

FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO

Integrating Gamification to Enhance Reading Engagement in Educational Context

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Resumo

O declínio progressivo do envolvimento dos alunos na leitura no ensino básico intensificou a procura por estratégias inovadoras para promover práticas de literacia sustentáveis. Este estudo aborda o desafio através da conceção, implementação e avaliação de uma plataforma de leitura gamificada adaptada a um contexto educativo real. Desenvolvida em parceria com a Escola Global em Portugal, a investigação apresenta uma plataforma nativa da nuvem integrada no ecossistema Microsoft Teams, construída com base no Azure Functions e no Cosmos Database.

Baseado na psicologia motivacional, o design da plataforma aproveita a SDT (Teoria da Autodeterminação) e a Teoria do Fluxo para equilibrar recompensas extrínsecas com motivação intrínseca. Uma inovação fundamental deste trabalho é a sua abordagem diferenciada por idade, oferecendo uma experiência estruturada e orientada pelo professor para alunos mais jovens (3.º e 4.º anos) e um modelo autónomo e orientado por escolhas para alunos mais velhos (5.º ao 8.º anos). O estudo empregou um projeto de pesquisa de métodos mistos, combinando desenvolvimento ágil de software com dados empíricos de registos do sistema, pesquisas com alunos e professores e feedback qualitativo para realizar uma análise robusta e multifacetada.

Os resultados demonstram que a intervenção gamificada aumentou significativamente o envolvimento, embora a natureza desse envolvimento variasse de acordo com a idade. Os alunos mais novos responderam fortemente às recompensas baseadas em tarefas dentro do programa estruturado, enquanto os alunos mais velhos exibiram um comportamento mais autodirigido e habitual, evidenciado por sequências de leitura mais longas. Uma descoberta crítica foi o papel essencial da agência do professor, onde a facilitação ativa estava diretamente correlacionada com o maior sucesso dos alunos. Além disso, a análise confirmou que o sistema de questionários integrado serviu como um mecanismo eficaz para garantir a integridade académica, validando a conclusão dos livros.

Esta tese contribui com uma estrutura clara e baseada em evidências para a gamificação diferenciada por idade, um modelo validado para o design de plataformas centradas no professor e uma arquitetura técnica replicável para ferramentas educacionais integradas. As descobertas fornecem insights acionáveis para educadores e desenvolvedores, demonstrando que a gamificação alinhada pedagogicamente pode efetivamente aumentar o envolvimento com a leitura quando projetada com consideração cuidadosa pelas necessidades de desenvolvimento e envolvimento ativo do professor.

Palavras-chave: Gamificação, Leitura, Educação Digital, Microsoft Teams, Motivação, Psicologia Educacional

Abstract

The progressive decline in student reading engagement in primary education has intensified the search for innovative strategies to foster sustainable literacy practices. This study addresses the challenge by designing, implementing, and evaluating a gamified reading platform tailored for a real-world educational context. Developed in partnership with Escola Global in Portugal, the research presents a cloud-native platform integrated within the Microsoft Teams ecosystem, built upon Azure Functions and Cosmos Database.

Grounded in motivational psychology, the platform's design leverages SDT (Self-Determination Theory) and Flow Theory to balance extrinsic rewards with intrinsic motivation. A key innovation of this work is its age-differentiated approach, offering a structured, teacher-led experience for younger students (Grades 3–4) and an autonomous, choice-driven model for older students (Grades 5–8). The study employed a mixed-methods research design, combining agile software development with empirical data from system logs, student and teacher surveys, and qualitative feedback to conduct a robust, multi-faceted analysis.

The results demonstrate that the gamified intervention significantly increased engagement, though the nature of this engagement varied by age. Younger students responded strongly to task-based rewards within the structured program, while older students exhibited more self-directed, habitual behavior, evidenced by longer reading streaks. A critical finding was the essential role of teacher agency, where active facilitation was directly correlated with higher student success. Furthermore, the analysis confirmed that the integrated quiz system served as an effective mechanism to ensure academic integrity by validating book completions.

This thesis contributes a clear, evidence-based framework for age-differentiated gamification, a validated model for teacher-centric platform design, and a replicable technical architecture for integrated educational tools. The findings provide actionable insights for educators and developers, demonstrating that pedagogically aligned gamification can effectively enhance reading engagement when designed with careful consideration for developmental needs and active teacher involvement.

