

GAMIFICATION ADOPTION IN MOBILE APP TO SUPPORT STUDENTS IN HIGHER EDUCATION

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Gamification Adoption in Mobile App to support students in Higher Education

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Resumo

O envolvimento dos estudantes com as plataformas digitais é crucial para melhorar a sua experiência académica e o acesso à informação institucional.

No Instituto Politécnico de Viana do Castelo (IPVC), a aplicação móvel myIPVC serve como a principal ferramenta para os estudantes acederem a conteúdos académicos, atualizações administrativas e outros recursos essenciais.

No entanto, apesar da sua utilização generalizada, a aplicação enfrenta dificuldades em manter elevados níveis de interação por parte dos estudantes, o que leva a uma subutilização do seu potencial total.

Este projeto aborda esta questão através da integração de elementos de gamificação na aplicação myIPVC, com o objetivo de aumentar o envolvimento dos utilizadores e criar uma experiência mais interativa. A gamificação, que aplica princípios de design de jogos em contextos não relacionados com jogos, tem sido amplamente reconhecida pela sua capacidade de aumentar a motivação, incentivar a participação regular e melhorar a retenção de conhecimento. Ao incorporar funcionalidades como medalhas de conquista (*achievement badges*) e sistemas de recompensas, a nova versão da aplicação pretende promover uma experiência de utilização mais envolvente e gratificante.

A implementação destas funcionalidades de gamificação será realizada utilizando *React Native*, uma *framework* de desenvolvimento multiplataforma que garante a compatibilidade com diferentes sistemas operativos móveis. A eficácia da solução proposta foi avaliada através da análise do comportamento dos utilizadores e das métricas de interação antes e depois da introdução dos componentes gamificados. Esta avaliação permitirá determinar o impacto da gamificação na interação dos estudantes e na utilização geral da aplicação.

Ao tirar partido das tecnologias móveis e das estratégias de gamificação, este projeto procura transformar a aplicação myIPVC numa plataforma mais dinâmica e envolvente, melhorando, assim, a forma como os estudantes interagem com os conteúdos académicos e os serviços institucionais.

Abstract

Student engagement with digital platforms is crucial for improving their academic experience and access to institutional information. At the Polytechnic Institute of Viana do Castelo (IPVC), myIPVC mobile application serves as the primary tool for students to access academic content, administrative updates, and other essential resources. However, despite its widespread use, the app struggles to maintain high levels of student interaction, leading to the underutilization of its full potential.

This project addresses this issue by integrating gamification elements into myIPVC app to enhance user engagement and create a more interactive experience. Gamification, which applies game design principles to non-game contexts, has been widely recognized for its ability to increase motivation, encourage regular participation, and improve knowledge retention. By incorporating features such as achievement badges, and reward systems, the new version of the app aims to foster a more engaging and rewarding user experience.

The implementation of these gamification features will be carried out using React Native, a cross-platform development framework that ensures compatibility across different mobile operating systems. The effectiveness of the proposed solution will be evaluated by analyzing user behavior and engagement metrics before and after the introduction of gamified components. This assessment will help determine the impact of gamification on student interaction and overall app usage.

By leveraging mobile technologies and gamification strategies, this project seeks to transform myIPVC app into a more dynamic and engaging platform, ultimately improving the way students interact with academic content and institutional services.

Index Terms - Gamification, Higher Education, Mobile Learning, Engagement, Student Support

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*“You should be glad that bridge fell down.
I was planning to build thirteen more to that same design”*

Isambard Kingdom Brunel

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Acronyms

AI	Artificial Intelligence
AR	Augmented Reality
DSR	Design Science Research
ECTS	European Credit Transfer and Accumulation System
ELT	English Language Teaching
FinTech	Financial Technology
IPVC	Polytechnic Institute of Viana do Castelo
LMS	Learning Management System
RPG	Role-Playing Game
SDT	Self-Determination Theory
SUS	System Usability Scale
UI	User Interface
VR	Virtual
XP	Experience Points

Chapter 1

Introduction

In recent years, mobile applications have become an indispensable component of the higher education ecosystem. As students increasingly rely on digital tools to manage their academic responsibilities, mobile platforms have evolved into primary channels for communication, information access, and academic planning. The presence of smartphones and the demand for real-time access to institutional resources underscore the growing importance of mobile solutions designed to meet student needs.

At the Polytechnic Institute of Viana do Castelo (IPVC), myIPVC mobile application plays a central role in facilitating students' access to essential academic services. Through this platform, students can consult class schedules, receive institutional announcements, track academic progress, and stay informed about relevant updates. However, despite the app's practical value, its current usage model remains largely passive. Many students interact with the app only when strictly necessary, which limits its potential as a daily academic companion and engagement tool.

To address this issue, this project explores strategies to foster more consistent and meaningful interactions with the app. One promising approach is integrating gamification—the use of game-design elements in non-game contexts—to enhance user engagement and motivation. By incorporating features such as achievement systems, point accumulation, progression indicators, and reward mechanisms, the app can offer a more interactive and appealing experience that encourages frequent use.

Gamification has shown positive results across various educational and technological domains, particularly in increasing motivation, user retention, and the perceived value of digital platforms. In the context of higher education, these benefits can translate into improved student engagement, better information retention, and a stronger sense of connection to institutional life.

This project aims to analyze the current limitations of myIPVC application, design and propose gamified features that align with the needs and preferences of IPVC students, and evaluate the potential impacts of these enhancements on the user experience. By doing so, it aspires to contribute to a more engaging digital environment that supports both academic success and a stronger institutional identity.

1.1 Context

The evolution of the mobile applications has made them an integral part of higher education, with mobile platforms serving as essential tools for student communication and access to academic information. At the Polytechnic Institute of Viana do Castelo (IPVC), myIPVC mobile application plays a crucial role in providing students with institutional updates, academic schedules, and other important resources.

Despite its widespread use, the app lacks features that encourage continuous student engagement, leading to a passive interaction model. To enhance the overall user experience and increase the frequency of interaction, improvements are necessary. This project proposes the integration of gamification elements into myIPVC app as a strategy to make it more engaging, interactive, and rewarding for students.

Gamification, which involves applying game-design principles to non-game contexts, has been widely recognized for its potential to boost motivation, participation, and user retention. By incorporating features such as achievement badges, progress tracking, and reward-based incentives, the app can create a more dynamic and immersive experience. These enhancements aim not only to increase user engagement but also to improve the perceived value of the application in students' academic lives.

By leveraging mobile technology and gamification strategies, this project seeks to transform myIPVC into a more interactive and engaging platform, ultimately strengthening the connection between students and the institution's digital ecosystem.

1.2 Problem Statement and Motivation

The problem lies in the current lack of sustained engagement with the my IPVC app. The app is functional and provides the necessary academic information. However, there is significant room for improvement through the integration of new features capable of increasing user engagement. The app lacks interactive elements that could foster continuous usage and involvement. Therefore, the need arises to integrate gamification strategies that could improve and enhance both of user experience and the app's value to students. Gamification, a concept very applied in numerous applications in various domains, has shown the potential to increase user participation and loyalty through rewards, challenges and a sense of accomplishment.

The motivation for this project is based in the desire to create a more engaging educational environment by applying these game-like mechanics to a mobile platform that students already use regularly. A successful implementation could not only improve the my IPVC app but also serve as a model for future educational tools, enhancing overall student learning outcomes.

1.3 Methodology

To conduct this research, the Design Science Research (DSR) methodology was employed, as it offers a structured and systematic approach particularly suited for studies aiming to develop innovative solutions and address practical problems.

DSR is a well-established methodological framework, widely recognized in the fields of Information Technology (IT) and Information Systems (IS). It is particularly effective in contexts where the goal is not only to understand phenomena but also to create and evaluate artifacts designed to solve identified problems. These artifacts can take various forms, including methods, models, constructs, frameworks, and even social innovations, all aimed at generating valuable contributions to both academic knowledge and practical application.

This methodology is characterized by its iterative and problem-solving nature, which allows researchers to move between the phases of design, implementation, and evaluation. It encourages a cyclical process in which the artifact is continuously refined and improved based on feedback and testing, ensuring that the solution effectively addresses the research problem.

The application of DSR in this study follows a structured process composed of the following stages:

- **Problem Identification and Motivation** – The initial phase involves recognizing and clearly defining the research problem. In this case, the challenge lies in the low levels of student engagement with myIPVC mobile application. Understanding the factors contributing to this lack of interaction is essential to justify the relevance of the study and highlight the need for improvement.
- **Definition of Objectives for a Solution** – Based on the problem identified, specific objectives are established. The primary aim is to enhance user engagement through the integration of gamification elements, so that improving the students' overall experience with the application.
- **Design and Development** – This phase focuses on creating the proposed solution. In this research, it involves the conceptualization and development of gamification features—such as achievement badges, reward systems, and other interactive elements—using React Native, a cross-platform framework that ensures broad compatibility across mobile operating systems.
- **Demonstration** – The developed solution is then applied in a practical context to demonstrate its potential effectiveness. This involves integrating the gamified components into myIPVC app and allowing users to interact with the new features.
- **Evaluation** – The effectiveness of the implemented solution is assessed by analyzing user behavior and engagement metrics before and after the introduction of gamification elements. This analysis helps determine whether the proposed changes have led to a measurable improvement in user interaction and overall app usage.

- Communication – The final stage involves documenting and presenting the findings. This includes discussing the outcomes of the research, highlighting the contributions made to the field of study, and suggesting areas for future research and development.

By following the principles of the Design Science Research methodology, this study ensures a systematic approach that bridges the gap between theoretical research and practical application. The iterative nature of DSR allows for continuous refinement of the solution, fostering the development of a robust and effective tool aimed at enhancing student engagement with myIPVC application.

1.4 Organization

This thesis is structured into five chapters, each contributing to a comprehensive understanding of the research topic and guiding the reader through the various stages of the study.

Chapter 1 serves as the Introduction, providing a contextual framework for the research. It outlines the background and relevance of the study, presents the problem statement, and clearly defines the objectives that guided the development of this work. Additionally, this chapter details the research methodology adopted and offers an overview of the structure of the thesis, helping readers understand how the study is organized.

Chapter 2 focuses on the State of the Art and Literature Review and is divided into two main sections. The first section delves into the concept of Gamification, exploring its definitions, theoretical foundations, and the various strategies and methods applied to integrate gamification across different environments and contexts. This exploration highlights how gamification has been successfully implemented in sectors such as education, business, and healthcare, reinforcing its relevance and versatility. The second section presents a critical analysis of existing applications that incorporate gamification elements. It examines notable case studies, highlighting how these applications leverage gamification to enhance user engagement, motivation, and behavior. Additionally, this section identifies and discusses the most commonly used gamification elements—such as points systems, achievement badges, leaderboards, and reward mechanisms—emphasizing their role in fostering user interaction and retention.

Chapter 3 outlines the Solution Proposal adopted for this research. It describes the design of the study, the tools and technologies used (including the use of React Native for app development), and the process through which gamification elements were integrated into myIPVC application. This chapter also explains the procedures for data collection and analysis, which were used to evaluate the impact of the proposed solution on user engagement.

Chapter 4 presents the Results and Discussion. This chapter details the outcomes of the implemented solution, supported by quantitative data. The results are then interpreted in light of the research objectives and compared with findings from the literature review.

Chapter 5 concludes the thesis by summarizing the key findings and contributions of the research. It reflects on the implications of integrating gamification into educational platforms and

outlines potential limitations encountered during the study. Finally, this chapter offers recommendations for future research and suggests possible directions for further development and improvement of myIPVC application.

Chapter 2

Literature Review

This chapter presents the theoretical and conceptual foundations relevant to this project. It begins by examining the concept of gamification and its psychological principles, followed by an analysis of mobile applications that successfully employ gamification strategies. Finally, it explores the role of gamification in higher education and highlights examples of gamified educational systems developed by universities and industry platforms.

2.1 Gamification

2.1.1 Terminology and Conceptual Foundations

Gamification is broadly understood as the use of game design elements in non-game contexts with the purpose of enhancing motivation, engagement and participation. Although the concept is widely applied in education, marketing, health and other domains, its effective use requires a clear understanding of the terminology involved.

In this thesis, the term elements of gamification refers to the observable components commonly used in gamified systems, including points, badges, levels, leaderboards, progress indicators, feedback mechanisms, narrative elements and challenge structures. These elements operate through underlying game mechanics, such as reward loops, progression systems, competition, cooperation, task completion and interaction cycles. At a higher conceptual level, these mechanics contribute to game dynamics, such as achievement, autonomy, relatedness, curiosity or narrative engagement — motivational responses that emerge from interacting with the system.

This distinction between components, mechanics and dynamics provides a consistent foundation for the terminology used throughout this chapter. It also supports the accurate interpretation of later sections where notions such as branching structure and specific gamification elements are discussed. By establishing this conceptual base, the analysis of gamification becomes more coherent and aligned with established educational and motivational frameworks, including Self-Determination Theory (SDT), previously referenced in the literature [1].

2.1.2 Gamification in Medical Education and Dermatology

Recent evidence highlights the potential of gamification in medical education, with particular applicability in dermatology. A narrative review by Szeto et al. (2021) [2] examined both general medical and dermatology-specific implementations of gamified learning. The review concluded that gamified interventions enhance learner motivation, engagement, and enjoyment while improving reinforcement of educational objectives compared to traditional approaches. In dermatology, gamification showed promise in improving diagnostic accuracy, retention of complex visual information, and student interest in the specialty. Additionally, patient-oriented gamified interventions improved knowledge acquisition and self-examination awareness. Despite these positive findings, current evidence is limited, emphasizing the need for further rigorous studies to confirm these benefits.

2.1.3 Gamification in Higher Education / Teaching Contexts

Gamification has emerged as an effective strategy in the field of education, particularly within higher education environments. By incorporating game design elements into non-game contexts, gamification aims to enhance user engagement, motivation and participation—factors essential for fostering meaningful learning experiences and improving educational outcomes.

The effectiveness of gamification is grounded in established motivational theories such as SDT, which emphasizes the importance of autonomy, competence and relatedness as drivers of intrinsic motivation [1]. Game elements often reinforce these needs by providing:

- Autonomy, through user-driven interactions
- Competence, via feedback, challenges and progression systems
- Relatedness, through social components such as leaderboards or collaborative goals

A study conducted by Dominguez et al.[3] revealed that students exposed to gamified educational settings exhibited higher levels of engagement and improved performance in practical assignments. Key gamification elements such as leaderboards, badges and progress tracking played an important role in promoting active participation and fostering a sense of achievement.

Similarly, Murillo-Zamorano et al.[4] introduced the “8-Pointed Higher Education Gamification Star”, a framework incorporating essential components such as points, badges, levels and leaderboards. Their findings demonstrated that integrating these elements not only improved student motivation but also contributed to more effective knowledge retention and better academic outcomes.

Khaldi, Bouzidi & Nader (2023) [5] present a systematic literature review on gamification applied to e-learning in higher education, exploring how game-design elements have been used, combined, and theorized in digital learning contexts. Their analysis of 39 empirical studies reveals that traditional game-elements — such as points, badges, leaderboards (PBL), levels, and

feedback — remain the most commonly used in gamified e-learning systems, although more complex features like challenges and storytelling are increasingly incorporated. They further highlight that only a small subset of these studies explicitly ground their gamification design in motivational or learning-theory frameworks (e.g. self-determination theory, flow, goal-setting), signaling a gap between practice and theoretically-informed design. The authors conclude that, while gamification is gaining traction as a promising method to counter low motivation and engagement in online higher education, there is no universal “one-size-fits-all” recipe — effective gamification requires careful selection and combination of game elements, context sensitivity, and ideally a theoretical underpinning.

Recent reviews of the literature on gamification in language education provide additional support for the adoption of game-design elements in second-language instruction. For instance, Wulantari et al.[6] surveyed empirical and theoretical studies on the application of gamification in English Language Teaching (ELT) and concluded that gamified interventions consistently enhance student motivation, engagement, active participation, and language-learning outcomes. Their review highlights that common gamification elements — such as points, leaderboards, badges, rewards, progress tracking, interactive tasks and collaborative challenges — help create a sense of achievement, reinforce intrinsic motivation, encourage persistence, foster peer interaction and feedback, and provide real-time progress monitoring. At the same time, the authors note some challenges and prerequisites: technological infrastructure, pedagogical planning, teacher training, and alignment between gamified activities and curricular objectives are essential for successful implementation.

Gamification has also shown positive effects in domains such as healthcare and fitness, where it encourages individuals to maintain healthy behaviors [7]. Gamified applications can foster healthier lifestyles by transforming daily routines into enjoyable, trackable activities, benefiting groups such as older adults or individuals managing chronic conditions [8].

Beyond traditional classroom settings, gamification has also demonstrated significant potential in fully online and digital learning environments. Jayawardena et al. (2022) [9] conducted a systematic literature review analyzing gamification strategies aimed at enhancing engagement across online education and digital platforms. Their findings highlight that game elements such as leaderboards, progress feedback, achievement-oriented features, and carefully designed interactive interfaces can effectively increase motivation, participation, and sustained interaction among learners. The study further emphasizes that tailoring gamification strategies to different learning styles and contexts enhances their effectiveness, while also reinforcing long-term commitment and satisfaction. These insights complement existing evidence from traditional higher education contexts, suggesting that thoughtfully implemented gamification can improve both engagement and learning outcomes in a broad range of educational settings, including fully online courses.

In addition to traditional and online learning platforms, recent work by Cleto (2021) demonstrates the potential of combining immersive technologies — augmented and virtual reality (AR/VR) — with gamification to enhance learning systems [10]. In this chapter, "Learning Systems and Gamification: Blending Augmented and Virtual Reality With Gamification Strategies", the author

reviews literature and reports teacher-led experiments where immersive web environments were used alongside gamified mechanics such as progress feedback, challenges, and interactive tasks. The results suggest that blending AR/VR with game elements can significantly increase student engagement, motivation, and active participation, while supporting complex learning objectives that benefit from visual and experiential learning. Such integration expands the scope of gamification beyond traditional and digital course formats, offering a promising pathway for pedagogical innovation in higher education and technology-enhanced learning environments.

2.1.4 Empirical Evidence and Design Considerations

Sailer and Homner (2019) conducted a meta-analysis and found that gamification yields positive effects on cognitive learning outcomes ($g \approx 0.49$), motivation ($g \approx 0.36$) and behavioral outcomes such as engagement ($g \approx 0.25$). However, only cognitive gains remained statistically reliable when limiting the analysis to high-quality studies, suggesting that motivational and behavioral effects may be less stable [11]. The authors highlight the importance of contextual factors, such as narrative integration and combinations of competition and collaboration.

Effective gamification requires aligning game elements with curricular content to ensure that they enhance rather than distract from learning objectives [12]. Mechanics such as rewards, challenges, feedback loops and narrative features must be strategically integrated to reinforce educational goals. This alignment creates a balance between challenge and enjoyment, increasing engagement and supporting deeper learning.

Gamification is also widely used in marketing to strengthen brand loyalty and customer engagement [13]. Companies create interactive and memorable experiences that drive consumer interaction, improve retention, and support long-term brand affinity.

2.1.5 Gamification in FinTech and Digital Economies

Gamification is not limited to educational or entertainment contexts; it increasingly shapes practices within financial technology (FinTech) platforms. Lai and Langley (2024) [14] examine how gamified design elements, such as reward loops, interactive user interfaces, progress tracking, and behavioral cues, are embedded in FinTech applications to influence user engagement and financial decision-making. Their analysis highlights that these gamification strategies go beyond simple motivation or user satisfaction: they actively reshape the intermediation process, altering how financial services are offered, consumed, and mediated. By blending playful mechanics with economic interactions, FinTech platforms can capture user attention, guide behaviors, and foster continuous engagement, creating new socio-technical dynamics in digital economies. The study underscores that gamification in financial contexts carries implications not only for user experience but also for broader questions of agency, responsibility, and the structuring of financial relationships in the digital age.

2.1.6 Gamification as a Pedagogical Strategy

Gamification can foster competition and collaboration depending on how its elements are structured. Competitive elements like leaderboards motivate students to strive for better results, whereas collaborative tasks or shared rewards encourage peer interaction and collective problem-solving.

A systematic review by Zeybek & Saygı (2024) [15] showed that gamification has been applied across a wide range of educational disciplines, predominantly in higher education. Most studies reported improvements in student motivation, engagement, participation and perceived learning.

Kovácsné Pusztai (2020) [16] demonstrated that gamification strategies such as points-based assessments, interactive digital activities and immediate feedback can significantly enhance motivation and academic performance, particularly for digitally oriented generations such as Gen Z and Alpha.

More recently, Alonso-Sánchez, Núñez Alonso & Santana-Monagas (2025) [17] implemented a structured gamification system combining narrative, points, badges, levels, collaborative missions and digital quizzes. Students reported improved learning, higher motivation and greater participation, supporting the viability of gamification even in theoretically dense courses.

The integration of gamification in educational settings presents a valuable opportunity to enhance learning by making it more interactive, enjoyable and effective. By strategically incorporating game elements aligned with curricular content, educators can foster increased engagement, motivation and academic success, transforming traditional environments into more dynamic and student-centered spaces.

2.2 Apps with gamification strategies

Gamification has been increasingly adopted across various domains to enhance user engagement, motivation, and behavior modification. Beyond its well-documented applications in education and corporate training, gamification has also been successfully integrated into mobile applications aimed at road safety and productivity. The following subsections analyze three relevant applications: **Fidelidade Drive**, **Habitica**, and **getBetter**.

2.2.1 Fidelidade Drive: Enhancing Road Safety Through Gamification

One notable example of gamification in the context of road safety is Fidelidade Drive¹, a mobile application designed to encourage and reward safe driving behaviors. This app, developed by Fidelidade, a leading insurance company, monitors users' driving patterns through various metrics, such as speed, braking, and acceleration. Based on their driving habits, users receive scores that reflect their overall driving performance, as which is shown in Figure 2.1.

The core gamification aspect of Fidelidade Drive lies in its reward system. Users who demonstrate safer driving habits earn points that can be converted into tangible benefits, such as discounts

¹ <https://www.fidelidade.pt/PT/particulares/Auto/servicos/drive/Paginas/default.aspx>

on insurance premiums. This approach creates a direct incentive for individuals to adopt more responsible driving behaviors, ultimately contributing to road safety. By leveraging game mechanics, such as real-time feedback, progress tracking, and achievement-based rewards, Fidelidade Drive transforms routine driving into a more engaging and conscious activity.

Additionally, the competitive element within the app fosters a sense of achievement and improvement. Drivers can compare their scores with peers or strive to surpass their own previous records. This dynamic not only promotes sustained engagement with the application but also reinforces long-term behavioral changes in favor of road safety.



Figure 2.1: Fidelidade Drive

2.2.2 Duolingo: Gamifying Language Learning

Duolingo² is a widely used language learning application that leverages gamification to enhance user engagement and motivation. The app transforms language acquisition into a game-like experience, using mechanics such as experience points (XP), streaks, levels, and virtual rewards.

Users progress through language lessons by completing exercises that test reading, writing, listening, and speaking skills. Correct answers earn points, unlock new levels, and maintain daily streaks, while mistakes may slow progression, providing immediate feedback for improvement as shown in Figures 2.2 and 2.3. The app also incorporates leaderboards and challenges to foster competition and social engagement among learners.

²<https://www.duolingo.com>

Duolingo's gamified approach encourages consistent practice, reinforcing intrinsic motivation and making language learning enjoyable. By combining structured lessons with game elements, the app effectively supports long-term engagement and skill development.

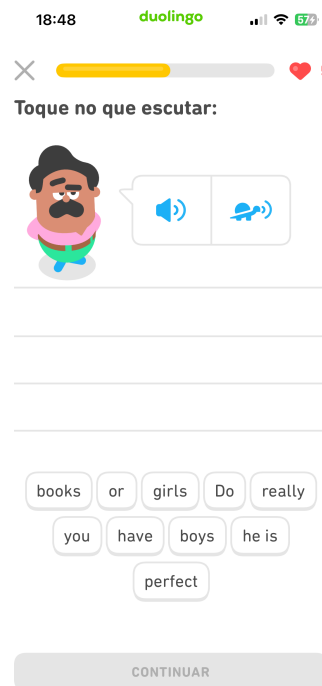


Figure 2.2: Duolingo App

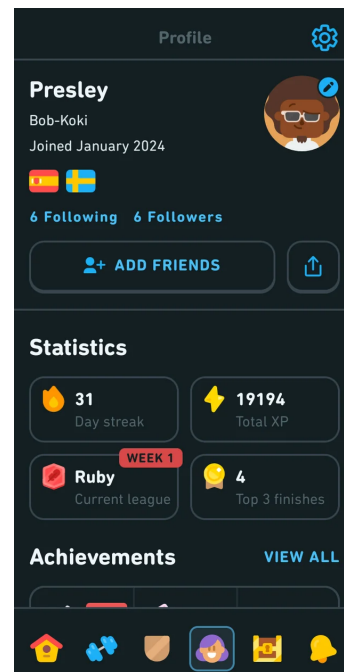


Figure 2.3: Duolingo App

2.2.3 Kahoot!: Gamifying Interactive Quizzes

Kahoot! ³ is an educational platform that gamifies the process of learning through interactive quizzes and competitions. Designed for classroom and online use, it transforms assessments into engaging game-like experiences.

As can be seen in Figure 2.4, instructors create quizzes, surveys, or polls that students answer in real-time. Points are awarded based on speed and accuracy, and leaderboards display top performers, adding a competitive dimension. The immediate feedback and interactive nature of the platform make learning dynamic and participatory.

By integrating game mechanics such as points, levels, and competition, Kahoot! increases student engagement, motivation, and retention of information. Its social and collaborative features also promote active learning and group interaction.

³<https://kahoot.com>

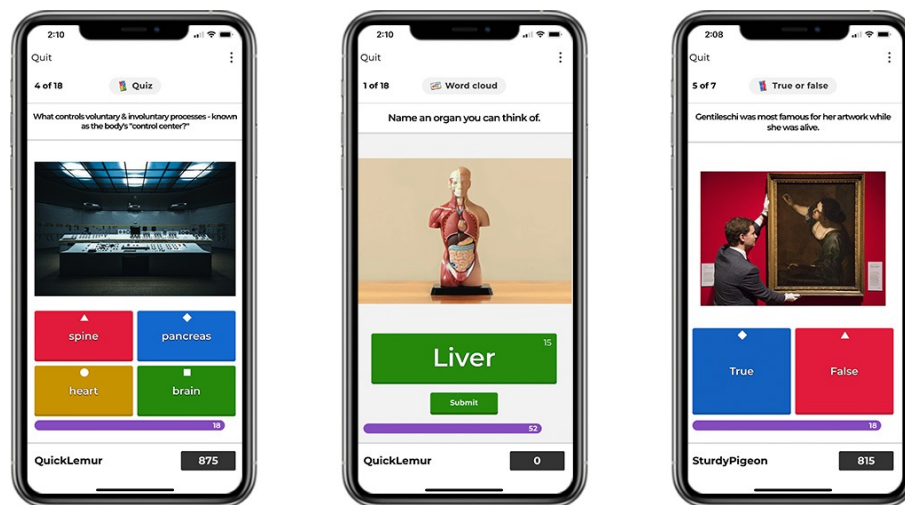


Figure 2.4: Kahoot App

2.2.4 Quizlet: Gamifying Memorization and Study

Quizlet⁴ is an educational application that uses gamification to support memorization and study practices. Through tools like flashcards, quizzes, and learning games, Quizlet transforms traditional study methods into interactive and motivating experiences.

Users can create study sets or access shared sets on various subjects. Gamified features, such as “Match” and “Gravity” games, reward speed and accuracy while providing immediate feedback. Progress tracking, badges, and points motivate learners to maintain regular study habits and achieve higher mastery.

Quizlet’s gamification elements enhance engagement, encourage repeated practice, and make learning more effective and enjoyable for students of all levels.

2.2.5 WizIQ: Gamifying Online Learning and Virtual Classrooms

WizIQ⁵ is an online learning platform that incorporates gamification to enhance engagement in virtual classrooms. The platform allows instructors to deliver courses, quizzes, and live sessions while integrating game mechanics to maintain learner motivation.

Gamification in WizIQ includes points, badges, leaderboards, and interactive assessments that incentivize participation and performance. Learners are encouraged to complete lessons and assignments on time, participate in discussions, and engage with multimedia content. Immediate feedback and recognition reinforce learning and progress.

Through its gamified structure, WizIQ transforms online education into an interactive and motivating experience, promoting consistent engagement and improved learning outcomes.

⁴<https://quizlet.com>

⁵<https://www.wiziq.com>

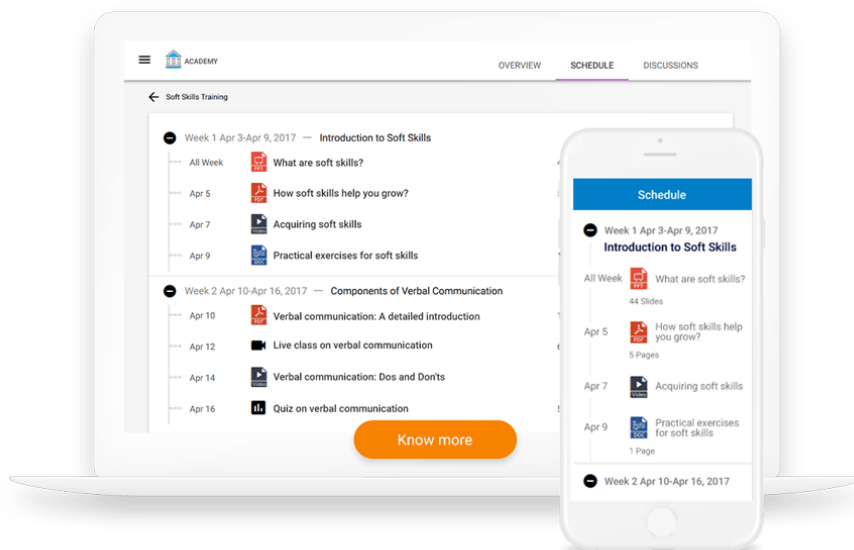


Figure 2.5: WizIQ

2.2.6 Habitica: Gamifying Productivity and Daily Tasks

Another compelling application that successfully integrates gamification principles is Habitica ⁶, a productivity tool designed to transform everyday tasks into a role-playing game (RPG). Unlike traditional to-do lists or productivity apps, Habitica incorporates game mechanics that make task management more engaging and rewarding for users.

In Habitica, users create their own avatars and set personal goals, which range from academic and professional tasks to health and lifestyle habits, as illustrated in Figure 2.6. By completing these real-life objectives, users earn experience points (XP), in-game currency, and other virtual rewards that allow them to customize their characters or unlock additional features. Conversely, failing to complete tasks results in penalties, such as losing health points, reinforcing accountability and self-discipline.

A key strength of Habitica is its collaborative and social dimension. Users can join parties with friends or participate in guild challenges, which introduce a cooperative element to productivity. This social reinforcement, combined with goal-setting and progress-tracking mechanisms, enhances user motivation and persistence in achieving long-term personal and professional objectives.

By integrating RPG elements into daily routines, Habitica makes productivity more engaging and enjoyable. The interactive nature of the app fosters intrinsic motivation, transforming mundane responsibilities into a rewarding experience.

⁶<https://habitica.com/static/home>

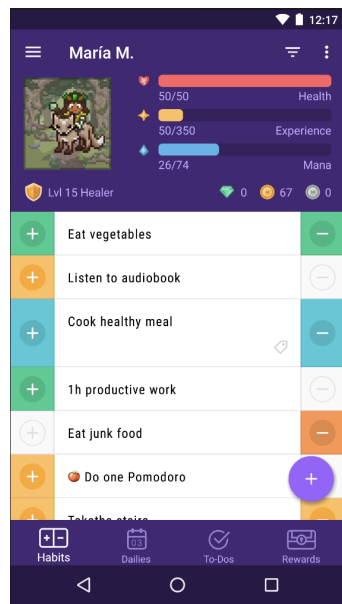


Figure 2.6: Habitica

2.2.7 getBetter: Gamification-Enhanced Personal Growth Coaching

A particularly illustrative example of gamification applied to personal development is *getBetter*⁷, a mobile application that positions itself as an AI-powered personal growth coach. Although the app integrates artificial intelligence and behavioral analytics, its most distinctive feature is the strong reliance on gamification elements as presented in Figure 2.7.

The app generates individualized improvement plans consisting of daily, weekly, and monthly quests—mirroring the mission systems commonly found in digital games.

As users perform their tasks, they earn points, unlock cosmetic upgrades for their sidekick, and receive celebratory animations that reinforce a sense of achievement. This mechanism increase perceived reward value and making the process more engaging.

A 20-day progression cycle evaluates the user's performance and adapts the action plan, functioning similarly to level-based game progression. Each new cycle resembles a new “stage” with refreshed objectives, preventing monotony and maintaining user interest over time.

Other key game mechanics embedded in *getBetter* include:

- **Progress tracking dashboards**, which visually quantify achievements, streaks, and performance trends, promoting self-awareness and ongoing motivation.
- **Reward structures and unlockable content**, which provide extrinsic reinforcement and encourage users to maintain consistent behaviors.
- **Adaptive difficulty**, wherein the app adjusts recommendations according to user success, emulating game-level balancing techniques.

⁷<https://www.getbetter.app/>

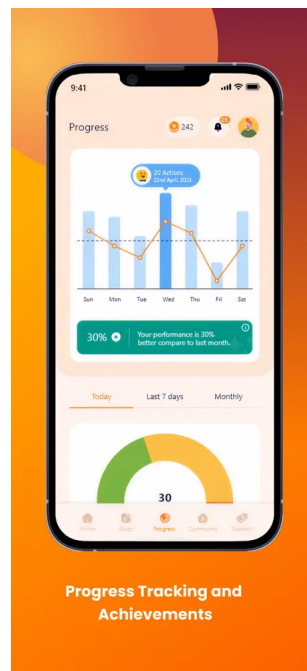


Figure 2.7: GetBetter App

2.3 Gamification in Higher Education

Gamification has emerged as a powerful pedagogical tool in higher education, enhancing student engagement, motivation, and learning outcomes. By integrating game-based elements into academic settings, educators can foster a more dynamic and interactive learning environment that encourages active participation and deeper understanding.

A study conducted by Dominguez et al. [3] investigated the impact of gamification in university-level learning environments. The findings revealed that students exposed to gamified educational experiences demonstrated higher engagement levels and improved performance in practical assignments. The study highlighted the motivational efficacy of gamification elements such as leaderboards, badges, and progress tracking in encouraging students to complete tasks and actively participate in coursework.

Similarly, Murillo-Zamorano et al. [4] explored the role of gamification in higher education through a structured gamified activity titled "The ECON+ Star Battles." Their research introduced the "8-Pointed Higher Education Gamification Star," a comprehensive framework incorporating essential gamification components, including points, badges, levels, leaderboards, and transformation potential. The study demonstrated that integrating these elements into academic settings fosters an interactive and enjoyable learning experience, ultimately leading to enhanced educational outcomes.

The fundamental principles of gamification are based on the notion that game-like mechanisms can significantly enrich the learning process by making it more engaging and stimulating.

When effectively implemented, gamification aligns game elements with curricular content, creating a balanced educational experience that integrates challenges, rewards, and enjoyment. This approach enhances students' intrinsic motivation, encourages sustained participation, and facilitates deeper learning.

Beyond engagement and motivation, gamification in higher education has been associated with improvements in critical thinking, collaboration, and problem-solving skills. The incorporation of competition and rewards encourages students to persist through challenges, while collaborative elements foster teamwork and communication skills. Moreover, real-time feedback mechanisms inherent in gamified systems enable students to monitor their progress and make informed decisions regarding their learning strategies.

Despite its benefits, successful gamification in higher education requires thoughtful design and implementation. Merely adding game elements to a course does not guarantee engagement, instead, educators must carefully consider the alignment between gamified components and learning objectives. Research suggests that the most effective gamification strategies integrate elements that enhance the intrinsic value of learning rather than merely incentivize participation through extrinsic rewards.

Furthermore, challenges such as potential disengagement due to over-competitiveness, varying student preferences, and the need for technological infrastructure must be addressed. Adaptive gamification approaches, which tailor game elements to individual learner profiles, are gaining attention as a means to optimize engagement and effectiveness.

In conclusion, gamification presents a promising approach to transforming higher education by fostering motivation, engagement, and active learning. When thoughtfully designed, gamified learning environments can significantly enhance educational experiences and prepare students for real-world problem-solving and critical-thinking challenges. Future research should continue exploring innovative gamification models and their long-term impact on student learning outcomes and academic success.

In recent years, higher education institutions have increasingly adopted gamification to enhance student engagement, improve learning outcomes, and foster a more immersive educational environment. By integrating game-like elements, universities and colleges aim to create interactive learning experiences that motivate students to actively participate in their academic journeys. Various applications have been developed to incorporate gamification into higher education, transforming traditional educational models into dynamic and engaging systems.

2.3.1 Universidade de Coimbra: Space of Knowledge

One notable example of gamification in higher education is the Space of Knowledge mini-app, developed as part of the UC One platform at the University of Coimbra ⁸. This application allows users to explore the university campus through interactive maps, detailed images, and immersive

⁸<https://www.uc.pt/ucframework/apps/sok/>

audio guides. Designed to enhance both remote and in-person visits, Space of Knowledge offers pixel-art-style maps that guide users through various historical and cultural points of interest.

To make the experience more engaging, the app allows users to select avatars and access exclusive photo galleries for each site they visit, personalizing their exploration. By incorporating these interactive elements, Space of Knowledge not only enhances campus navigation but also encourages users to engage with the university's rich historical heritage in a more immersive and enjoyable manner as shown in Figure 2.8.

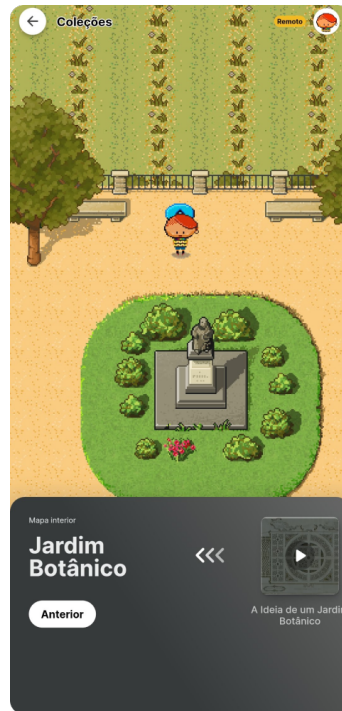


Figure 2.8: Universidade de Coimbra: Space of Knowledge

2.3.2 Polytechnic University of Madrid: AppQuitectura

Similarly, the Polytechnic University of Madrid has developed AppQuitectura, an application designed to gamify the study of architecture. This app engages students through quizzes, weekly challenges, and an interactive question-and-answer format that reinforces architectural concepts. Students earn points and badges for academic achievements, fostering a sense of competition and motivation to improve their knowledge.

By integrating these game mechanics, AppQuitectura helps students retain complex information in an engaging manner while promoting active learning. The competitive aspect of the app also encourages peer interaction, as students strive to achieve higher scores and demonstrate their expertise in architectural studies.



Figure 2.9: AppQuitectura

2.3.3 University of Michigan: GradeCraft

Another excellent example of a gamified educational tool is GradeCraft, developed at the University of Michigan⁹. This game-inspired learning management system allows students to take control of their educational experience by offering various features such as progress bars, optional quests, and point-based learning.

With GradeCraft, students can strategically navigate their courses by selecting assignments that best align with their interests and learning styles. The system also provides real-time feedback, enabling students to track their academic progress and set personalized learning goals. By fostering autonomy and motivation, GradeCraft enhances student engagement and contributes to better academic performance.

2.3.4 CYPHER Learning: A Versatile Gamification Platform

Beyond university-specific applications, CYPHER Learning stands out as a cloud-based platform that integrates gamification into education¹⁰. Designed for both academic and corporate learning environments, CYPHER Learning provides a personalized approach to student engagement. The platform incorporates various game mechanics, such as leaderboards, badges, and achievement-based rewards, to make learning more dynamic and enjoyable, as shown in Figure 1.10.

What sets CYPHER Learning apart is its adaptability to different educational contexts. Whether used for university courses, online training programs, or professional development, the platform

⁹<https://gradecraft.com/>

¹⁰<https://www.cypherlearning.com/>

effectively applies gamification principles to enhance knowledge retention and motivation. Its broad applicability makes it a valuable tool for institutions seeking to modernize their educational models through technology-driven engagement strategies.

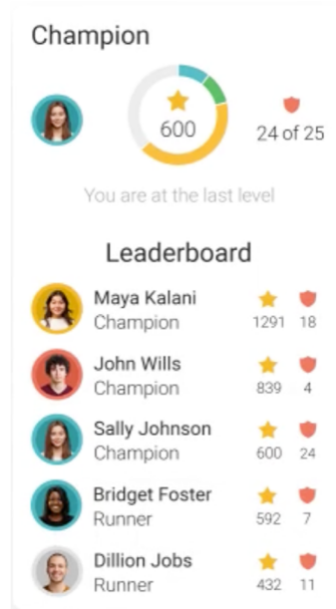


Figure 2.10: CYPHER Learning

Chapter 3

Solution Proposal

Currently, myIPVC app features a well-structured and functional design, effectively providing essential academic information in a clear and accessible manner. The app stands out for offering key resources such as class schedules, academic grades, school blueprints, tutoring and mentoring services, and various other academic tools. However, its current interaction model is primarily transactional, meaning that students typically engage with the app only when they have specific needs. As a result, its potential for continuous engagement remains limited, particularly during periods of lower academic activity.

This project proposes the integration of gamification as a strategy to increase student interaction, reinforce academic commitment, and transform the app from a utilitarian tool into a more engaging and motivational platform [3, 4, 18, 7]. This chapter details the design and development of the gamified system, including the definition of gamified elements, point allocation logic, badge system, architecture, data model, UI mockups, technical implementation (frontend and backend), and supporting cron automation tasks.

3.1 Gamified Elements

To achieve these objectives, it is essential to identify the key areas of the app that would most benefit from gamification. After thorough analysis, the following aspects have been selected for gamification:

1. **Semester ECTS Credits:** Progress in completing ECTS credits will be transformed into a gamified journey. Each credit earned will be linked to achievements or badges, visually representing the student's progression throughout the semester. This system will encourage students to plan ahead and work towards their academic goals more strategically [4].
2. **Semester Grade Average:** The semester's academic average will be integrated into a dynamic scoring system. Students achieving an average greater than fifteen will unlock rewards, such as exclusive badges, points, or other in-app incentives. This mechanism aims to foster engagement and motivate students to maintain or enhance their academic performance [3, 13].

3. **Tutoring Hours:** Scheduled and completed tutoring hours will be tracked and rewarded. Each successfully completed session will contribute to earning points, reinforcing the importance of tutoring and encouraging students to make greater use of this academic support service [3, 8].
4. **Mentoring Interactions:** The frequency of interactions with mentoring services will also be gamified. Through a point-based system, students will be rewarded for both mentoring others and participating as mentees. This will help strengthen peer learning and academic collaboration within the student community [3, 12].

These gamified elements have been carefully selected based on an in-depth analysis conducted by a dedicated working group. Their goal was to identify the best approach to enhance engagement while maintaining the app's primary focus on academic success.

To further enhance motivation, the gamification features will include a system where accumulated points can be converted into monetary value for use on the student card (similar approaches that tie points to financial or tangible rewards have been explored in industry apps). Additionally, for a certain number of points, declared in the database, the students will receive normal badges, while unlocking certain achievements will grant special badges [3, 19]. These distinctions will serve as a mark of academic commitment and excellence, making the learning experience not only productive but also rewarding.

3.2 Gamification Structure

The gamification structure was designed to encourage user engagement, motivation, and active participation on the platform. Key elements such as points, levels, badges, and leaderboards were defined to create a dynamic and rewarding environment. The logic behind each component was developed with modularity and scalability in mind, allowing future adjustments based on user behavior and platform evolution [18, 7, 13].

3.2.1 Points

With all the elements defined, the next step was to establish the logic behind awarding points and badges to users. The point allocation system was designed to assess academic performance and engagement in tutoring and mentoring activities. This logic was developed with scalability in mind, allowing the values for both points and criteria to be easily configured through the database. The following rules were defined:

1. **ECTS** - For every 30 ECTS completed at the end of each semester, the user is awarded with a certain number of points. This rule was designed to be scalable, meaning both the number of ECTS and the corresponding points can be adjusted in the database.

Number of ECTS	Points
30	10

Table 3.1: ECTS Points

2. **Grades Average** -At the end of each semester, if a student achieves an average grade of 14 (on a 0–20 scale), they receive a certain number of points. As with the ECTS rule, both the grade threshold and the points awarded can be modified in the database.

Grades Average	Points
14	10

Table 3.2: Grades Average Points

3. **Tutoring Hours** - When a user accumulates a defined number of tutoring hours, they are awarded with a certain number of points.

Hours of Tutoring	Points
1	2

Table 3.3: Tutoring Points

4. **Mentoring Interactions** - When a user reaches a defined number of mentoring interactions, they are awarded a certain number of points, as specified in the database.

Interactions of Mentoring	Points
1	2

Table 3.4: Mentoring Points

3.2.2 Badges

The badge system was designed to reward users for both consistent engagement and significant achievements. Two distinct categories of badges were defined: *normal badges* and *special badges*, each serving a different motivational purpose within the gamification structure [3, 19].

1. **Normal Badges** – These badges are earned automatically as users accumulate points through regular platform activities. A tiered badge system was implemented to reflect increasing

levels of commitment and progression. The logic behind the progression is summarized in Table 3.5.

Badge Type	Acquisition Criteria	Equivalence
Bronze	1 badge for every 200 points earned	–
Silver	Earned by collecting 5 bronze badges	5 bronze = 1 silver
Gold	Earned by collecting 5 silver badges	5 silver = 1 gold

Table 3.5: Badge Progression Logic

This tiered system encourages continuous participation, as users are able to visually track their advancement and strive toward higher-level badges. The conversion between tiers adds a sense of progression and long-term reward [3].

2. **Special Badges** – Unlike normal badges, special badges are not based on point accumulation but instead require the completion of specific objectives or milestones. These goals are predefined and may include:

- Completing a certain number of mentoring sessions
- Achieving perfect scores on academic evaluations
- Completing a certain number of ECTS annually

Special badges are intended to recognize exceptional effort, performance, or contribution. Their exclusivity makes them highly desirable and adds variety to the gamification system, rewarding users who go beyond the expected level of participation [19].

This dual-badge system ensures a balanced motivational design: normal badges support sustained activity through incremental rewards, while special badges create aspirational goals tied to excellence and dedication [3, 19].

3.3 Architecture

The my IPVC app architecture for integrating gamification follows a structured, layered model that ensures efficiency, scalability, and seamless integration of gamified elements. The architecture is divided into three primary layers, as shown in Figure 3.1. Each is responsible for a specific set of functionalities:

1. **Presentation Layer:** This layer is responsible for displaying all gamification-related visuals and interactive elements to the user. It includes:
 - Semester ECTS credits tracking
 - Semester grade average visualization
 - Tutoring hours progress

- Number of mentoring interactions

All these elements will be implemented using React Native, the core technology of the application. The UI will be designed to present a visually engaging experience, incorporating progress bars, badges, and achievement notifications to motivate users.

2. **Business Layer:** This layer handles the logic required for processing gamification features. It serves as the intermediary between the Presentation Layer and the Data Layer, ensuring smooth communication and data retrieval. The existing server logic will be updated to support the newly introduced gamified elements. New functionalities such as point calculations, badge assignment, and reward distributions will be implemented within this layer to ensure a seamless user experience [12, 8].

3. **Data Layer:** This layer is responsible for storing and managing all data related to students and gamification. It includes:

- Student academic records (ECTS credits, grades, tutoring sessions, mentoring interactions)
- Gamification progress tracking (points, badges, stars, leaderboards)
- Reward history and in-app purchases (if applicable)

A robust and secure database system will be used to store this information, ensuring data integrity and scalability as the number of users increases [18, 13].

By adopting this layered architecture, myIPVC app will effectively integrate gamification elements without compromising performance or usability. This model ensures that students receive real-time updates on their progress while allowing for future enhancements and expansions of gamified features [3].

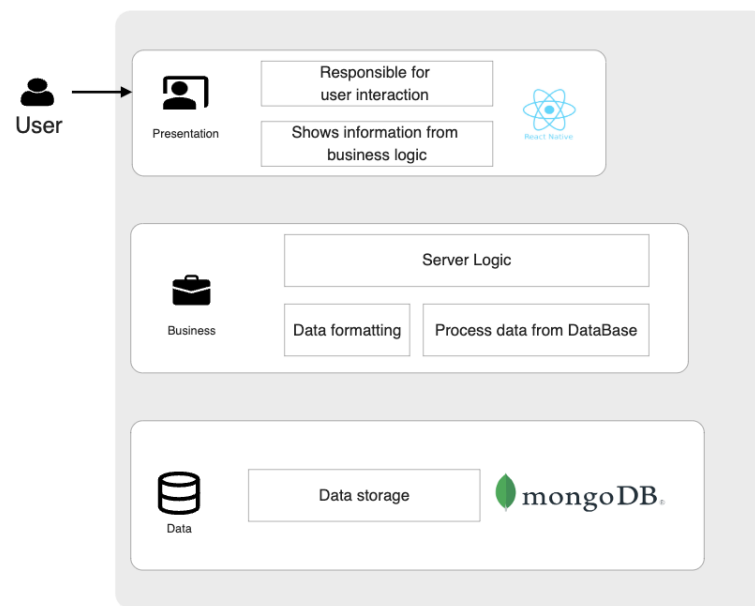


Figure 3.1: Architecture

3.4 Data Model

The data model illustrated in Figure 3.2 represents a structured gamification system designed to enhance user engagement by tracking activities, achievements, and progress. This schema defines the relationships between users and the key motivational components of the system, ensuring a seamless and rewarding experience [18, 3].

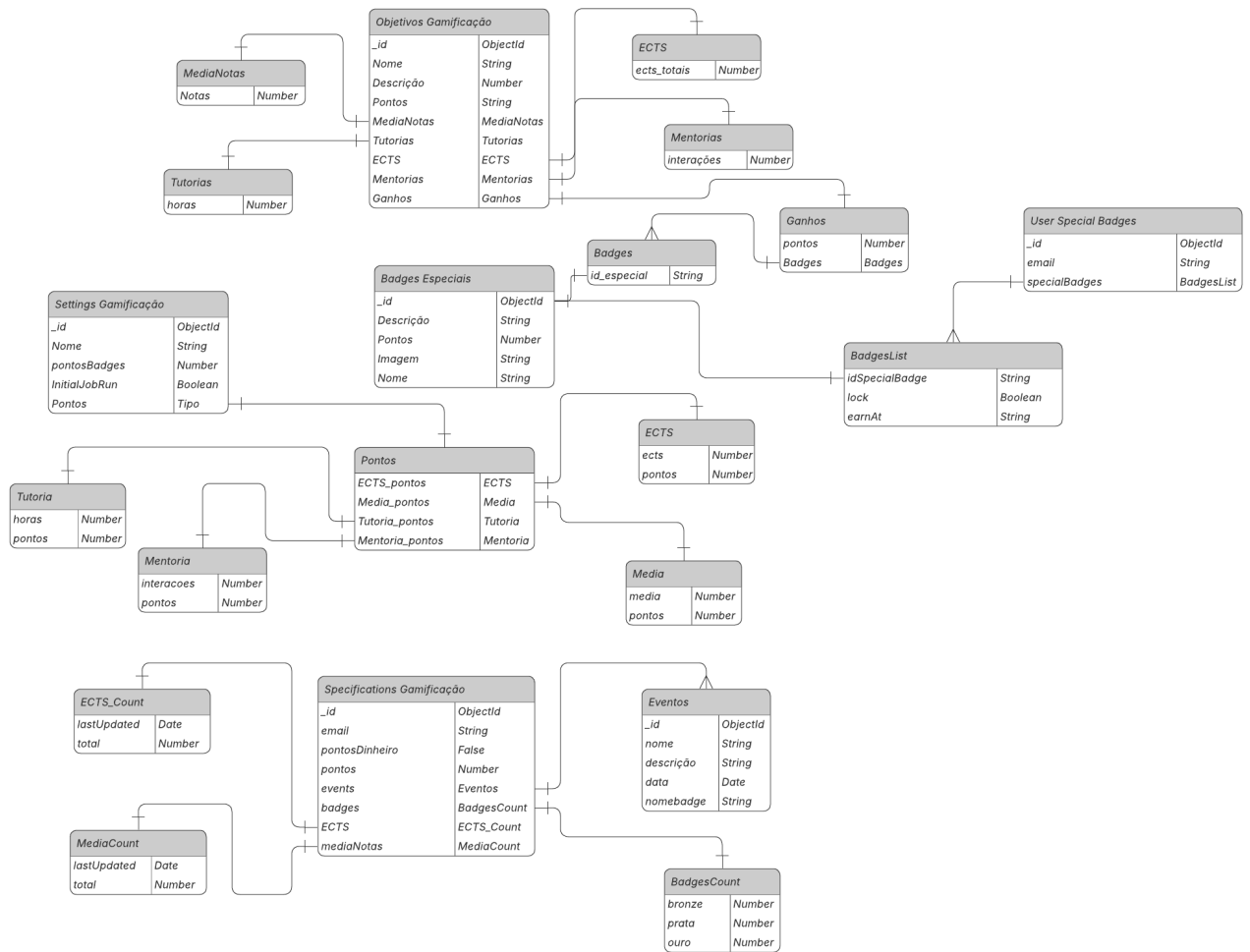


Figure 3.2: Data Model

1. **Objectives Gamification:** This collection defines the specific goals and logic that determine how users earn points and badges within the platform. It establishes the relationship between academic activities (such as tutoring, mentoring, grades, and ECTS credits) and their corresponding rewards. The entity aggregates subcomponents like *AverageGrades*, *Tutoring*, *Mentoring*, and *ECTS*, each representing a measurable academic indicator. The *Earnings* subdocument defines how many points and badges are granted when an objective is achieved. This structure allows flexible configuration of gamification criteria directly through the database [3, 4].
2. **Settings Gamification:** This collection defines the global configuration parameters of the gamification system. It acts as a reference model that determines how many points are assigned for specific academic metrics. The entity includes general attributes such as *name*, *pointsBadges*, and *initialJobRun*, as well as a nested object called *Points*. The *Points* subdocument contains four elements — *ECTS_pontos*, *Averages_pontos*, *Tutoring_pontos*, and *Mentoring_pontos* — each describing the rule used to convert user actions into gamified

rewards. This configuration ensures consistency across the entire system and allows for dynamic updates without modifying the source code [18, 13].

3. **Specifications Gamification:** This collection stores all user-specific gamification data, tracking individual progress and achievements over time. Each document is associated with a user (identified by their *email*) and includes their accumulated points, badges, event history, and academic indicators. The subdocuments *BadgesCount*, *ECTS_Count*, and *AverageCount* register detailed statistics such as total earned credits, updated averages, and badge distribution across bronze, silver, and gold levels. The *Events* subdocument logs every action that leads to a gamification update, including the event name, description, date, and related badge. This data structure supports continuous monitoring and evaluation of user engagement and academic performance [3, 12].
4. **Special Badges e User Special Badges:** The *Special Badges* collection defines exclusive rewards that users can earn by achieving significant milestones. Each badge is characterized by a name, description, image, and required point value. The *User Special Badges* collection records which special badges each user has unlocked, including the badge identifier, status (locked or unlocked), and the date it was earned. This relationship ensures traceability of special achievements and facilitates the display of personalized badges in the user interface [19].

The model is designed with well-defined one-to-many relationships, ensuring a scalable and structured approach to tracking academic and engagement progress. By integrating these elements, the gamification system enhances motivation and provides a clear pathway for student success [3].

3.5 Mockups development

The following mockups illustrate how gamified elements can be seamlessly integrated into the app's interface, enhancing its functionality while adding layers of interactivity and motivation for users. These visual enhancements align with the app's educational objectives, maintaining a balance between engagement and academic focus.

1. **Home Screen:** The home screen, shown in Figure 3.3 will feature new icons and badges displaying the user's total points and progress. A dedicated button will provide more information about gamified elements.
2. **Gamified Elements Details:** A dedicated page will present all events that generate points or badges, with timestamps. Users will have access to a 'Badges' section, along with a toggle to convert points into money for use with their student card, as show in Figure 3.4 (a).

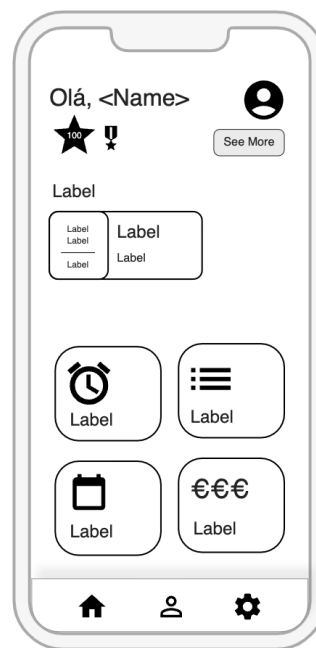
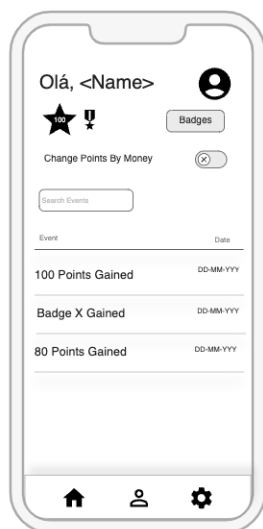
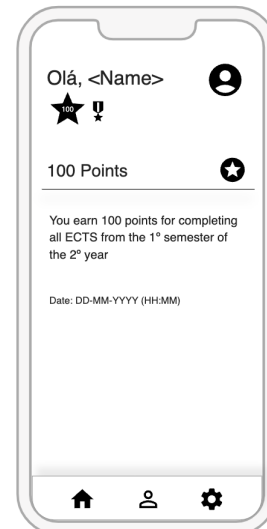


Figure 3.3: Home Screen



(a) Gamified Elements Details



(b) Event Details

Figure 3.4: Badges List and Learn More pages

3. **Event Details:** Each event will have a detailed description, highlighting associated badges and points earned (Figure 3.4 (b)).
4. **Points Modal:** A real-time notification system will inform users whenever they earn points or unlock badges, showed in Figure 3.5 (a).

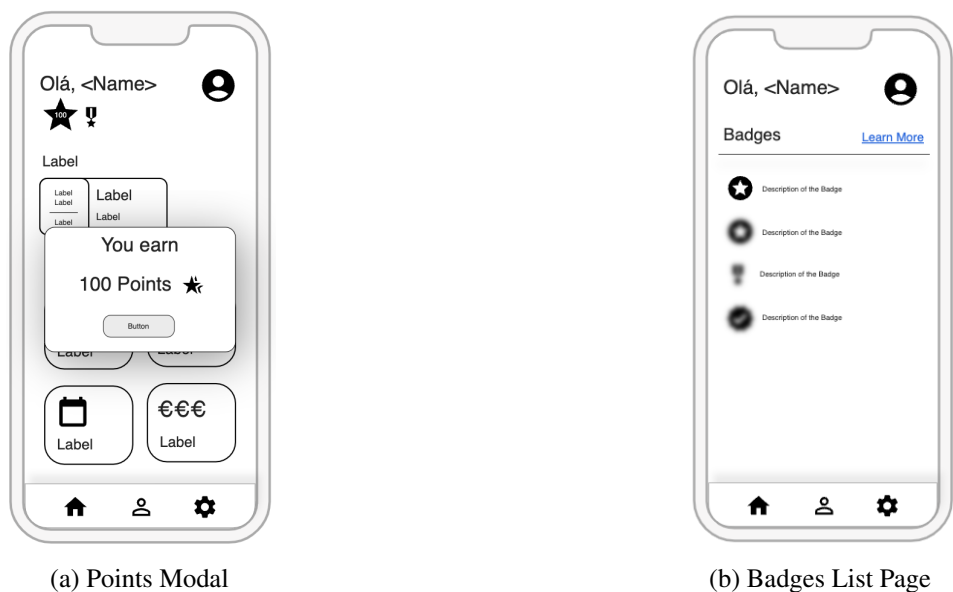


Figure 3.5: Badges List and Learn More pages

- 5. **Badges List Page:** Displays all earned badges with descriptions and requirements for unlocking them. Locked badges will appear blurred but remain visible (Figure 3.5 (b)).
- 6. **Learn More Page:** A static page providing detailed information on how the gamification system works, explaining how users can earn points, stars, and badges (Figure 3.6).



Figure 3.6: Learn More Page

3.6 Mobile Application

The myIPVC mobile application is designed to provide students with a seamless and interactive experience, integrating gamified elements to enhance engagement. To ensure efficiency, scalability, and a user-friendly interface, the app is structured into two main components: the FrontEnd, responsible for the user interface and interactions, and the BackEnd, which manages data processing, logic, and communication with external services.

3.6.1 Front End

The myIPVC app's FrontEnd is developed using React Native, a powerful cross-platform framework that enables compatibility with both iOS and Android devices. This choice ensures optimal performance while maintaining a consistent user experience across different platforms.

The different changes made in the FrontEnd repository are the same as the ones in the mock-ups.

1. **Home Page:** In the home page, some changes were made, a button to see more about gamification, and a list of badges were displayed.



Figure 3.7: Home Page

2. **Gamification Details:** The gamification details page is the page that has more information about the gamification. Shows all the points of the student, the badges, and the events. It also enables the user to convert gamification points into money by accumulating the money in the student's card.



Figure 3.8: Gamification Details Page

3. **Event Description:** The Events page gives a brief description of the event stored in the database. It can be events of gaining points or badges.



Figure 3.9: Events Description Page

4. **Badges List:** In the badges list page, all the special badges are displayed. It also shows the student's badges unlocked.



Figure 3.10: Badges List Page

5. **Badge Description:** The badge description page shows a brief description about the badge, defined in the database.

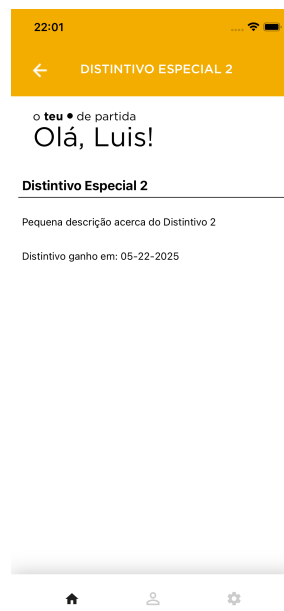


Figure 3.11: Badge Description Page

6. **Learn More:** For the Learn More page, the accordion element from other pages was reused.

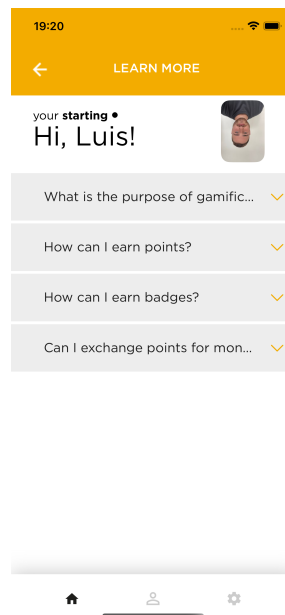


Figure 3.12: Learn More Page

3.6.2 Backend

For the backend implementation, various approaches were adopted to support the interaction between the frontend and the database. To enable data communication with the frontend, a total of six endpoints were developed—five using the HTTP GET method and one using the POST method:

1. GET */specialBadges* - Retrieves all special badges stored in the database.
2. GET */specialUserBadges* - Retrieves all special badges associated with a specific user.
3. GET */pontos* - Retrieves the total points of a specific user.
4. GET */eventos* - Retrieves all gamification events linked to a specific user.
5. GET */pontosDinheiro* - Retrieves the current conversion rate for exchanging points for credit on the student card.
6. POST */updatePontosDinheiro* - Updates the conversion rate for exchanging points for credit on the student card.

In addition to the API endpoints, modifications were made to the MongoDB database by introducing several collections to support the application's gamification logic. The collections created include:

1. **Objetivos Gamificação** - Stores all objectives related to earning points, including the required actions, points awarded, associated badges, and a brief description.

```
1 const model = Mongoose.Schema({
2   nome:{
3     type: String
4   },
5   descricao:{
6     type: String
7   },
8   pontos:{
9     type: Number
10  },
11  badges:{
12    id_especial: {
13      type: [String]
14    },
15    id_normal: {
16      type: [String]
17    }
18  },
19  tutorias: {
20    horas: {
21      type: Number
22    }
23  },
24  mentorias: {
25    interacoes: {
26      type: Number
27    }
28  },
29  ects: {
30    ects_totais: {
31      type: Number
32    }
33  },
34  mediaNotas: {
35    notas: {
36      type: Number
37    }
38  },
39  extras: {
40    type: Object
41  },
42  ganhos: {
43    pontos: {
44      type: Number
45    },
46    badges: {
47      id_especial: {
48        type: String
49      },
```

```
50     id_normal: {
51       type: String
52     }
53   }
54 }
55 });
56 export default Mongoose.model("objetivosGamificacao", model);
```

2. **Badges Especiais** - Contains all special badges available in the system. Each badge includes a name, description, image, and the number of points required to unlock it.

```
1 const model = Mongoose.Schema({
2   nome:{
3     type: String,
4   },
5   descricao: {
6     type: String
7   },
8   pontos: {
9     type: Number
10  },
11  imagem: {
12    type: String,
13  }
14 });
15 export default Mongoose.model("badgesEspeciais", model);
```

3. **User Special Badges** - Records all special badges obtained by users. Each entry includes the student's email, badge ID, status (locked/unlocked), and the date it was earned.

```
1 const model = Mongoose.Schema({
2   email:{
3     type: String,
4   },
5   specialBadges: [{
6     idSpecialBadge: {
7       type: String,
8       required: true
9     },
10    lock:{
11      type: Boolean
12    },
13    earnedAt: {
14      type: Date,
15      default: Date.now
16    }
17  }]
18 });
19 export default Mongoose.model("userSpecialBadges", model);
```

4. **Settings Gamificação** - Defines how many points a student can earn from each gamification element. It specifies requirements such as the number of ECTS credits, tutoring hours, mentoring sessions, and semester grade averages.

```
1 const model = Mongoose.Schema({
2   nome: {
3     type: String
4   },
5   pontos: {
6     ECTS_pontos:{
7       ects: {
8         type: Number
9       },
10      pontos: {
11        type: Number
12      }
13    },
14    Media_pontos:{
15      media: {
16        type: Number
17      },
18      pontos: {
19        type: Number
20      }
21    },
22    Tutoria_pontos:{
23      horas: {
24        type: Number
25      },
26      pontos: {
27        type: Number
28      }
29    },
30    Mentoria_pontos:{
31      interacoes: {
32        type: Number
33      },
34      pontos: {
35        type: Number
36      }
37    }
38  },
39  pontosBadges: {
40    type: Number
41  }
42 });
43 export default Mongoose.model("settingsgamificacao", model);
```

5. **Specifications Gamificação** - This is the most detailed collection, storing comprehensive

information about each student. It includes their total points, badge counts (bronze, silver, and gold), gamification events, and specific metrics such as grade averages, ECTS earned, tutoring hours, and mentoring interactions.

```
1 const model = Mongoose.Schema({
2   email:{
3     type: String,
4     required: true,
5     unique: true
6   },
7   pontosDinheiro: {
8     type: Boolean
9   },
10  pontos: {
11    type: Number
12  },
13  badges: {
14    bronze: {
15      type: Number
16    },
17    prata: {
18      type: Number
19    },
20    ouro: {
21      type: Number
22    },
23  },
24  events: [
25    {
26      nome: {
27        type: String
28      },
29      descricao: {
30        type: String
31      },
32      data: {
33        type: Date
34      },
35      nomeBadge: {
36        type: String
37      },
38      idBadge: {
39        type: String
40      },
41      pontosGanhos: {
42        type: String
43      }
44    }
45  ],
```

```
46   mediaNotas: {
47     media: {
48       type: Number
49     },
50     lastUpdated: {
51       type: Date
52     }
53   },
54   ECTS: {
55     total: {
56       type: Number
57     },
58     lastUpdated: {
59       type: Date
60     }
61   },
62   tutorias: {
63     horas: {
64       type: Number
65     },
66     lastUpdated: {
67       type: Date
68     }
69   },
70   mentorias: {
71     interacoes: {
72       type: Number
73     },
74     lastUpdated: {
75       type: Date
76     }
77   }
78 });
79 export default mongoose.model("specificationsGamificacao", model);
```

3.6.3 Cron Jobs

To automate data updates and ensure the gamification system remains synchronized with user activity and academic performance, two scheduled cron jobs were implemented using the node-cron library. These cron jobs are responsible for executing specific logic at predetermined intervals, avoiding the need for manual intervention.

1. Weekly Update: Tutoring and Mentoring Activities

```
1 cron.schedule("0 0 * * 0", async () => {
2   try {
3     const todayDate = new Date().toLocaleDateString("pt-PT", { day: "2-digit"
4       , month: "2-digit" });
5     const usersBD = await Users.find();
```

```
5
6   for (const user of usersBD) {
7       if (user.num_utilizador.length <= 1 || user.id_curso.length <= 1)
8           continue;
9       const userSpecs = await specificationsGamificaco.findOne(
10           { email: user.email },
11           { "tutorias.lastUpdated": 1, "mentoria.lastUpdated": 1, _id: 0 }
12       );
13       if (!userSpecs) continue;
14
15       if (userSpecs?.tutorias?.lastUpdated !== todayDate) logicaTutoria();
16       if (userSpecs?.mentoria?.lastUpdated !== todayDate) logicaMentoria();
17
18       getBadges();
19       getBadgesEspeciais();
20   }
21 } catch (error) {
22     console.error("Erro no cron job:", error);
23 }
24 };
```

Execution Frequency: Every Sunday at midnight (00:00).

Purpose: This cron job ensures that tutoring and mentoring data are regularly validated and updated for all users weekly, as shown in Figure 3.13.

Workflow:

- (a) The system fetches all users from the database.
- (b) It skips any users with incomplete information (e.g., missing student number or course ID).
- (c) For each valid user, it checks whether their tutoring and mentoring data has already been updated on the current date.
- (d) If not, the appropriate logic functions (`logicaTutoria()` and `logicaMentoria()`) are executed to update this information.
- (e) After that, two additional functions—`getBadges()` and `getBadgesEspeciais()`—are called to verify if the updated data qualifies the user for any new badges or special badges.

Benefits:

- (a) Ensures the tutoring and mentoring metrics are current.
- (b) Supports real-time badge assignment logic based on user progress.

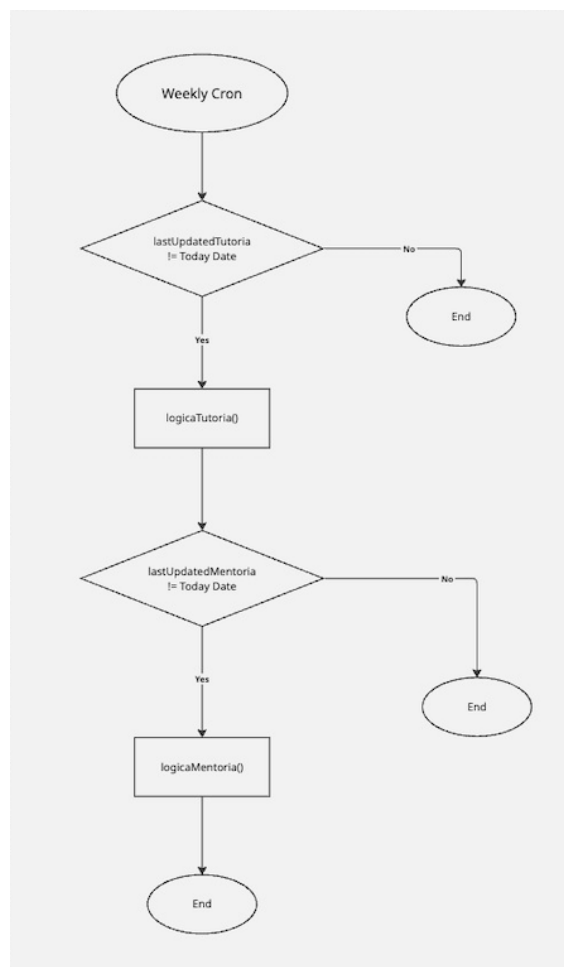


Figure 3.13: Weekly CronServer

2. Triannual Update: Grade Averages and ECTS Credits

```

1  cron.schedule("0 0 28-31 1,5,9 *", async () => {
2    try{
3      const todayDate = new Date().toLocaleDateString("pt-PT", { day: "2-
4        digit", month: "2-digit" });
5      const usersBD = await Users.find();
6
7      for (const user of usersBD) {
8        if (user.num_utilizador.length <= 1 || user.id_curso.length <= 1) {
9          continue;
10         }
11
12        const userSpecs = await specificationsGamificacao.findOne(
13          { email: user.email },
14          { "mediaNotas.lastUpdated": 1, "ECTS.lastUpdated": 1, _id: 0 }
15        );
16
17        if (!userSpecs) {
18          console.log(`Erro ao encontrar settings do user ${user.email}`);
19        }
20      }
21    } catch (error) {
22      console.log(error);
23    }
24  }
25 }

```

```
18         continue;
19     }
20
21     const lastUpdatedMediaNotas = userSpecs?.mediaNotas?.lastUpdated ||
22         null;
23     const lastUpdatedECTS = userSpecs?.ECTS?.lastUpdated || null;
24
25     if (lastUpdatedMediaNotas !== todayDate) {
26         logicaNotas();
27     }
28
29     if (lastUpdatedECTS !== todayDate) {
30         logicaECTS();
31     }
32
33 } catch(error) {
34     console.error("Erro no cron job:", error);
35 }
36 });
```

Execution Frequency: Three times a year, specifically between the 28th and 31st of January, May, and September, at midnight. These dates align with the typical end-of-term academic calendar.

Purpose: To update each student's academic performance data, namely their average grades and total ECTS credits, based on the most recent academic records as displayed in Figure 3.14.

Workflow:

- (a) Similar to the weekly job, the system retrieves all users and filters out those with incomplete profiles.
- (b) For each user, it checks if their grade average and ECTS data have already been updated for the current date.
- (c) If not, it triggers logicaNotas() and logicaECTS() to compute and store the new academic values.

Benefits:

- (a) Keeps academic records up to date with minimal latency after term completion.
- (b) Ensures the gamification system reflects accurate academic progress for point and badge calculations.

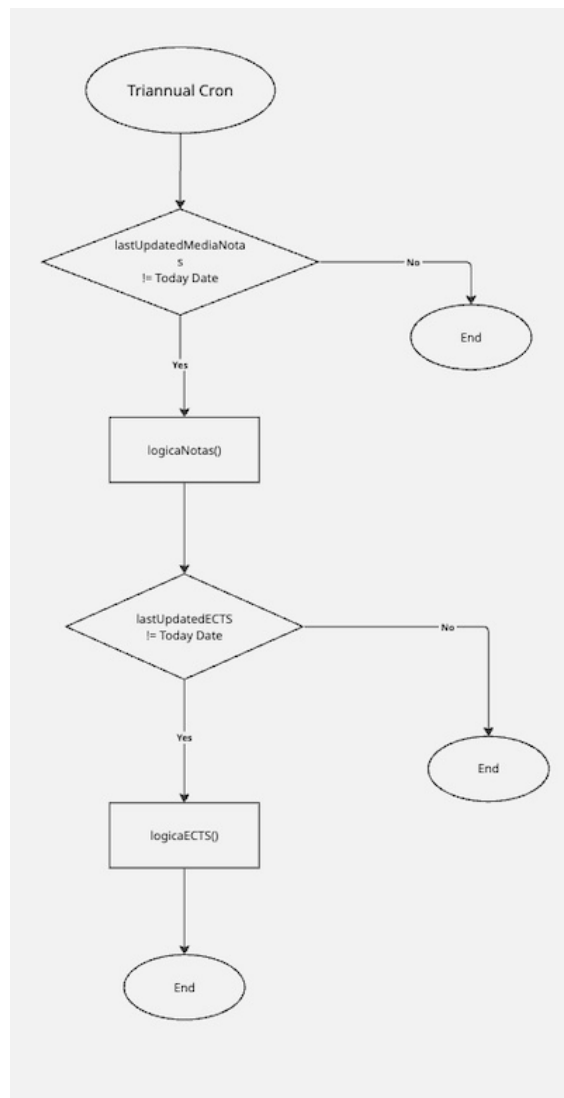


Figure 3.14: Triannual CronServer

Chapter 4

Evaluation

This chapter presents the evaluation of the gamification system implemented in myIPVC mobile application. The primary objective is to assess the usability and user experience of the newly integrated gamified features and to determine their potential impact on student engagement.

The evaluation was conducted using the System Usability Scale (SUS), a widely accepted method for measuring perceived usability. The SUS provides a global benchmark score based on user responses and allows comparison with industry standards [20]. Additionally, qualitative feedback was collected to capture user impressions, preferences, and suggestions for improvement.

4.1 Evaluation Methodology

4.1.1 System Usability Scale (SUS)

The **System Usability Scale** is a standardized questionnaire consisting of ten statements rated on a five-point Likert scale, where respondents express their level of agreement from "Strongly Disagree" to "Strongly Agree." The SUS is particularly effective due to its simplicity, reliability, and ability to generate a single usability score ranging from 0 to 100.

The ten SUS statements alternate between positive and negative wording to reduce response bias. The scoring method involves converting each response to a numeric value, summing the adjusted values, and multiplying the result by 2.5 to obtain the final score. A SUS score:

- **Above 68** is considered above average
- **Above 80** indicates excellent usability
- **Below 50** is considered poor usability

This evaluation method was selected due to its flexibility and its suitability for early-stage prototypes and iterative development processes.

4.1.2 Preparation

The evaluation was presented to a group of students familiar with the myIPVC application. Participants used the gamified features, including badge displays, points and event history, before completing the SUS questionnaire. This ensured that users had real, hands-on interaction with the interface.

The questionnaire consisted of ten statements rated on a five-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5). The statements are presented below:

- I think that I would like to use this gamified system frequently.
- I found the gamified features made the system unnecessarily complex.
- I thought the gamified system was easy to use.
- I think that I would need the support of a technical person to understand the gamified elements of this system.
- I found that the gamified elements and core functions were well integrated.
- I thought there was too much inconsistency between the gamified elements and the rest of the system.
- I would imagine that most people would learn to use the gamified features of this system very quickly.
- I found the gamified interactions (points, badges) very awkward to use.
- I felt very confident using the gamified aspects of the system.
- I needed to learn a lot of things before I could understand how the gamification in this system works.

4.1.3 Evaluation Results

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total	SUS
3	1	5	2	3	2	5	2	5	1	33	82.5
3	3	4	1	3	3	4	3	3	1	26	65.0
4	2	4	1	2	3	4	2	3	3	26	65.0
4	2	5	2	5	1	5	1	5	1	37	92.5
4	1	5	1	3	3	4	2	4	2	31	77.5
5	1	5	1	4	2	5	1	5	1	38	95.0
4	5	5	4	5	4	5	4	5	4	23	57.5
5	1	5	2	5	1	5	1	5	1	39	97.5
5	1	5	2	4	2	5	1	5	1	37	92.5
5	2	4	1	5	2	4	1	4	2	34	85.0
Average SUS										81.0	

Table 4.1: Individual participant responses to each item of the System Usability Scale (SUS) with average SUS.

The collected SUS responses were aggregated to calculate the final score. The resulting SUS score was 81, which, according to SUS interpretation standards, falls within the "Excellent Acceptable" range.

This indicates that:

- The usability of the gamification system is very well integrated
- Users generally understood the functionalities
- There is room for refinement and improvement in UI clarity, workflow simplicity, and overall user experience

4.2 Discussion of Results

The objective was to assess how users interacted with the gamified features, such as points, normal badges, and special badges, and to determine whether these elements contributed to improving engagement and usability.

After one week of active use of the application, all participants completed the SUS questionnaire, which consists of ten items rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

A total of 10 students participated in the evaluation. The results were analyzed following the methodology, where each individual SUS score is converted to a value between 0 and 100. The overall average SUS score obtained for the application was **81.0**, which, according to standard interpretation, corresponds to an "Excellent" level of usability. Scores above 80 typically indicate that users found the system efficient, consistent, and pleasant to use.

Chapter 5

Conclusion and Future Work

This dissertation presented the design, implementation, and evaluation of a gamification system integrated into myIPVC mobile application. The primary purpose of the project was to enhance student engagement by enriching the app with motivational game-like elements, thereby transforming routine academic interactions into more rewarding experiences.

The solution introduced a structured gamification model based on points, badges, and academic progression. The integration was supported by a modular three-layer architecture composed of a React Native frontend, a backend responsible for business logic, and a MongoDB database. Automated cron jobs were implemented to ensure regular synchronization of academic data, enabling the system to deliver up-to-date achievements and rewards.

To assess the usability of the gamified system, the System Usability Scale (SUS) was employed. The system achieved a SUS score of 81, which places it in the category of “Excellent Usability.” This score indicates that users found the gamification features intuitive, pleasant to use, and well integrated within the existing myIPVC environment. Additionally, participants reported that the new gamified elements increased their interest in revisiting the application and made the academic information feel more meaningful.

The evaluation confirms that gamification has strong potential to enrich student interaction with institutional digital platforms. By connecting academic progress with motivational feedback, the system has the capacity to support student persistence, promote the use of academic services, and foster a more dynamic learning ecosystem.

5.1 Limitations

While the implemented system successfully demonstrates the value of gamification in an academic mobile application, several limitations were identified:

1. **Narrow Scope of Gamified Metrics** Only four academic elements. ECTS, grade averages, tutoring hours, and mentoring interactions were gamified.

2. **Dependence on Institutional Data Quality** The effectiveness of the gamified components relies on timely and accurate updates from academic services, which may fluctuate depending on institutional workflows.
3. **Limited Evaluation Sample Size** The usability evaluation involved a relatively small sample of participants (10), limiting the statistical generalizability of the findings.
4. **Early-Stage Gamification System** The system currently provides foundational gamified elements and does not yet include more advanced mechanics such as collaborative challenges, leaderboards, or adaptive difficulty.

5.1.1 Comparison with Similar Studies

The obtained SUS score of 81.0 aligns with or slightly exceeds results reported in similar studies evaluating gamified educational and productivity applications. Previous research indicates that SUS scores between 75 and 85 are generally associated with systems that are both effective and enjoyable to use [20].

Consistent with these findings, the results of this evaluation confirm that the integration of gamified elements, when designed coherently, can enhance motivation and engagement without introducing significant usability barriers. The participants' engagement metrics (points and badges earned) further support this conclusion, demonstrating active interaction with the system throughout the testing period.

5.1.2 Reflection on Design Choices

The design decisions adopted during development proved largely successful in meeting the project's objectives. The introduction of points and badges effectively reinforced user motivation by providing clear and immediate feedback on progress. The minimalistic interface and visual consistency across screens contributed to an overall smooth and intuitive experience.

Nevertheless, some usability aspects require further refinement. A small number of participants reported confusion in understanding badge progression and certain navigation paths. These issues suggest that additional onboarding support, such as a short tutorial or visual hints, could further improve the initial learning curve for new users.

5.1.3 Future Work

Based on the identified limitations and the positive evaluation results, several future development directions are proposed:

1. **Expansion of Gamification Mechanics** To create a richer and more engaging user experience, additional game elements may be incorporated:
 - Weekly and monthly missions

- Leaderboards for friendly competition
- Long-term quests tied to academic goals
- Avatar customization and personalization features
- Leveling systems to represent academic evolution

These additions would enhance sustained participation and introduce new motivational layers.

2. Integration of New Academic and Extracurricular Metrics Future versions of the system could track a broader range of student activities, such as:

- Library visits
- Participation in extracurricular events
- Lecture attendance
- Completion of online training modules
- Volunteering or community projects

This would create a more comprehensive gamified ecosystem that recognizes diverse forms of student engagement.

The integration of gamification into myIPVC application proved to be a promising approach for improving student engagement and enhancing the user experience. The SUS score of 81 confirms that the system not only functions effectively but is also well-received by students. With additional refinements, expanded features, and broader evaluations, this work can serve as a foundation for building a more interactive and student-centered academic platform.

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