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a cura di
Stefania Capogna, Donatella Cannizzo, Concetta Fonzo

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INDICE

GAMIFICATION IN HIGHER EDUCATION: A SELF-DETERMINATION THEORY PERSPECTIVE ON THE REWARD SYSTEM[1]

by Giada Marinensi[*], Brunella Botte[**], Marc Romero Carbonell[***]

Abstract: *Educational gamification is a rising area, and several studies have already been conducted in the context of Higher Education, with encouraging results, especially about the effectiveness of gamification in increasing students' perceived motivation to learn. The authors of this study explore how game elements commonly used in gamified learning systems, such as badges, points, progression bars and levels, can affect students' motivation by fulfilling their needs for competence, relatedness, and autonomy, in the framework of the self-determination theory (SDT). The final goal is to better understand how to build the reward system of an educational gamified application aimed at maximising students' motivation.*

Keywords: flipped learning, moodle, active learning, achievements.

Abstract: *L'applicazione di tecniche di gamification in ambito formativo è aumentata considerevolmente negli ultimi anni, e numerosi studi sono stati già condotti nello specifico contesto della Formazione Superiore con risultati*

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incoraggianti, in particolare in riferimento all'efficacia della gamification nel promuovere la motivazione all'apprendimento degli studenti. Gli autori di questo studio si focalizzano sull'analisi del modo in cui gli elementi di gioco più comunemente usati nei sistemi di apprendimento gamificati, come badge, punti, barre di progressione e livelli, possano influenzare la motivazione degli studenti soddisfacendo i loro bisogni di competenza, relazione e autonomia, nel quadro della self-determination theory (SDT). L'obiettivo finale è quello di ricavare delle indicazioni utili alla progettazione del sistema di ricompense delle applicazioni gamificate in modo che possa supportare efficacemente la motivazione degli studenti ad apprendere.

Keywords: flipped learning, moodle, active learning, ricompense.

1. Introduction

Following the Bologna Declaration and the European Higher Education Area (EHEA) creation, European Higher Education Institutions (HEIs) have set out on a difficult path of structural reforms. Among the aims of these reforms, there is the adoption of innovative models for teaching and assessing students' learning, with a particular focus on active learning methodologies that encourage students to take an active role in creating their learning process (López, 2017).

However, shifting from the traditional lecture-focused classroom setting to more learner-centred environments is still an ongoing, complex transition for all the involved subjects: academic bodies, teachers and students. In this transition, the role of the students is critical because, in contrast to traditional teaching methodologies, active methodologies are based primarily on the students' responsibility for their own learning through active participation and engagement. Therefore, finding effective ways to foster students' engagement and motivation has never been more

crucial. A possible strategy to achieve this goal may include adopting a gamified approach. The use of game elements in learning contexts can indeed be appealing for the new generations of students, which are digital natives, have a high level of familiarity with the video games language (Glover, 2013), and are open to the concept of learning from this medium (Prensky, 2003).

Recent studies about the use of gamification in HEIs have already achieved promising results, above all concerning the improvement of students' perceived motivation in learning (Ab Rahman, Ahmad, & Rabaah Hashim, 2018; Alsawaier, 2018; Chapman & Rich, 2018; Costello & Lambert, 2018).

The relation between gamification and motivation can be analysed in light of the framework provided by the self-determination theory (SDT) and its explanation of how human motivation works. According to SDT, human beings seek to satisfy three basic needs: competence, relatedness, and autonomy. Competence is the feeling of being successful in one's social environment; relatedness is the feeling of being connected to others; and autonomy is the feeling of being in charge of one's own behaviour (Deci & Ryan, 2002).

In this study, we address the issue of how to design the reward system of a gamified application, using different kinds of achievements such as points, badges, levels etc., to foster students' motivation by satisfying their need for competence, relatedness and autonomy.

2. Defining gamification

The term "gamification" is relatively recent since it entered more widespread use in industry and academia only around 2010, and it is still often confused with similar concepts such as

"serious games", "game-based learning", and "games". Thus, it can be helpful to define "gamification" and briefly explain how to relate this topic to other topics of interest in the vast research field of applied games.

2.1 Highlighting the differences between gamification, serious games, game-based learning, games

Gamification refers to the process of using game elements and game-design techniques in non-game contexts to motivate and engage users to solve problems and reach real-life goals (Deterding, Khaled, Nacke, & Dixon, 2011; Kapp, 2012; Werbach & Hunter, 2012; Zichermann & Cunningham, 2011).

Therefore, it is possible to distinguish gamified apps from serious games since serious games are complete games designed mainly for non-entertainment purposes (Barca, Botte, Marinensi, Matera, & Medaglia, 2012). On the other hand, gamification, rather than creating entire games, foresees just the application of game elements (Marczewski, 2018).

Furthermore, specifying that gamified applications are meant to be used in 'non-gaming contexts' enables us to draw a line between the world of gamified applications (as well as serious games) and the world of games, since the latter's primary purpose is entertainment (Marczewski, 2018).