Keywords: Gamification, Reading Engagement, Digital Education, Microsoft Teams, Motivation, Educational Psychology

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José Artur Lima Assunção

*“A reader lives a thousand lives before he dies.
The man who never reads lives only one”*

George R.R. Martin

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Abreviaturas e Símbolos

API	Application Programming Interface
DB	Database
DFS-2	Dispositional Flow Scale-2
PNL	Plano Nacional de Leitura
SDT	Self-Determination Theory
STEM	Science, Technology, Engineering and Mathematics
UI	User Interface

Chapter 1

Introduction

1.1 Context and Motivation

The progressive decline in literacy participation among school-aged students is a critical challenge for contemporary education, especially as digital technologies shape literacy practices (Plano Nacional de Leitura, 2017). In Portugal, recent studies echo this trend, highlighting a steady decrease in voluntary reading among primary students (Plano Nacional de Leitura, 2017). This decline in sustained reading practice has profound implications for cognitive development, academic achievement, and future career prospects, as strong literacy skills remain fundamental to educational success across disciplines.

Simultaneously, educational institutions are increasingly adopting integrated digital ecosystems such as Microsoft Teams (Microsoft Corporation (2024c)) to facilitate teaching and learning processes. These platforms offer unprecedented opportunities for scalable and accessible educational interventions seamlessly incorporated into existing classroom practices, allowing more sophisticated educational applications that respond dynamically to pedagogical needs while maintaining performance at scale.

Gamification, defined as "the use of game design elements in non-game contexts" (Deterting et al., 2011), has emerged as a promising pedagogical strategy to address declining student engagement across various educational domains. Recent systematic reviews and meta-analyses have demonstrated statistically significant positive effects of gamification on learning outcomes (Chen et al., 2023; Li et al., 2023) and intrinsic motivation (Sailer and Homner, 2020) when implemented with careful attention to psychological and pedagogical principles. The integration of gamification principles within educational technology represents a potentially powerful approach to reinvigorating reading engagement among digital natives.

Within the Portuguese educational context specifically, initiatives such as PNL (Plano Nacional de Leitura) (Plano Nacional de Leitura (2017)) have prioritized the development of robust reading habits among students, acknowledging the critical importance of literacy for academic achievement and lifelong learning. These national priorities align with the broader policy framework of the European Union, such as the Digital Education Action Plan (2021-2027) (European

Commission (2021), which emphasizes the importance of innovative digital pedagogies in promoting literacy development.

1.2 Problem Statement

Despite the promise of gamification and the increased investment in educational technology, fostering sustained reading engagement in real-world classrooms remains a significant challenge. The literature and preliminary fieldwork reveal that many existing digital reading tools fail not on their technical merits but due to a disconnect from the practical realities of the classroom environment. These empirical challenges manifest themselves in several key areas.

First, many gamified platforms exist as standalone applications, creating "digital islands" that are disconnected from the school's primary technological ecosystem. This lack of integration forces teachers and students to manage multiple logins and navigate disparate interfaces, disrupting the natural flow of a lesson and increasing the administrative burden on educators who must manually transfer data or track progress across systems.

Second, a common failure is the adoption of a "one-size-fits-all" pedagogical model. These tools often apply generic gamification mechanics, the same points, badges, and leaderboards, to all age groups, ignoring the profound developmental differences in what motivates a 3rd grade student and an 8th grade student. This frequently results in a design that is too simplistic for older students or too complex for younger ones, failing to effectively engage either group.

Finally, existing tools often suffer from a lack of teacher agency. They frequently position educators as passive facilitators of a "black-box" system that they cannot control or customize. Teachers are unable to align the platform's challenges with their specific curriculum, differentiate tasks for students with diverse learning needs, or access meaningful analytics that could inform their teaching practice. This transforms a potentially powerful educational aid into a rigid constraint, limiting its adoption and long-term effectiveness.

This research addresses these practical challenges directly by proposing and validating an integrated gamification platform designed to operate seamlessly within an existing school environment.

1.3 Research Questions

To address the empirical problems identified above, this thesis is guided by four central research questions. These questions are designed to investigate the complex interplay between gamification, student participation, teacher participation, and developmental psychology within an authentic classroom context.

1. How do gamified interventions, when integrated into a school's existing digital ecosystem, impact student reading engagement and comprehension?

2. How can teacher agency be designed into a gamified system to allow effective curriculum integration and support sustained student engagement?
3. What practical factors in a classroom setting, such as time constraints, technical support, and alignment with assessment, affect a teacher's adoption and sustained use of a gamified reading platform?
4. How do different age groups (grades 3-4 vs. 5-8) respond to tailored gamification mechanics, and how should these age-related variations influence the design of future interventions?

1.4 Study Objectives

Building upon the preceding research questions, this study pursues a set of five core objectives that bridge software engineering, pedagogical validation, and theoretical inquiry. The primary technical objective is to architect, develop, and rigorously validate a robust, cloud-native gamified reading platform that leverages the Microsoft Teams ecosystem [Microsoft Corporation \(2024c\)](#), with a backend powered by Azure Functions [Microsoft Corporation \(2024a\)](#) and Cosmos DB [Microsoft Corporation \(2024b\)](#). From a pedagogical standpoint, the study aims to empirically evaluate whether and how specific gamification features influence student engagement with reading tasks, analyzing these effects across immediate, short-term, and sustained timescales.

A key methodological objective is to document and analyze the nuanced patterns of interaction that emerge between teachers, students, and the platform within authentic educational settings. This involves gathering and synthesizing multidimensional evidence regarding the usability of the platform, its motivational effects, and its perceived educational value through a mixed methods data collection strategy. Ultimately, the research seeks to contribute new theoretical and practical knowledge on the design principles that govern the development of effective and sustainable educational gamification, particularly in the domain of motivation for reading.

1.5 Significance and Expected Contributions

This research is positioned to offer significant contributions that are multifaceted, and also address specific gaps identified in previous studies and existing tools. While many gamified platforms exist, this work distinguishes itself through its deep integration, pedagogical alignment, and contextual sensitivity. The expected contributions can be understood across the theoretical, practical, and methodological dimensions.

Theoretically, this study extends existing gamification frameworks by providing a detailed examination of an integrated, teacher-mediated implementation. Unlike many standalone applications that isolate the gamified experience, this platform operates within the school's digital ecosystem, allowing for an analysis of gamification as it interacts with authentic classroom workflows. This provides novel insights into motivational theory, particularly by investigating the interplay between extrinsic elements (e.g., points) and intrinsic motivation when an educator is actively

guiding the experience. Furthermore, it advances the understanding of how age-differentiated digital interventions translate into observable behaviors, offering empirical evidence that contrasts with the one-size-fits-all approach common in many existing tools.

On a practical level, this thesis provides a validated technical architecture for deep integration within an existing institutional environment (Microsoft Teams). This represents a significant departure from standalone applications, offering a replicable and scalable model that lowers the barrier to adoption for schools. The work also delivers empirically tested design principles that are novel in their emphasis on co-design with educators. The resulting practical guidelines for teachers are not generic, but are derived directly from the feedback and collaborative process within a specific school context. Critically, the platform introduces a quiz-as-validation system, a practical innovation designed to ensure academic integrity and address the common problem of students "gaming the system", a solution not explicitly detailed in many previous studies.

Methodologically, the research demonstrates the value of a mixed-methods evaluation approach that validates the gamification design itself. Data triangulation is used not only to measure engagement, but also to confirm that the mechanics (e.g., completion points) are tied to genuine learning activities, establishing a robust protocol for evaluating the pedagogical effectiveness of a gamified system beyond surface-level metrics. This approach provides a more holistic and rigorous model for future research on educational technology.

1.6 Structure of the Thesis

This thesis is organized into seven chapters, each building on the previous to provide a comprehensive understanding of the design, implementation, and evaluation of the gamified reading platform.

1. **Chapter 1** - Introduction: This chapter presents the motivation, objectives, and scope of the research. It introduces the educational context, outlines the main research questions, and sets the stage for the work developed throughout the thesis.
2. **Chapter 2** - State of the Art: A comprehensive review of relevant literature and existing solutions is provided. The chapter discusses current trends in educational technology, gamification in learning, and digital reading platforms, highlighting gaps and opportunities that inform the proposed approach.
3. **Chapter 3** - Methodology: This chapter details the research design and methodological framework adopted in the project. It describes the processes of requirements gathering, and the iterative development cycle.
4. **Chapter 4** - Implementation: The technical and pedagogical implementation of the platform is thoroughly described in this chapter. It covers architectural decisions, feature development, user experience design, and the rationale behind key technological choices.

5. **Chapter 5** - Results and Analysis: This chapter presents the outcomes of the platform's deployment and empirical evaluation.
6. **Chapter 6** - Conclusion: This chapter summarizes the main findings and contributions of the thesis. It reflects on the limitations of the current work, proposes directions for future research, and discusses the broader implications for the field of educational technology.
7. **Chapter 7** - Alignment with the Sustainable Development Goals: This final chapter reflects on the contributions of this dissertation in the context of the United Nations' SDGs, detailing how the project aligns with global goals for quality education, reduced inequalities, and innovation.

Chapter 2

State of the Art

2.1 Introduction

The persistent decline in reading participation among students, particularly pronounced in the digital era, has intensified the search for innovative pedagogical strategies to promote sustained literacy development (Matyakhan et al., 2024). Reading is widely recognized as a foundational skill, essential for meaning making, academic achievement, and lifelong learning, yet contemporary educational environments face unprecedented challenges in maintaining students' interest and commitment to reading (Rodrigues et al., 2022). This issue is especially critical in primary education, where early disengagement can have long-term consequences for cognitive development and academic performance (Matyakhan et al., 2024).

Among the approaches explored to revitalize motivation and learning outcomes, gamification has emerged as a particularly promising strategy (Li et al., 2023). Although the idea of using games or playful elements in education is not new, "gamification", defined as the use of game design elements in non-game contexts, entered mainstream educational discourse around 2010 and has since gained significant traction as a tool for enhancing engagement and learning outcomes (Dichev and Dicheva, 2017). Gamification is broadly defined as applying game design elements and principles in non-game contexts. More specifically, it can be understood as enhancing services with motivational amenities to evoke "gameful experiences" and promote desired behavioral outcomes (Hamari et al., 2014), or simply making activities more game-like. It is essential to distinguish gamification, which uses elements or components of games, from game-based learning, which uses fully functional games to impart skills or knowledge (Li et al., 2023).

The adoption of gamification has expanded rapidly in all sectors, including business, marketing, health, and especially education, due to its potential to foster motivation, participation, friendly competition, and collaboration (Li et al., 2023). In schools, gamified approaches are increasingly seen as a strategy to address declining student involvement, particularly in digital environments where traditional reading activities may struggle to compete for attention (Matyakhan et al., 2024). Studies suggest that gamification can make learning more interesting and fun, particularly in digital environments (Matyakhan et al., 2024). Empirical evidence supports the positive

effects of gamification on both behavioral (e.g. participation, persistence) and cognitive (e.g., comprehension, test performance) outcomes (Rodrigues et al., 2022). In particular, the integration of game mechanics such as points, badges, progress bars, and streaks has been shown to make learning more engaging and enjoyable, and to support the development of language and reading skills (Meng et al., 2024).

Despite its growing popularity and perceived benefits, empirical findings on the effectiveness of gamification in education have been mixed and inconsistent (John et al., 2023). There remains no unified agreement among researchers on its effective implementation, and some studies have reported uncertain or even prejudicial results (Smiderle et al., 2020). There are concerns that the practice of gamifying learning has outpaced researchers' understanding of its underlying mechanisms and methods (Dichev and Dicheva, 2017). A critical review highlights that there is not enough evidence to support the long-term benefits of gamification in educational contexts (Dichev and Dicheva, 2017), and the knowledge of how to effectively gamify an activity according to specific educational contexts is still limited (Meng et al., 2024). Measurement issues have also been cited as a reason for the inconsistency in findings, as different measures are used to evaluate student outcomes (Li et al., 2023).

This chapter provides a critical synthesis of the literature on gamification in education, with a specific focus on reading engagement, a domain where empirical research, particularly at the primary level, is still limited (Matyakhan et al., 2024). Examines the psychological foundations of gamification, exploring how elements of game design can serve as motivational tools (Meng et al., 2024), potentially influencing both extrinsic and intrinsic motivation (Meng et al., 2024) and contributing to satisfaction of psychological needs. The role of social interaction and the sense of community that is engrained by competitive-collaborative elements in boosting motivation is also considered (Matyakhan et al., 2024). However, it also addresses potential downsides, such as the risk of overreliance on incentive systems that reduce intrinsic motivation (Meng et al., 2024) and the widely discussed "novelty effect," where initial engagement spikes may decrease over time as novelty diminishes, although recent evidence also suggests a "familiarization effect" where benefits can recover (Rodrigues et al., 2022).

2.2 Theoretical Foundations: The Psychology of Gamification

The educational impact of gamification is best understood through the lens of motivational psychology, particularly SDT (Self-Determination Theory) and Flow Theory. These frameworks provide a robust foundation for explaining how game design elements can influence student motivation, engagement, and learning behaviors within nongame contexts (Dichev and Dicheva, 2017; Li et al., 2023).

Central to SDT, developed by Ryan (2023), is the premise that human motivation is contingent on the satisfaction of three innate psychological needs: autonomy, competence, and relatedness. Educational gamification directly addresses these needs through specific design choices (Ryan, 2023). The need for *autonomy*, or the desire to be the causal agent of one's own life, is fostered by

providing learners with meaningful choices, such as self-directed goals or personalized learning paths, which in turn enhance intrinsic motivation. The need for *competence*, or the desire to master challenges, is supported through clear progress feedback, such as points and progress bars, and scaffolded challenges that are optimally balanced with the student's skill level. Finally, the need for *relatedness*, the universal desire to interact with and be connected to others, is nurtured through collaborative tasks and social recognition systems such as leaderboards, which foster a sense of community and peer connection.

2.3 Flow Theory in Gamified Learning

Complementing SDT, Flow Theory, pioneered by Csikszentmihalyi (2000), describes a state of deep absorption in which individuals experience intense focus, intrinsic motivation, and a loss of self-consciousness when engaged in an optimally challenging task. This psychological framework posits that the state of "flow" arises from a delicate equilibrium between an individual's perceived skills and the challenge presented by an activity (Csikszentmihalyi, 2000). In the context of educational gamification, flow manifests itself when students encounter tasks adapted to their abilities, supported by immediate feedback and clear, achievable goals, which collectively work to maintain deep engagement (Rodrigues et al., 2022; Meng et al., 2024).

The experience of flow is characterized by several core dimensions, which can be broadly categorized as the prerequisite *conditions* for entering the state and the psychological *outcomes* that define it. The primary conditions that a designer can manipulate include maintaining a clear challenge-skill balance, where tasks are difficult enough to be engaging but not so difficult as to cause frustration; establishing clear goals, which direct the student's attention and effort; and providing immediate feedback through mechanics like points or progress updates, which validates actions and sustains motivation (Csikszentmihalyi, 2000; John et al., 2023; Smiderle et al., 2020).

When these conditions are successfully met, students can experience the defining outcomes of flow. These include an autotelic experience, where the activity becomes intrinsically rewarding and enjoyable for its own sake; a transformation of time, where one's perception of time is altered during deep engagement; and a loss of self-consciousness, where awareness of external judgments fades as the student becomes fully immersed in the reading task (Hamari et al., 2014; Csikszentmihalyi, 2000; Wang et al., 2009).

Flow in Gamification Design

Gamification mechanics, such as progress visualization (streak counters), directly target flow conditions (Li et al., 2023). For example, the MDA framework emphasizes the alignment of quantifiable game elements (*mechanicals*) with emotional experiences (*aesthetics*) to sustain engagement (Hunicke et al., 2004; Li et al., 2023). Empirical studies show that designs that combine these elements produce higher learning outcomes, with effect sizes up to $g = 0.82$ (Li et al., 2023).

However, gamification's structured nature prioritizes certain flow dimensions over others. Although *clear goals* and *feedback* are strongly reinforced, immersive outcomes such as *time transformation* are less prominent compared to full-fledged games (Hamari et al., 2014). This structured focus can improve task persistence, but may limit deep cognitive absorption in reading activities (Dichev and Dicheva, 2017).

Key challenges in fostering flow include the novelty effect, where initial engagement spikes often decline as mechanics become familiar (Rodrigues et al., 2022). Another concern is extrinsic overload, where overemphasis on points and leaderboards can undermine intrinsic motivation (John et al., 2023). