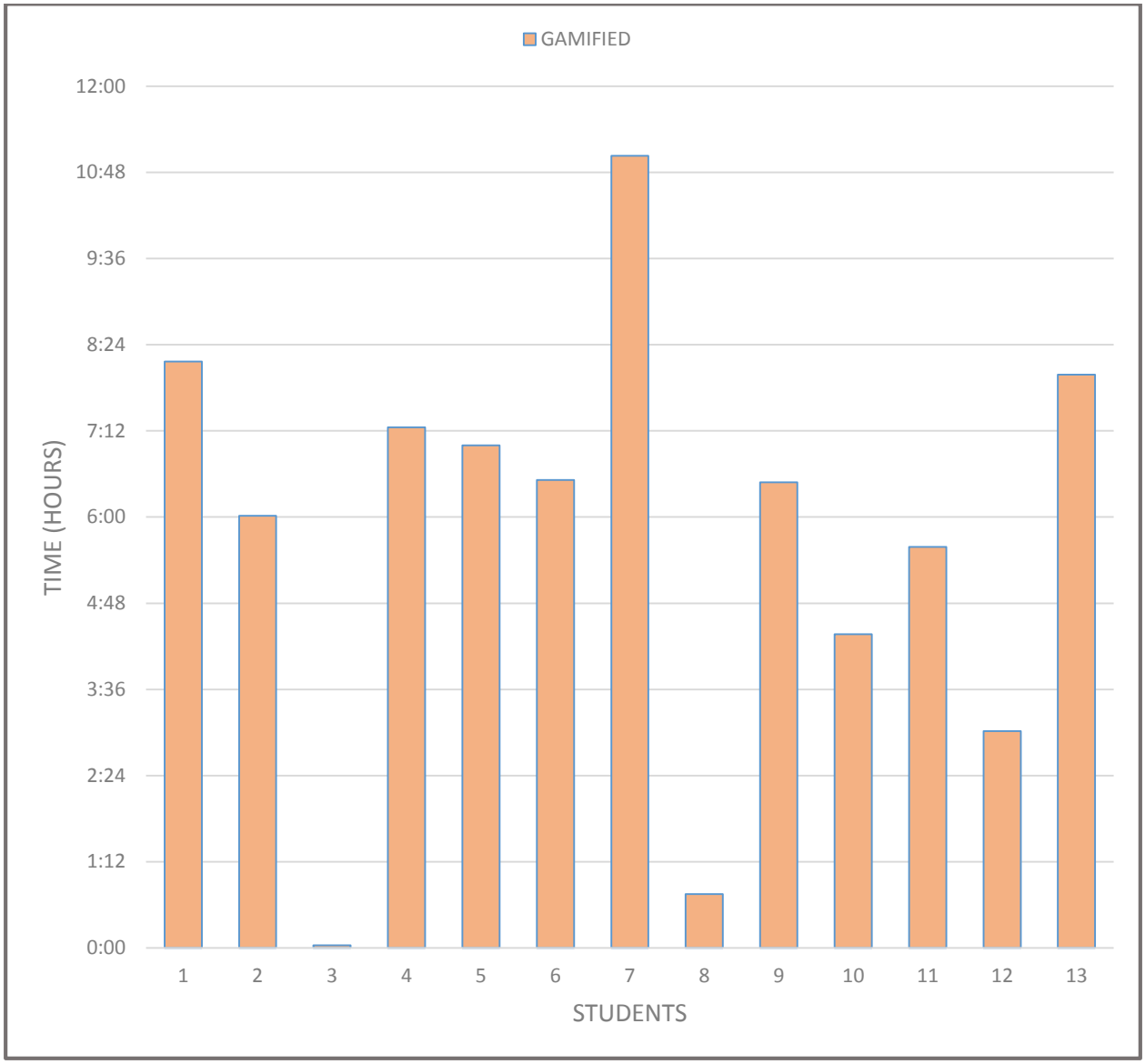


Figure 5.7 [total Duration for each student throughout the entire experiment]

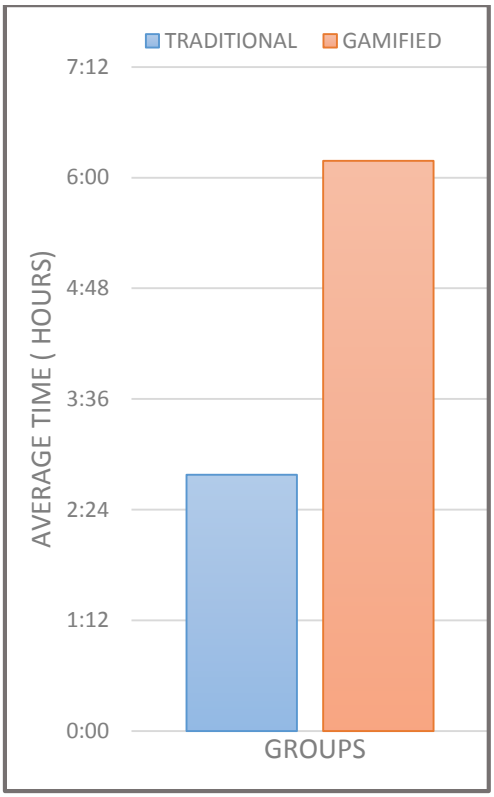


Figure 5.8 [average Duration per group throughout the entire experiment]

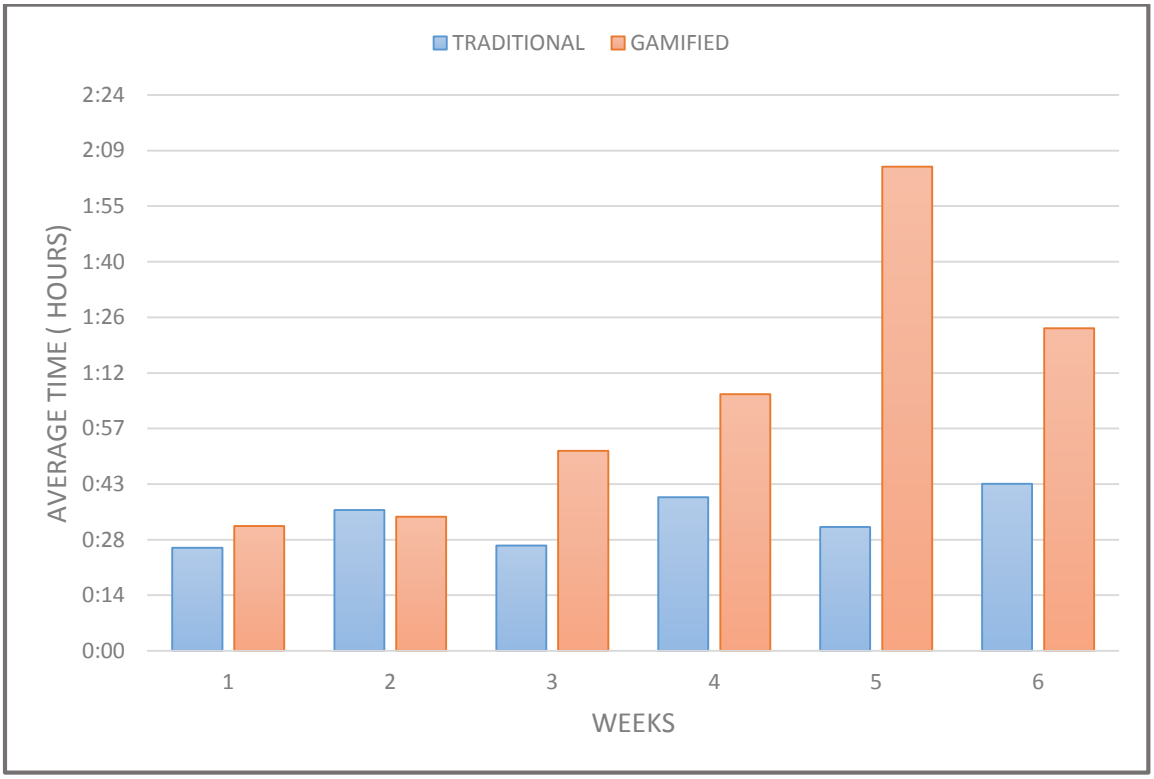


Figure 5.9 [average Duration per group for each week of the experiment]

Engagement

Collectively, Frequency, Recency and Duration have been amalgamated as an engagement score. In order to form this score, the relative importance of each of these metrics have been used as explained in Chapter 4.4. In an attempt to qualitatively depict the difference in the engagement rates between the two groups, the average engagement of the control group was considered, as the overall average engagement rate, for any typical group given. The results of this process are shown in Figure 5.10, and suggest higher engagement up to 19.7% for the treatment group which engaged to the gamified platform, compared to the control group which engaged to the typical one.

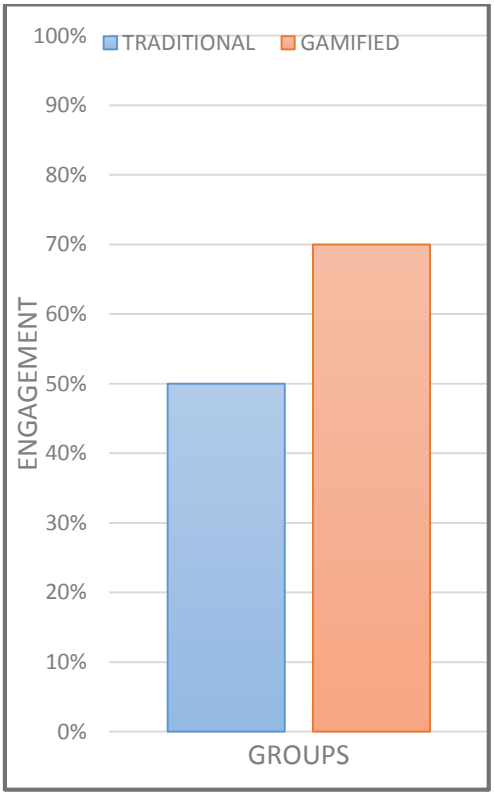


Figure 5.10 [average Engagement per group throughout the entire experiment]

5.2 Student Achievement

Course Participation

Complementary to the data collected, so as to measure the student engagement to each platform, data was collected from Moodle's report tools, in order to measure the general course participation, and therefore further evaluate the two E-Learning systems. Figure 5.11 depicts the total actions per module students have performed, while interacting with each system.

More precisely, as shown in Figure 5.12, students of the gamified platform tend to perform more actions on modules regarding assignments, compared to the students of the typical platform. A total of 864 actions were performed on all five assignment modules of the gamified platform throughout the experiment, which corresponds to an average of 72 actions per student for all modules cumulatively, while a total of 473 actions were performed on the same modules of the typical system, which correspond to an average of 31.533 actions per student on the respective modules. As depicted in Figure 5.13, up to 128.3% more actions on the assignment modules of the gamified platform were performed, compared to the same modules of the typical one. This particular fact can be connected to the external motivation created by awarding accomplishment Badges to the students who completed those assignments on the gamified platform, which resulted in students making larger effort to complete assignments, compared to the effort made by the students of the typical one.

On the other hand, as depicted in Figure 5.14, students of the typical platform tend to perform more actions on modules regarding tutorials, compared to the students of the gamified platform. A total of 587 actions were taken on all tutorial modules of the typical platform throughout the experiment, which corresponds to an average of 39.133 actions per student for all modules cumulatively, while a total of 394 actions were taken on the gamified platform, which

correspond to an average of 32.833 actions per student for the respective modules. As depicted in Figure 5.15, up to 16.1% more actions on the tutorial modules of the typical platform were performed, compared to the same modules of the gamified one.

Collectively for all modules integrated to the systems, and as shown in Figure 5.16, an average of 92.066 actions per student were performed on the typical platform, while an average of 132.166 actions per student were performed on the gamified one. Therefore, up to 30.3% more actions per student were performed on all modules cumulatively of the gamified platform.

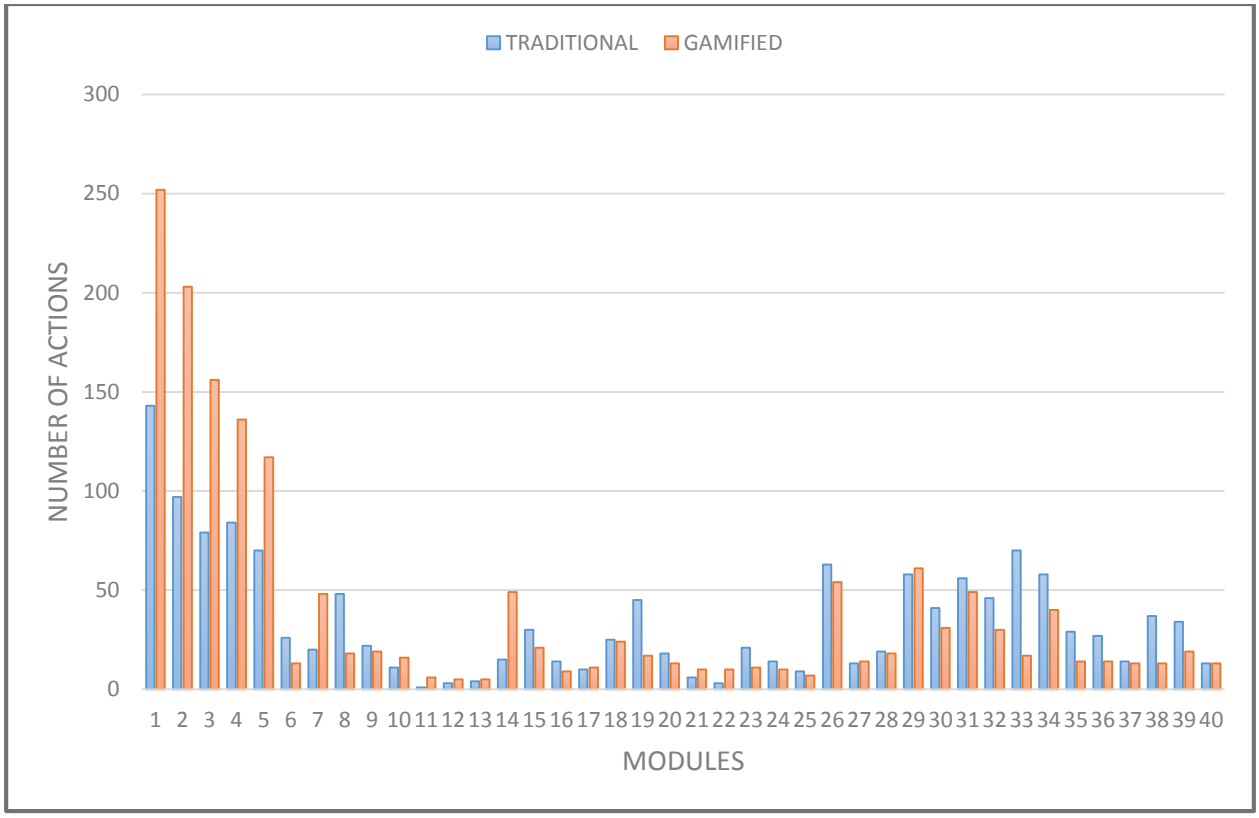


Figure 5.11 [total number of actions per module]

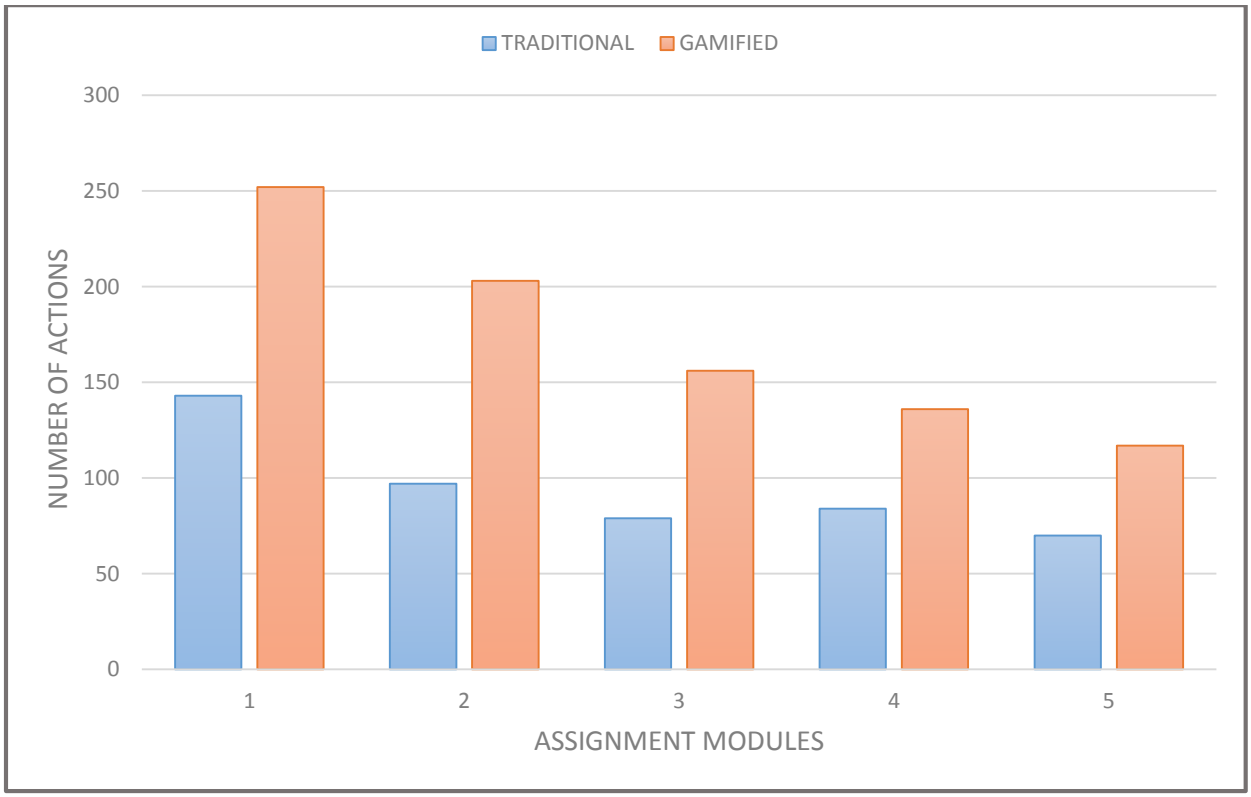


Figure 5.12 [total number of actions per assignment module]

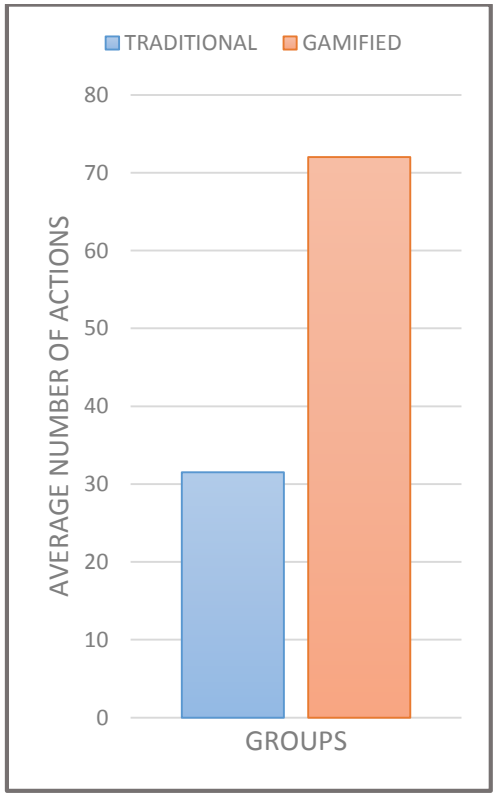


Figure 5.13 [average actions per group for all assignment modules cumulatively]

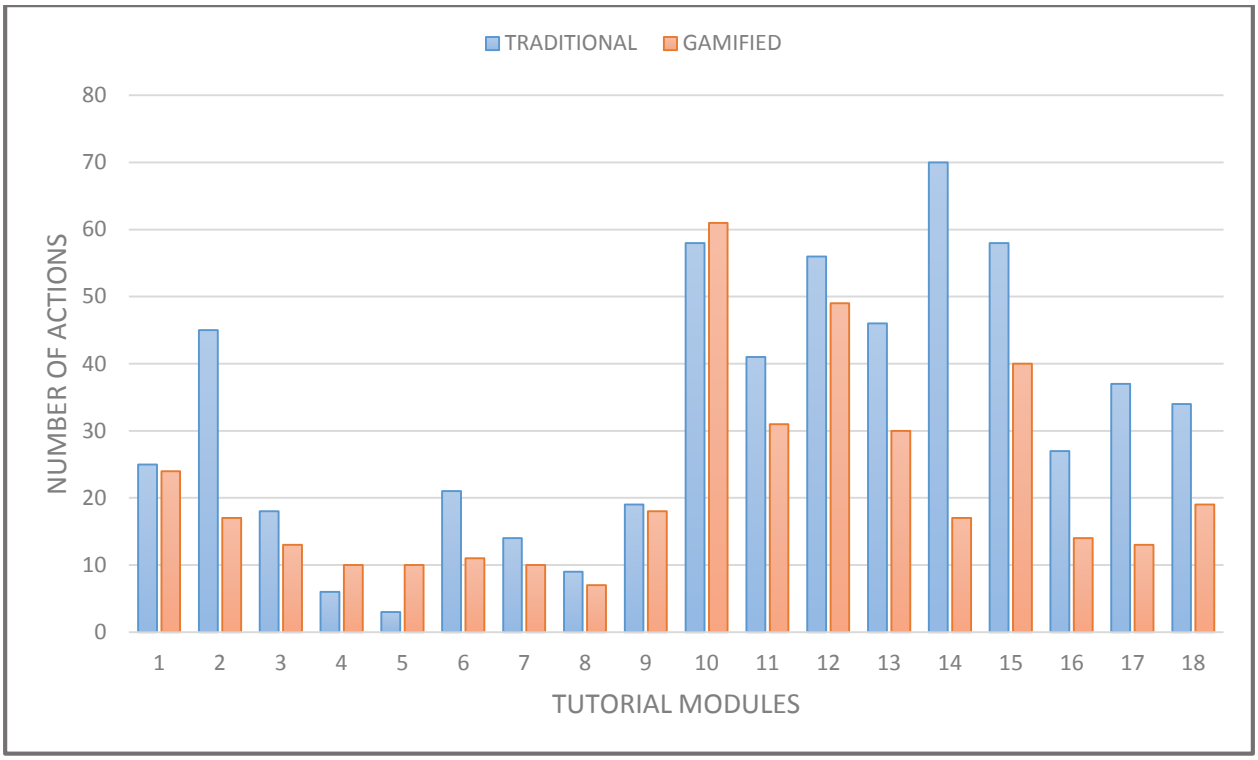


Figure 5.14 [total actions per tutorial module]

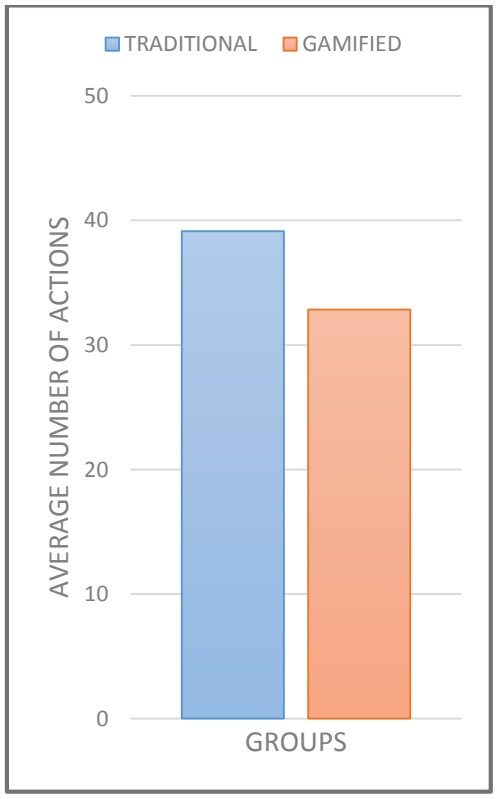


Figure 5.15 [average actions per group for all tutorial modules cumulatively]

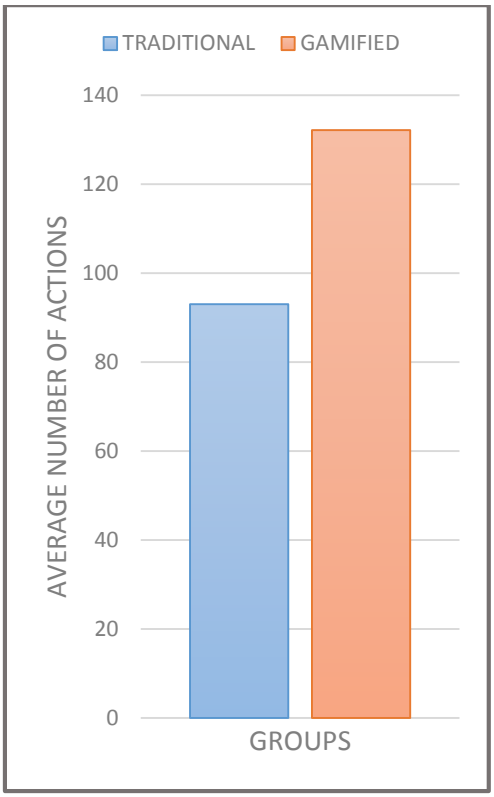


Figure 5.16 [average actions per group for all modules cumulatively]

Activities Completion

Furthermore, an additional way to measure students' accomplishments, and to evaluate how they interacted with both E-Learning systems, is to examine the data collected from Moodle's report tools, regarding the activities completed by the students.

As shown in Figure 5.17, an average of 16.333 activities per student are completed in the typical platform, while an average of 24.25 activities per student are completed in the gamified one, which results in 32.7% more activities completed in the gamified E-Learning system. More precisely, Figure 5.18 depicts the students' percentages on each platform, which completed each of the five assignments throughout the experiment. While the percentages for the students of the gamified platform range from 75% to more than 91%, the respective percentages for the students

of the typical platform range from 20% to 60%. Moreover, as depicted in Figure 5.19, only 60% of the students of the typical platform completed the first quiz, while all of the students of the gamified one completed it. The same percentage maintained for the second quiz at the typical platform, while 75% of the students of the gamified platform completed it.

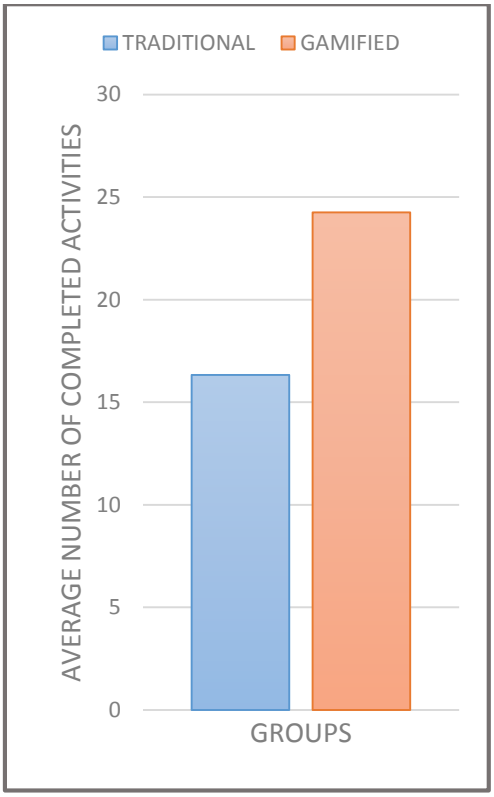


Figure 5.17 [average completed activities per group]

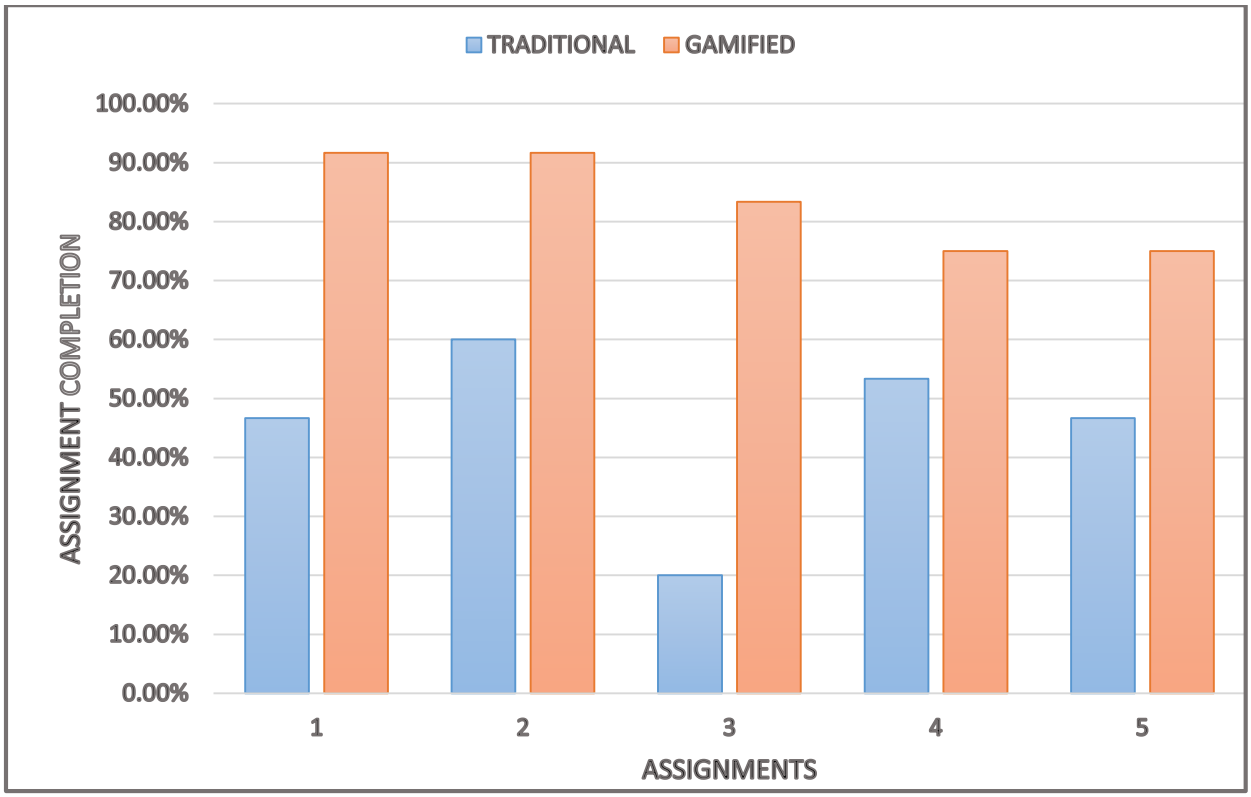


Figure 5.18 [assignment completion per group]

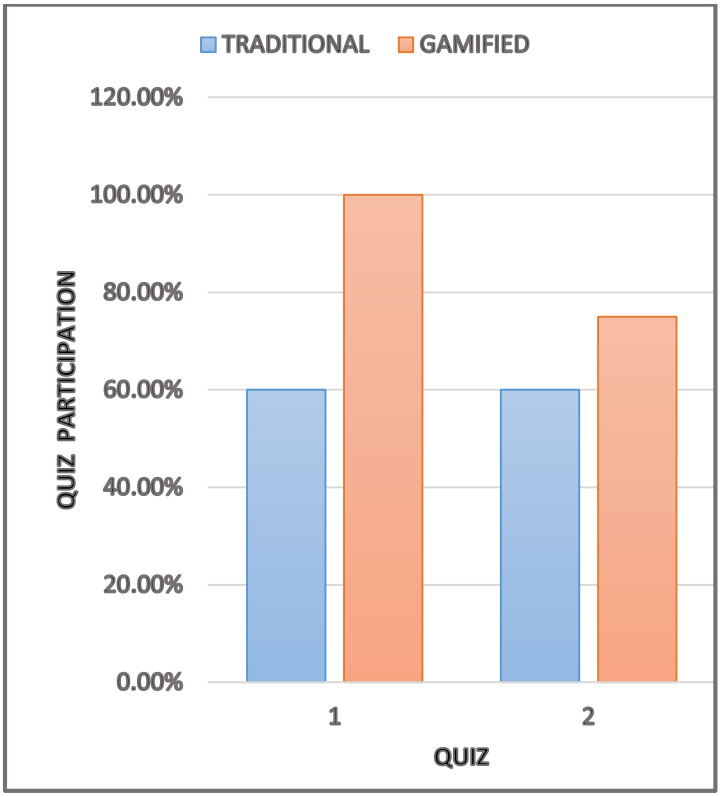


Figure 5.19 [quiz completion percentages per group]

5.3 Attitudinal Survey

The survey was conducted in the form of questionnaires, and the gathered responses came from the students of both platforms. Generally, the respondents were asked to answer various questions by either filling with a sort text, choosing true or false, or choosing a value from 1 to 5. The scale represented various statements from “not at all”, “a little”, “somewhat”, to “very” and “totally”, for 1 to 5 respectively.

Moreover, the survey ought to uncover issues, such as the students' familiarity level accomplished in using the computer, as well as using the ICT tools they were taught throughout the experiment, their attitudes regarding the use of E-Learning platforms, Video Games and multimedia tools during the educational process, and finally, issues regarding the general usability and usefulness of the E-Learning systems they used throughout the experiment.

Quantitative Analysis

As depicted in Figure 5.20, students of the typical platform encountered the process of installing new software tools on the computer, and using the specific tools they were taught, “somewhat” easy, while the students of the gamified platform felt closer to “very” easy. Students of both platforms, when asked the same question in the pre-test, responded that they considered the specific procedure from “not at all” to “a little” easy, as it is shown in the same figure. Therefore, it is considered that there has been improvement in students' attitudes, regarding the specific issue.

Furthermore, the students responded to hypothetical scenarios, such as whether they would find it useful to include an E-Learning system or a multimedia content software in order to assist students during the educational process. Users of the typical platform ranged between “somewhat” and “very” useful regarding the use of both the E-Learning system and the multimedia content

software, while users of the gamified platform were closer to “very” useful regarding the E-Learning system, and they ranged between “very” and “totally” regarding the multimedia content software, as shown in Figure 5.21 and Figure 5.22.

Another hypothetical scenario users of both platforms were asked to respond, was whether they would find it useful to include Video Games in order to assist students during the educational process. As depicted in Figure 5.23, users of both platforms were rather skeptical towards the specific subject during the pre-test. However, during the post-test, users of the typical platform ranged between “somewhat” and “very” useful, while users of the gamified platform were closer to “very” useful.

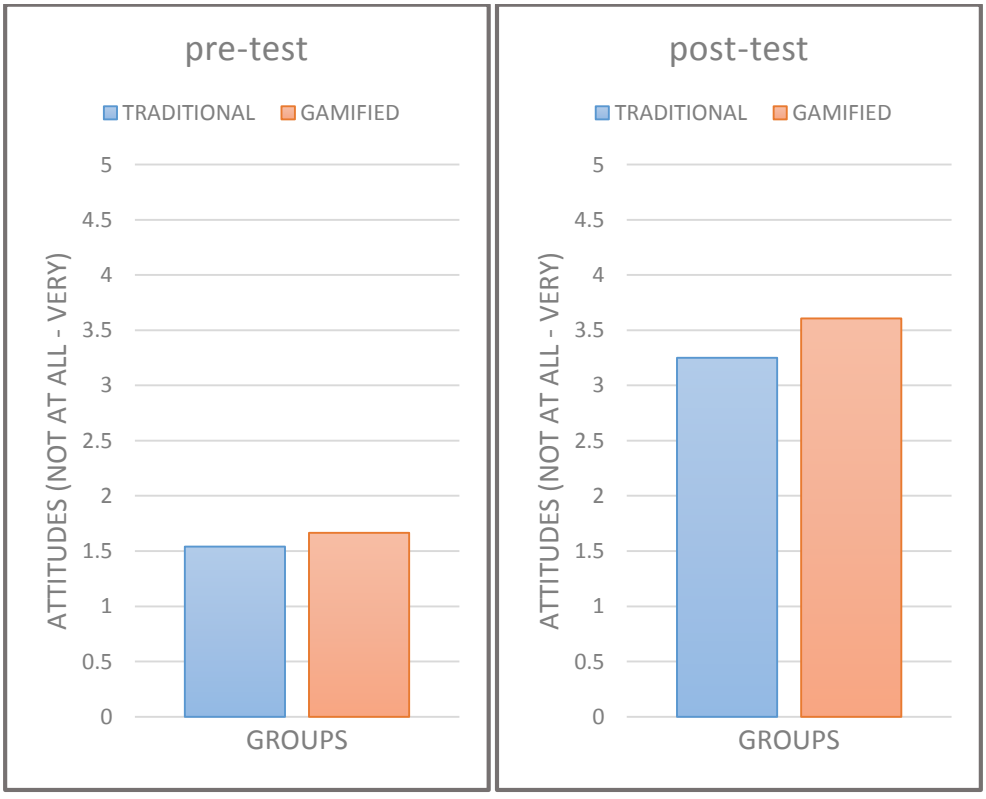


Figure 5.20 [familiarity level in using the Computer and ICT tools]

Figure 5.21 [attitudes on integrating an E-Learning platform to the educational process]

Figure 5.22 [attitudes on integrating multimedia content to the educational process]

Figure 5.23 [attitudes on integrating Video Games to the educational process]

Qualitative Analysis

Finally, students provided feedback about their perceptions towards the E-Learning systems and the learning experience as a whole. In general the responses were positive. More specifically, students stressed the importance of teachers keeping up with the changes in ICTs: *"..of course it is required for a teacher to keep up with such developments, particularly a teacher in special education, an area where information technologies provide access to SEN pupils, who otherwise may not have had it."*

The questionnaires included questions to indicate whether or not the students found the systems useable. Responses to those questions by the users of the typical platform ranged between "a little" and "somewhat" useable, while responses by the students of the gamified platform ranged

between “somewhat” and “very” useable, as depicted in Figure 5.24. The differences between the responses of control and treatment groups regarding the usability of the platforms are particularly interesting, due to the fact that besides the existence of Badges, the two platforms were identical.

The students also responded to the questions of whether or not they found the system helpful during the specific course, and whether or not they would find a similar system helpful during other courses. Responses to both questions by the users of the typical platform were close to “somewhat” helpful, while responses to both questions by the students of the gamified platform ranged between “somewhat” and “very” helpful, as depicted in Figure 5.25 and Figure **5.26** respectively.

Specifically, users of the gamified platform responded to whether or not they found the use of Badges motivating or disturbing. Responses to the first question were close to “very” motivating, while responses to the second question ranged between “not at all” and “a little” disturbing, as depicted in Figure 5.27. Moreover, students’ responses indicate, that Badges in general, have been positively received. Students of the treatment group characteristically reported: *“..it was nice to watch the Badge popping up, every time you somehow managed to earn it.”* or *“..i liked watching on my profile page the badges I had earned, and also comparing them to the Badges of my classmates.”* However, some of those students reported that they did not pay much attention to the Badges: *“They did not really affect my studying at all.*”

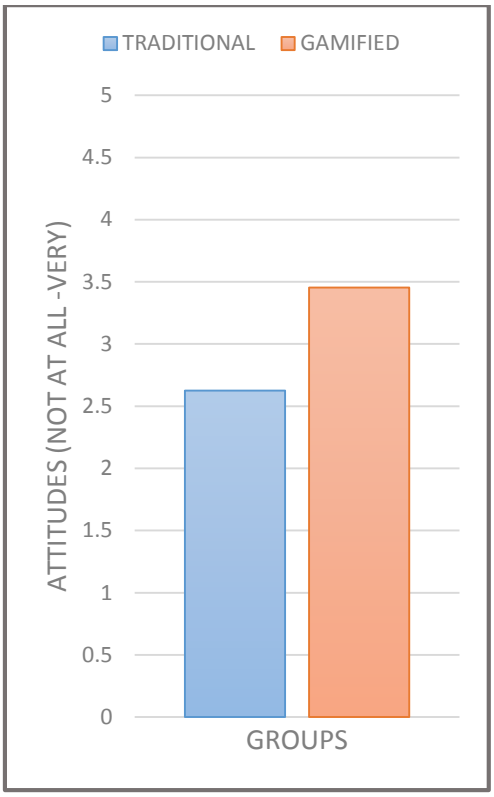


Figure 5.24 [attitudes regarding the usability of the platforms]

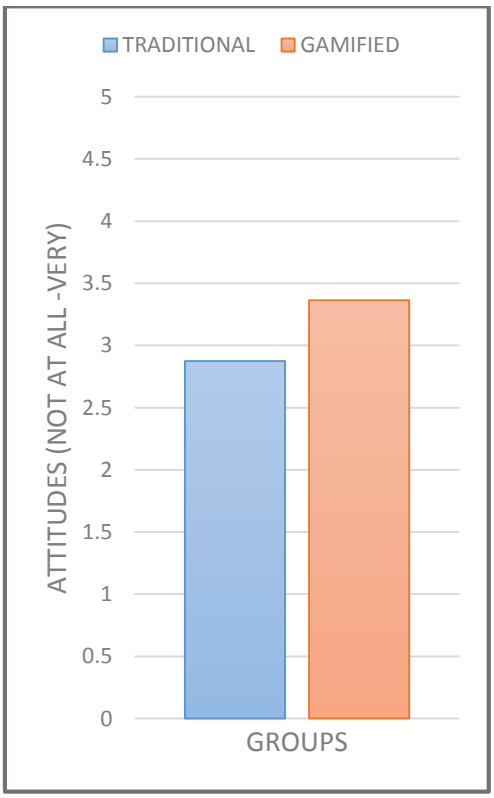


Figure 5.25 [attitudes regarding helpfulness during the particular course]

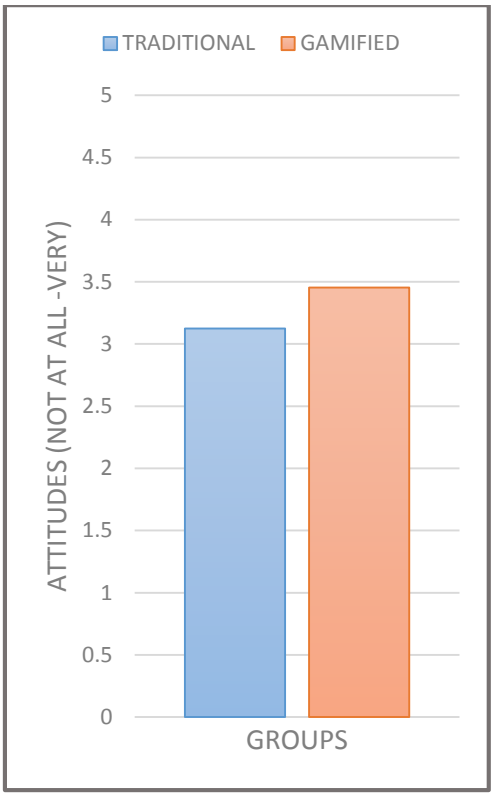


Figure 5.26 [attitudes regarding helpfulness during other courses]

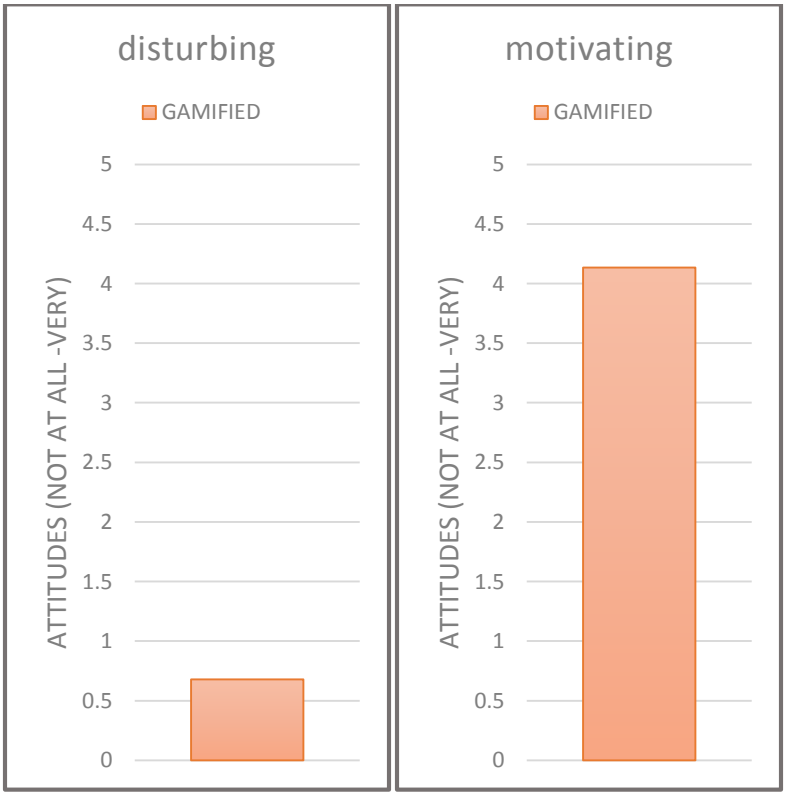


Figure 5.27 [attitudes regarding Badges]

6. Discussion

The results derived from the evaluation give measures to discuss and answer the research questions put forward by this thesis. Each question will be viewed in the light of the most important findings of this research.

Technical Research Questions

Question 1: *Is it feasible for a reward system, merely based on badges, to uplift students' motivation, and further engender engagement to an E-Learning system?*

The results provided by this particular research indicate increased engagement for the students of the gamified platform, compared to the students of the typical one. Precisely, for the treatment group, greater Frequency rate up to 7.2% was noted. Moreover, lower Recency rate up to 18.2% was noted, compared to the control group. Finally, students of the gamified platform spent up to 123.5% more time on the system, compared to the students of the typical one. Therefore, this particular study proved higher motivational level engendered by accomplishment Badges, to undergraduate female students of the Special Education Department of the University of Thessaly in Greece.

Question 2: *How do students respond to the gamified E-Learning system developed for the purposes of this research?*

Students of treatment group responded positively to the gamified E-Learning system by committing more to it, than the students of the typical system did. Not only have they noted higher engagement rates but they have also accomplished more, compared to the students of control group. More specifically, students of the gamified platform performed up to 30.3% more actions on all modules cumulatively, throughout the entire experiment, while they completed up to 32.7% more

activities, compared to the students of the typical platform. Finally, treatment group perceived Badges as "very" motivating, and between "not at all" and "a little" disturbing.

Question 3: *How usable and helpful do students find the gamified E-Learning system developed for the purposes of this research?*

The generalized response of the students of treatment group, towards the gamified E-Learning system's usability and helpfulness has been rather positive. Students perceived the system between "somewhat" and "very" useable, while they found it between "somewhat" and "very" helpful within the context of the specific course. Students also believe, that a respective system would also be between "somewhat" and "very" helpful within the context of other courses.

Question 4: *To what extent are modern teachers familiar to Information and Communication Technologies used in education? Where do they stand with regard to using such technologies in real life educational settings?*

During the particular research, an unexpected statistic was revealed, which indicated low familiarization levels of students of the Special Education Department, regarding the ICT tools and new technologies used in education. Pre-control indicated, that the initial attitudes of the sample were negative towards the specific technologies, faced with hesitation during the beginning of the experiment. However, after the end of the experiment, post-tests revealed a shift in students' attitudes, regarding the specific subject. The majority of the students responded, that they would find between "somewhat" and "very" helpful the integration of Video Games or E-Learning systems during the educational process, while they would find "very" helpful the use of multimedia content creating tools.

Overall Research Questions

Question 1: *Is it possible for students to learn from games?*

"Brain scientists over the world agree that games' challenge-achievement-reward loop promotes the production of dopamine in the brain, reinforcing our desire to play" [7]. The same challenge-achievement-reward loop proved increased desire on the part of students, to further engage to the E-Learning system. Therefore, it could be deduced, that games and game mechanics are potential tools, which could accommodate students to learn, by further motivating them. On the other hand, judging by the state of the educational software industry, children will not learn from a game, if it is not fun. In other words, balanced design of the educational and the fun aspects of the experience is of great importance, in order for the learning experience to work effectively.

Question 2: *Could Gamification be a simple yet still efficient approach, in order to make educational content more attractive, and engender the desired state for the student?*

Students need to get value for the time spent on a learning experience, and be efficiently driven towards further engaging, and accomplishing better grades. The main importance to applying Game Mechanics based E-Learning is that the intrinsic motivations of students needs to be supported. The results of this research prove that Gamification elements have engendered students to further engage to educational content up to 30.3%. It could be assumed, that earning reward for engaging to educational content makes the content itself show more attractive to students. Furthermore, the methodology adopted in the attempt to create the learning experience, did not include any costly resources, as the development of a Serious Game would had, and therefore, it can be considered a simpler, yet still efficient approach, compared to Serious Games.

Question 3: *Which is actually the desired state a student should reach, with respect to his interaction with an on-line experience?*

The desired state, regarding a player of a Game, is the state of flow, where the player balances between boredom and anxiety, and meets his own motivational level. For the purposes of this research, based on the notion that the same motivational level could be met in any given experience, by achieving the state of flow, the gamified E-Learning system was designed accordingly. The results indicate students of the treatment group engaging, participating and accomplishing more, compared to the students of the control group. Moreover, results indicate that the users of the gamified platform felt more comfortably while using the system, and also perceived it as more useful and helpful, compared to the users of the typical one. Therefore, it could be deduced that the general higher participation and performance of the students of the gamified platform, lies to the fact that they approached the state of flow more than the users of the typical one.

Question 4: *How motivating can a simple Game Mechanic be when integrated to an E-Learning system?*

Quantitative and qualitative data provided by this particular research, indicate high impact on students' behavior, caused by a simple game mechanic. However, previous research on the field, indicated that the impact of a simple game mechanic integrated to an E-Learning system is rather moderate. More specifically, Gaasland, who integrated a point system to a learning experience, noted that *"A simple Game Mechanic is not as motivating in itself as if it aligns with the overall goal of the student"* [2]. Moreover, Dominguez et Al, who integrated achievement Badges to a learning experience, stated that *"Although gamification impact on the cognitive aspects of educative content is limited, we still think that changing content design and structure to make it*

more fun can have great motivational impact" [19]. Therefore, further research is needed on testing isolated Gamification mechanisms, and their combinations as well.

7. Conclusions & Future Work

7.1 Conclusions

Although Gamification in E-Learning systems seems to have potential to increase student engagement, it is not trivial to achieve such effect. Gamification is not the tool to fix a product's core problems. Instead, careful design and implementation of the learning experience is required, in order to further apply Gamification elements and motivate the students. In this thesis, an attempt to explore the merits of Gamification and Game Mechanic based E-Learning has been made. Moreover, this thesis has:

- Introduced and charted the growing trend of Gamification, which is discussed to have potential societal impacts.
- Discussed some of the central elements of games, the basic theoretical aspects of player motivation, and introduced some of the basic Game Mechanics.
- Elaborated the challenges faced by Serious Games.
- Introduced the potential of using Game Mechanics based E-Learning as an alternative approach to Serious Games which would exclude a range of problems.
- Presented a practical implementation for Game Mechanics based E-Learning, and the methodology that was followed for the purposes of the development.
- Evaluated the use of achievement Badges within E-Learning, and presented the methodology that was followed for the purposes of the evaluation.

Furthermore, the main goal of this thesis was to contribute to the limited empirical evidence existing on the field, by the time of its writing. The results indicate differentiation between the way the two groups perceived the learning experience, as well as different proportions of engagement noted by them. More specifically, the research findings can be summarized as follows:

- Students of the gamified E-Learning system noted higher Frequency rates, compared to the students of the typical E-Learning system.
- Students of the gamified E-Learning system noted lower Recency rates, compared to the students of the typical E-Learning system.
- Students of the gamified E-Learning system noted higher Duration rates, compared to the students of the typical E-Learning system.
- Students of the gamified E-Learning system performed more actions to the modules integrated to the platform, compared to the students of the typical E-Learning system.
- Students of the gamified E-Learning system completed more activities integrated to the platform, compared to the students of the typical E-Learning system.

Finally, it must be highlighted, that in the process of gamifying an application, regardless of the topic this application might be related to, the core work is unchanged, and nothing is fundamentally shifted in the mechanics of designing the particular application. The applications developed for the purposes of this research are not an exception. The core work done in designing and implementing both platforms was totally unchanged. Only the perceptions of students have been altered for the better. *"Understanding the potential to experience the same things in two ways is the first step to understanding the power of Gamification"* [7].

7.2 Future Work

In future work there are several aspects of Gamification and Game Mechanic based E-Learning that could be researched. For the particular system presented in this thesis, it would be very interesting to test the system over an entire semester. Consequently, more data would be available, so as to ensure the effect of Badges on user engagement. Moreover, it would be important to test the same E-Learning system with different experimental subjects, as well as test it in different learning context, in order to validate the results presented in this thesis or turn to a different direction.

A different option would be to choose an entirely different game mechanic, and evaluate its potential to increase student engagement. However, it would be more valuable to evaluate each game mechanic on its own, and create a comparative overview of their individual motivational effect. Furthermore, several game mechanics could be combined in the same E-Learning system, so as to teste and compare, which combinations have a larger impact on student engagement.

Finally, it would be an interesting project to design, develop and implement a gamified E-Learning system from scratch. Such system would combine characteristics from different types of E-Learning systems, and it would also obtain a great range of Gamification elements, so as it could be fully gamified. It could also draw inspiration from popular Web applications and Social Networks, in order to further motivate the students, and also appear familiar to them.

8. References

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