Finally, there are relevant differences between gamification and game-based learning, as game-based learning occurs when students play actual games, both analogical and digital, for the purpose of learning (Schmidt, Emmerich, & Schmidt, 2015).

3. Gamification in Higher Education

Numerous studies have been conducted, in recent years, on the effectiveness of educational gamification, specifically in Higher Education. Most of these studies reported positive results in terms of learning outcomes, students' attendance and students' perceived motivation (Ab Rahman *et al.*, 2018; Alsawaier, 2018; Chapman & Rich, 2018; Costello & Lambert, 2018; De-Marcos, García-Cabot, & García-López, 2017; Lin, 2014).

In De-Marcos *et al.* (2017), a social gamification approach is applied to an undergraduate course and compared to a traditional e-learning approach. It was observed that the gamified group outperformed the control group on practical assignments. An empirical study carried out by Dias (2017) compared the results of a total of 150 first-year management students divided into two groups. The students taking the gamified version of the course showed a statistically higher mean score, pass percentage, participation and class attendance than the non- gamified group.

Various gamified experiences are based on technological tools, such as game-based student response systems, that allow teachers and learners in classroom settings to interact through competitive knowledge games. The study of Lin (2014), for instance, was focused on the use of a system named Kahoot![2]. The key findings of this study offer a good insight into the effectiveness of using Kahoot! in higher education: 100% of the students expressed their positive regard for the effectiveness of Kahoot! in the academic context, and 98% of the students communicated that Kahoot! did help foster their learning.

Ab. Rahman *et al.* (2018) also analysed the impact of using gamified student response systems (Kahoot! and Quizizz) to

[2] Available at https://kahoot.com/schools-u/.

improve students' engagement in the Database Design subject at Politeknik Muadzam Shah Pahang, Malaysia. The researchers adopted an empirical investigation method, and data were collected based on Technology Acceptance Model (TAM) and Student Course Engagement Questionnaire (SCEQ). The study highlighted that technology played a significant role in the students' perception of the gamification approach implemented. Students were indeed more inclined to use the gamification if the technology was easy to use.

4. The connection between gamification, motivation and learning

To understand the relationship between gamification and motivation, it's useful to briefly describe the connection between games, particularly digital ones, and motivation. Ryan *et al.*, state that playing video games can fulfill the SDT basic psychological needs and thus can be used as predictors of enjoyment and interaction during the gaming experience (Ryan, Rigby, & Przybylski, 2006).

The decision to begin playing a video game, on the other hand, is usually autonomous and therefore internally motivated, resulting in an experience that differs from one that is initiated by force, coercion, or other external stimuli (Przybylski, Rigby, & Ryan, 2010; Ryan & Sapp, 2007).

This highlights a significant difference between traditional gamification and video games for two reasons. To begin with, participation in gamified activities is not always voluntary; in fact, it is often expected (e.g., in learning contexts). Second, players who engage in gamified activities could not view them as entertainment

(but rather as training), putting significant restrictions on the player's subjective experience – and, by extension, need fulfillment.

Given that the tasks targeted by a gamification approach are often immutable since they are typically part of a predefined training program, a natural avenue for improving the efficacy of gamified training programs is to more specifically address the individual user's need fulfillment (Ryan & Deci L, 2017). To this scope, designing an effective reward system is crucial; therefore, it has to be considered the existing relationship between rewards and the three basic needs described in the self-determination theory.

4.1 The motivational pull of the gamification reward system

Rewards have a fundamental role in supporting motivation. Their efficacy is influenced non only by the rewards nature (Houlfort, Koestner, Joussemet, Nantel-Vivier, & Lekes, 2002; Ryan & Deci, 1987; Sailer, Hense, Mayr, & Mandl, 2017), but also by how the reward system is structured (Ryan & Deci, 1987).

Botte *et al.*, has already made an attempt to classify reward types according to their characteristics. The proposal of taxonomy includes the most widely used gamification achievements and hypothesize their predicted effect on SDT's three basic psychological needs. This study focuses on the typology of achievements more than one achievements themselves; achievements are classified according to their nature and area of impact (Botte, Bakkes, & Veltkamp, 2020). As shown in Table 1, different achievements impact distinctly on the three basic psychological needs: in some cases, they are satisfied (+), in others they have a negative impact (-), and in others more no specific impact may be expected (NA).

Table 1 – General correlation table of gamification achievements in relation to SDT basic psychological needs (Botte, Bakkes, & Veltkamp, 2020)

Area of impact	**Achievement type**	**SDT Basic psychological needs**		
		Autonomy	**Competence**	**Relatedness**
Evaluation	Measurement	-/+	+	NA
	Completion	*Cf.* completion contingent achievements		
Completion	Performance contingent	-	+	NA
	Non-Performance contingent	NA	NA	+
Goal orientation	Performance-oriented	NA	+	NA
	Mastery oriented	+	+	NA
Predictability	Expected	+	+	NA
	Unexpected	NA	NA	NA
Functionality	Cosmetic	+	NA	+
	Functional	+	+	NA
Flexibility	Achievement as gift	-	NA	+
	Achievement as currency	+	+	NA
Clustering criteria	Incremental	NA	+	NA
	Meta-achievements	-	+	NA
Competitiveness	Competitive	+	+	+/-
	Non-competitive	NA	+	+

Considering this classification as a starting point, it is possible both to design a more effective reward system and make assumptions on the efficacy of an already existing reward system.

5. Gamifying a Higher Education course: the Chronicles of Knowledge experience

The Chronicles of Knowledge is a gamified platform specifically designed to enhance active learning in Higher Education courses and foster students' engagement and motivation. This study is part of doctoral research, which adopts the Design-Based Research (DBR) methodology (Corbin & Strauss, 2014; Goff & Getenet, 2017), and is articulated in four main phases: (1) analysis of the problem; (2) design of the proposed intervention; (3) iterative cycles of testing and refinement of solutions in practice; (4) reflection to produce a set of guidelines for the implementation of the gamification-enhanced flipped learning approach.

This article discusses the results collected at the end of the second iteration of phase 3. The first complete prototype of "The Chronicles of Knowledge" has been tested in the course "Serious Games and Gamification Strategies", involving 14 full-time students of the master's degree in "Technologies, Codes and Communication" offered by Link Campus University in the second semester of the academic year 2019/2020 (Marinensi & Romero Carbonell, 2020).

The solution was re-designed according to the results of the first iteration, and a new version of the solution was tested in two courses: "Applied Games and Gamification Strategies", involving seven full-time students of the Master's Degree in "Technologies, Codes and Communication", Videogames

Curriculum; and “Gamification Strategies”, involving five full-time students of the master’s degree in “Technologies, Codes and Communication”, Interaction Design Curriculum.

As in the previous iteration, both courses lasted one semester and consisted of 24 hours of synchronous videoconferencing, organised in twelve 2-hours weekly meets, plus approximately 114 hours of individual study, supported by an online learning environment (Moodle e-learning platform).

Both courses adopted a flipped learning approach: the teacher encouraged students to gain first exposure to theoretical contents through the online learning environment (specific learning materials, such as video lectures or reading materials, were provided each week by the teacher). In-class time was, instead, devoted to verifying the understanding of the theoretical contents and applying the acquired knowledge to practical projects, encouraging the critical discussion of each topic among the group of peers, with the teacher’s supervision.

To allow for a higher level of interactivity during the videoconferencing, different digital tools were integrated to enable collaborative work (Discord and Google Workspace for Education Fundamentals) and collect students’ feedback and opinions quickly (Mentimeter). Moreover, the e-learning platform Moodle was integrated with the plug-in Level up Plus specifically designed to keep track of students’ activities on Moodle and to automatise the process of rewarding them for their effort in the gamified system.

5.1 Describing the players’ journey

To better explain how The Chronicles of Knowledge works, it will be described highlighting its evolution throughout the course, using the “Player’s Journey” (Kim, 2011; Marczewski, 2018) as a framework.

5.1.1 Onboarding

During the first video conference, the teacher presented The Chronicles of Knowledge's imaginary world to the students and the role they will play in it. The students play as the citizens of a fictional small town called Wisdom Wharf. The Wise Council rules the city. Through a message from the Wise Council, the students learnt that dark forces are menacing Wisdom Wharf and that it's up to them to defend the city (Figure 1).

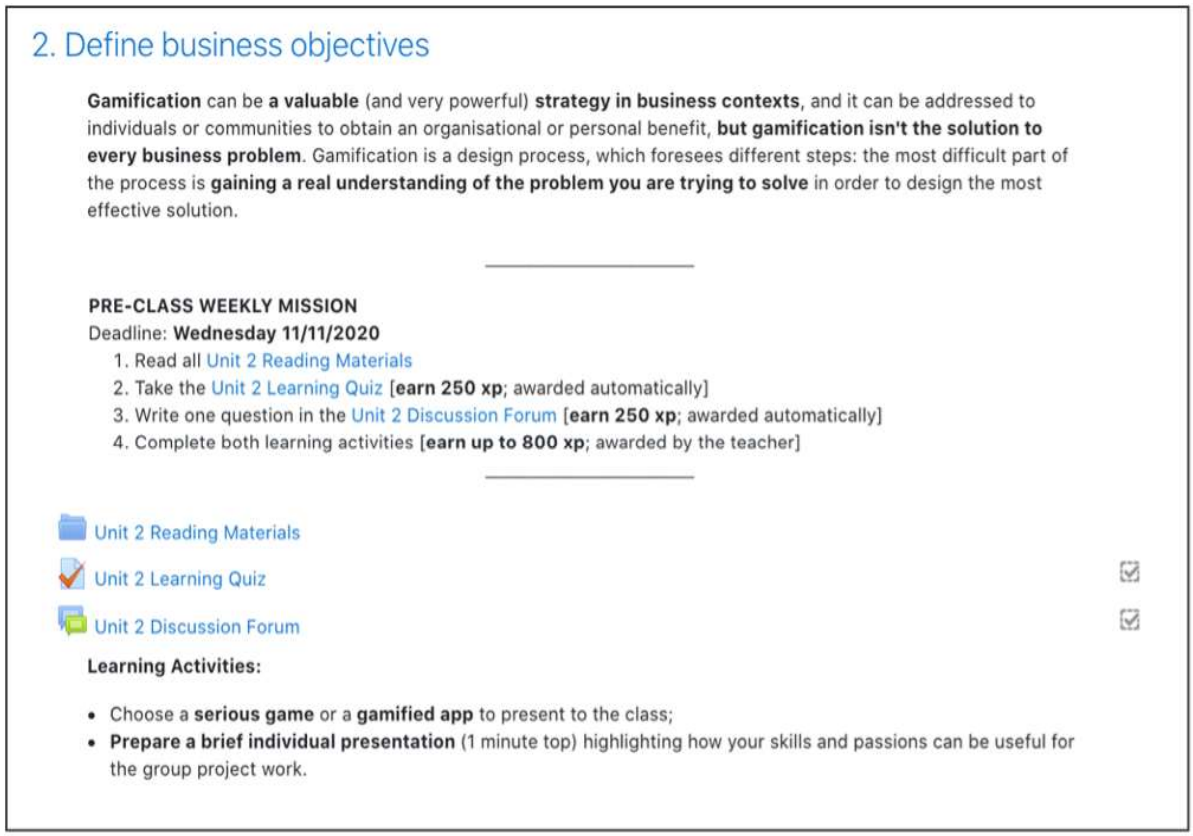
Figure 1 – The first message from The Wise Council.

To prepare themselves to defend the city, each week at home, the students had to access the Moodle platform to complete the missions that the Wise Council assigns to them, such as study the theoretical contents, complete the learning quiz, participate in the discussion forum (Figure 2). Then, in the following videoconference, they had to use their knowledge to complete specific learning activities planned for each lesson: (a) a brief review of the contents learnt in the individual space (carried out through game-like activities and, if needed, a Q&A moment); (b) a

learning activity designed to enable the students to deepen their understanding of the contents; (c) a group activity, specifically designed to let the students put into practice the contents in their group project work.

By doing so, they collect points, and they level up, becoming more powerful and getting ready to face the city's enemies.

Figure 2 - Example of weekly mission on the Moodle platform.



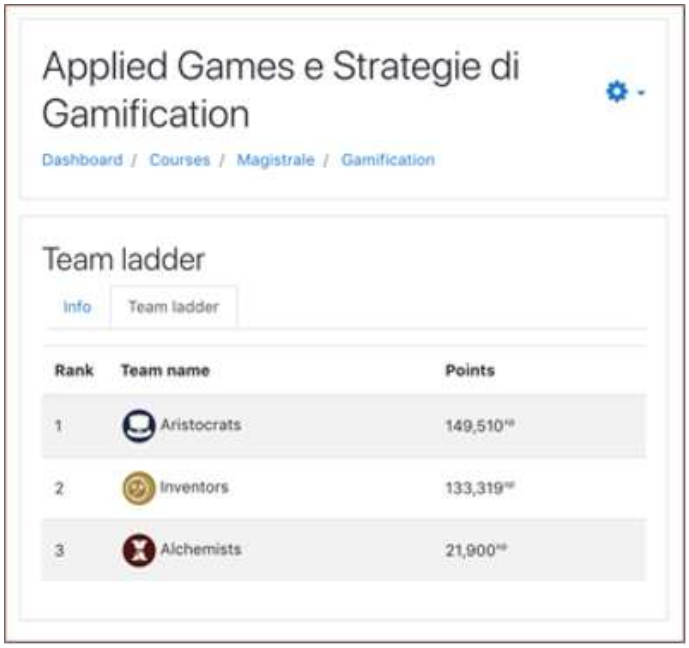
5.1.2 Habit-building and scaffolding

After the first week of the course, the system entered the Habit-building phase, and a new element was added to the gamified system: Guilds (or corporations), designed to foster

effective teamwork practices and a general collaborative attitude among all the students.

The Guilds were: Aristocrats, Thieves, Alchemists and Inventors. Each Guild's leader assigned a specific challenge to the students: to gamify a different existing mobile app. The students were then asked to form small teams and select one of the challenges. By choosing the challenge, they also determined the Guild they wanted to join. From that moment on, the points gained by each student also contributed to defining a Guilds' Leaderboard that was visible on the Moodle platform (Figure 3).

Figure 3 - Guilds' leaderboard.



To counteract the competitive dynamics potentially related to the Guilds' leaderboard, the students were informed that a mysterious enemy was approaching the coast of Wisdom Wharf, threatening to put the town under a siege. Therefore, the Guilds had to work together to protect the city, joining their forces, using their knowledge of the course's contents as their only weapon. The

aim of anticipating an imminent battle was to foster the students' motivation to complete each weekly mission, and consequently promote a good organisation of their workload, by providing an ulterior level of meaning to their actions in The Chronicles of Knowledge's narrative framework.

5.1.3 Mastery

Once the first half of the course was completed, the gamification system reached the Mastery phase. This phase's primary objectives were to assess the class's level of knowledge in a playful way and encourage the individual effort to acquire and share knowledge. In order to achieve these goals, two new elements of the gamified system were presented to the students: the first siege and the secondary missions.

The siege battle was organised using the same web application developed for the first siege, updated to improve its UX and fix bugs. The teacher shared the application with all students during the lesson through the desktop sharing function (Figure 4).

Figure 4 - Screenshot of the first siege web application.

The teacher prepared forty questions in advance, divided into ten easy questions, twenty intermediate questions, and ten difficult questions. During the battle, each student could decide the difficulty level of the question he had to answer and then had 45 seconds to listen to the question and try to answer (Figure 5). The enemy lost some of his health points if the answer was correct. The siege had a duration of 30 minutes maximum. If the enemy lost all his health points before the time ran out, he was defeated, and the siege was over.

Figure 5 - One of the questions of the first siege.

After the successful conclusion of the first siege, the students were granted access to a new section of the Moodle platform to find a list of secondary missions. Secondary missions were optional assignments that students could decide whether to carry out. Carrying out secondary missions allowed students to gain more experience points. One example of a secondary mission was the "peer teaching assignment": students had to study a topic selected

by the teacher or agreed with the teacher, then they had to prepare a brief presentation for the class. Another example of a secondary mission was contributing to creating a glossary of the course on Moodle, selecting key terms, and writing a brief definition.

5.1.4 End game

During the last part of the course, Wisdom Wharf faced the threat of a second siege, designed to be more difficult than the first one (Figure 6).

For instance, the students had less time to answer, the enemy had higher stamina, and the questions were about the course's entire programme.

A new element was added in the second iteration and was the possibility for the students to ask for a special power to use during the second siege if they reached a certain level.

This way, completing the missions to level up allowed the students to become more powerful during the upcoming siege and allowed them to decide the kind of power they wanted to have.

Figure 6 – Screenshot of the second siege web application.

After the second siege, the teacher assigned the final points to the students, and during the final videoconference of the course, the teacher proclaimed the Guild with the highest score the winner.

5.2 The reward system in "The Chronicles of Knowledge"

The rules set for "The Chronicles of Knowledge" allowed to reward the students as follow:

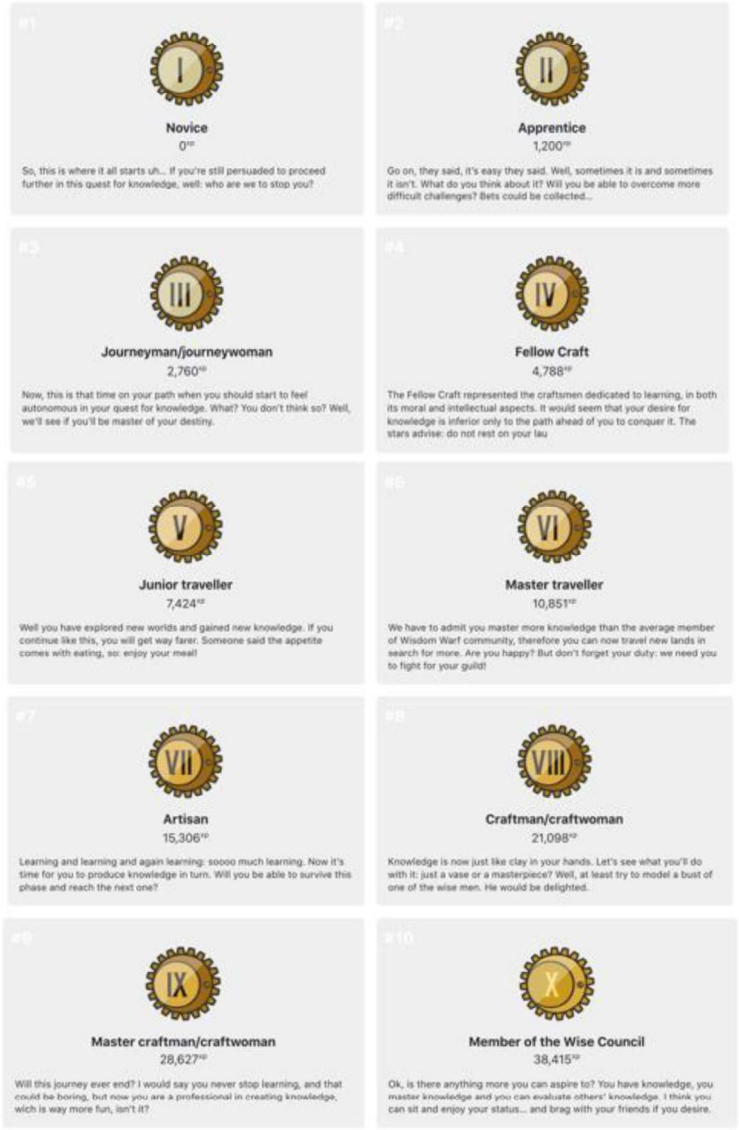
- 250 experience points were awarded each time they posted one message in the discussion forum of one of the learning units.
- 250 experience points were awarded each time they passed the Learning Quiz of one of the learning units.
- 500 experience points were awarded if they passed one of the two Learning Quizzes about the whole program of the course.
- 500 experience points were awarded if they posted in the course discussion forum, sharing their feedback about the gamification elements present in "The Chronicles of Knowledge".

The points were assigned as soon as the activity was completed, and the system immediately notified the students with an automatic message.

The students also gained points for submitting specific assignments (Learning Activities) through the Moodle platform. These points were assigned manually by the teacher each time he/she completed the evaluation of the assignment, and the system notified the students with a message customized by the teacher.

By collecting points, students were able to level up (Figure 7), becoming more powerful and unlocking new abilities and privileges. For instance, reaching Level 4, the students unlocked a special ability different for each Guild to be used during the siege.

Figure 7 – The Levels.



A badge system was designed to set specific goals for the students, foster their motivation to perform particular learning behaviours and celebrate outstanding performances. A complete list of the badges designed for the second iteration of "The Chronicles of Knowledge" is available in the following table (Table 2).

Table 2 – The Badges.

Badge Name	**Level**	**Predictability**	**Image**	**Description**
Quiz Champion	Bronze	Expected		To earn this badge, students need to pass the Learning Quizzes of Unit 2 and Unit 3.
Quiz Champion	Silver	Expected		To earn this badge, students must have earned the Bronze level of this badge, and they need to pass Quizzes of Unit 4, 5 and 6.
Quiz Champion	Gold	Expected		To earn this badge, students must have earned the Silver level of this badge, and they need to pass Quizzes of Unit 7, 8, 9 and 10.
Knowledge Seeker	Bronze	Expected		To earn this badge, students need to find out and share with the class at least 1 good learning resources. Learning resources may include articles, videos, books, etc., that are addressing specific aspects related to gamification, game thinking and behavioural design.
Knowledge Seeker	Silver	Expected		To earn this badge, students need to find out and share with the class at least 3 more good learning resources.

Knowledge Seeker	Gold	Expected		To earn this badge, students need to find out and share with the class at least 5 more good learning resources.
Course Attendance	Bronze	Expected		To earn this badge, students have to attend 2 classes, arriving on time.
Course Attendance	Silver	Expected		To earn this badge, students have to attend 3 more classes, arriving on time.
Course Attendance	Gold	Expected		To earn this badge, students have to attend 5 more classes, arriving on time.
Top fighter		Unexpected		To earn this badge, students have to answer correctly to all questions during the siege of Wisdom Wharf.
Improver		Unexpected		To earn this badge, students have to find out and correct one mistake in the course learning materials.
Explosive fighter		Unexpected		To earn this badge, students must get the highest score during the siege of Wisdom Wharf.

5.2.1 Correlation between gamification achievements available in "The Chronicles of Knowledge" and the SDT basic psychological needs

Summing up the elements already presented in the previous paragraph, is it possible to state that in The Chronicles of Knowledge, the reward system is composed of the following main elements.

Badges. Considering how badges are awarded, we can classify this type of reward as Completion Achievements, and more specifically, non-performance contingent reward. Badges are awarded in an expected way and, most of the time, are Incremental.

Experience points. They are awarded to the player on different occasions, they are needed to level up, the number of experience points depends on the type of activity performed, and sometimes they are linked to evaluation criteria. Thus, they can be considered performance-related achievements while also impacting the area of competitiveness (both competitively and non-competitively).

Levels. Level progression can be considered a type of reward. It is the most direct consequence of gaining experience points; therefore, it can be regarded as predictable and belonging to the set of performance-related rewards.

Progression bars. They give the students a visual indication of the progression toward the next level and highlight the missing points to level up.

Analysing the reward system of The Chronicles of Knowledge, we reported all the available achievements in Table 3, categorising them according to the correlation presented in Table 1.

Table 3. The "Chronicles of Knowledge" rewards system' characteristics according to Table 1 classification.

Area of impact	**Achievement type**	**Achievements in The Chronicles of Knowledge**			
		Badges	**Experience points**	**Progress bars**	**Levels**
Evaluation	Measurement	No	**Yes**	No	No
	Completion	*Cf.* performance contingent achievements			
Performance	Performance contingent	**Yes**	**Yes**	**Yes**	**Yes**
	Non-Performance contingent	**Yes**	**Yes**	No	No
Goal orientation	Performance-oriented	**Yes**	**Yes**	No	No
	Mastery oriented	**Yes**	**Yes**	**Yes**	**Yes**
Predictability	Expected	**Yes**	**Yes**	**Yes**	**Yes**
	Unexpected	**Yes**	No	No	No
Functionality	Cosmetic	**Yes**	No	No	**Yes**
	Functional	No	**Yes**	No	No
Flexibility	Achievement as gift	**Yes**	**Yes**	No	**Yes**
	Achievement as currency	No	No	No	No
Clustering criteria	Incremental	**Yes**	No	No	No
	Meta-achievements	**Yes**	No	No	No
Competitiveness	Competitive	**Yes**	**Yes**	No	**Yes**
	Non-competitive	**Yes**	**Yes**	**Yes**	**Yes**

According to the correlation hypothesised (Table1), theoretically, the impact of the four types of rewards included in "The Chronicles of Knowledge" should be summarised in Table 4.

- Badges: an almost neutral impact on autonomy, a positive impact on competence and a positive impact on relatedness.
- Experience points: a positive impact on autonomy and competence and an almost neutral impact on relatedness.
- Progress bar: an almost neutral impact on autonomy and relatedness and a positive impact on competence.
- Levels: a positive impact on autonomy, competence and relatedness.

Table 4. Final hypothesis about The Chronicles of Knowledge single reward impact on each of the SDT three basic needs

Achievement type	**SDT Basic psychological needs**					
	Autonomy		**Competence**		**Relatedness**	
	-	**+**	**-**	**+**	**-**	**+**
Badges	3	4	0	8	1	4
Experience points	3	5	0	8	1	4
Progress bars	1	2	0	4	0	1
Levels	2	4	0	5	1	4
Total	9	15	0	25	3	13

Based on the analysis summarised in Table 4, it is possible to highlight that The Chronicles of Knowledge reward system support all of the three basic needs of the SDT. Competence is the basic need mostly taken into account, as in many educational

gamified apps, since it is their primary objective to support users in acquiring new knowledge (Botte *et al.*, 2020).

Despite the prevalence of elements that have a positive impact on the students' need for competence, all the three basic needs are taken into account. A greater effort, anyway, could be made in order to design the reward system including more elements that could satisfy the students' need for autonomy. A gamified system capable of satisfying to a higher degree the students' need for autonomy will be perceived by them as less controlling and more learner-centred.

Finally, the reward system seems capable of satisfying the individual need for relatedness, an especially important aspect of a completely online course.

6. Conclusion

The adoption of gamification techniques in education is spreading, and the results reported by the scholars who already implemented them in Higher Education showed that they are effective in increasing students' perceived motivation to learn. In this study, the authors addressed the issue of how properly design the reward system of a gamified educational application, using different kinds of achievements, to foster students' motivation by satisfying their need for competence, relatedness and autonomy in the framework of the self-determination theory (SDT).

The research was carried out starting with an analysis of the available literature investigating the relationship between types of rewards and basic needs in order to describe the specific role that each kind of achievement has in supporting motivation.

Then a case study was taken into account: the gamified platform The Chronicles of Knowledge, specifically designed to

enhance active learning in Higher Education courses and foster students' engagement and motivation. By presenting this experience, it was possible to highlight how to design a reward system capable of supporting all of the three basic needs of the SDT, even though not all of the three basic needs of the SDT are satisfied to the same degree.

With the aim of creating educational environments that are less controlling and more learner-centred, gamification designers should indeed pay more attention to building a reward system implementing the specific kind of achievements that are more likely to satisfy the students need for autonomy.

Finally, especially in the context of digital learning, gamification designers should be aware of the impact that specific elements of the reward system can have in satisfying students need for relatedness, thus diminishing their feeling of isolation during the learning process.

These results will be the starting point for the re-design of The Chronicles of Knowledge at the beginning of the next iteration of the solution. Then the solution will be further tested, with the aim of ascertaining whether the changes made have produced the desired improvement in the satisfaction of students' needs and in their overall level of motivation and engagement.

References

Ab Rahman, R., Ahmad, S., & Rabaah Hashim, U. (2018). The effectiveness of gamification technique for higher education students engagement in polytechnic Muadzam. *International Journal of Educational Technology in Higher Education, 15*(41). Retrieved from https://doi.org/10.1186/s41239-018-0123-0.

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *International Journal of Information and Learning Technology*. https://doi.org/10.1108/IJILT-02-2017-0009.

Barca, S., Botte, B., Marinensi, G., Matera, C., & Medaglia, C. M. (2012). A taxonomy and a proposal for a classification of serious games. In M. M. Cruz-Cunha (Ed.), *Handbook of Research on Serious Games as Educational, Business and Research Tools* (Vol. I, pp. 1064–1079). IGI Global. https://doi.org/10.4018/978-1-4666-0149-9.ch055.

Botte, B., Bakkes, S., & Veltkamp, R. (2020). Motivation in Gamification: Constructing a Correlation Between Gamification Achievements and Self-determination Theory. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. https://doi.org/10.1007/978-3-030-63464-3_15.

Chapman, J. R., & Rich, P. J. (2018). Does educational gamification improve students' motivation? If so, which game elements work best? *Journal of Education for Business*, *93*(7), 314–321. https://doi.org/10.1080/08832323.2018.1490687.

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications.

Costello, R., & Lambert, M. (2018). Motivational Influences for Higher Education (HE) Students. *International Journal of Online Pedagogy and Course Design*, *9*(1), 38–50. https://doi.org/10.4018/ijopcd.2019010103.

De-Marcos, L., García-Cabot, A., & García-López, E. (2017). Towards the Social Gamification of e-Learning: a Practical Experiment. *International Journal of Engineering Educadion*, *1*, 1–14. Retrieved from https://portal.uah.es/portal/page/portal/epd2_profesores/prof23288/publicaciones/0PaperSocialGamificationv5.4_IJEE_preprint.pdf.

Deci, E. L., & Ryan, R. M. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). Woodbridge, UK: University Rochester Press.

Deterding, S., Khaled, R., Nacke, L., & Dixon, D. (2011). Gamification: toward a definition. *Chi 2011*.

Glover, I. (2013). Play as you learn: gamification as a technique for motivating learners. *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telemcommunications*.

Goff, W. M., & Getenet, S. (2017). Design-based research in doctoral studies: Adding a new dimension to doctoral research. *International Journal of Doctoral Studies*, *12*, 107–121. https://doi.org/10.28945/3761.

Houlfort, N., Koestner, R., Joussemet, M., Nantel-Vivier, A., & Lekes, N. (2002). The impact of performance-contingent rewards on perceived autonomy and competence. *Motivation and Emotion*. https://doi.org/10.1023/A:1022819120237.

Kapp, K. M. (2012). Games, gamification, and the quest for learner engagement. *T+D*, *66*(6), 8.

Kim, A. J. (2011). *Gamification 101: Designing the player journey*. Google Tech Talk.

Lin, N. (2014). Assessing classroom participation and performance through gamification systems in foreign language classrooms. In *Society for Information Technology & Teacher Education International Conference* (pp. 1772–1777). Association for the Advancement of Computing in Education (AACE), Waynesville, NC.

López, M. A. R. (2017). European Higher Education Area-Driven Educational Innovation. *Procedia - Social and Behavioral Sciences, 237* (June 2016), 1505–1512. https://doi.org/10.1016/j.sbspro.2017.02.237.

Marczewski, A. (2018). *Even Ninja Monkeys Like to Play: Unicorn Edition*. Gamified UK.

Marinensi, G., & Romero Carbonell, M. (2020). Combining Gamification and Flipped Classroom to improve students' engagement in Higher Education. *QTimes-Journal of Education, Technology and Social Studies, Anno XII* (3), 290–308. Retrieved from https://www.qtimes.it/?p=combining-gamification-and-flipped-classroom-to-improve-students-engagement-in-higher-education.

Prensky, M. (2003). *Don't Bother Me Mom: I'm learning. How computer and video games are preparing your kids for 21st Century success and how you can help*. St Paul, Minnesota, Minnesota: Paragon House.

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A Motivational Model of Video Game Engagement. *Review of General Psychology*. https://doi.org/10.1037/a0019440.

Ryan, R. M., & Deci, E. L. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Psychology*, *53*(6), 1024.

Ryan, R. M., & Deci L, E. (2017). Self-determination theory: basic psychological needs in motivation. *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*. https://doi.org/10.1007/s11031-006-9051-8.

Ryan, R. M., & Sapp, A. R. (2007). Basic psychological needs: A self-determination theory perspective on the promotion of wellness across development and cultures. In *Wellbeing in Developing Countries: From Theory to Research*. https://doi.org/10.1017/CBO9780511488986.004.

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371–380. https://doi.org/10.1016/j.chb.2016.12.033.

Schmidt, R., Emmerich, K., & Schmidt, B. (2015). Applied Games – In Search of a New Definition. In *Entertainment Computing - ICEC 2015. Lecture Notes in Computer Science. Lecture Notes in Computer Science* (Vol. 9353). Springer, Cham. https://doi.org/10.1007/978-3-319-24589-8.

Werbach, K., & Hunter, D. (2012). For the win: How game thinking can revolutionise your business. Wharton digital press. Wharton digital press.

Zichermann, G., & Cunningham, C. (2011). *Gamification By Design*. Sebastopol, California: O'Reilly Media.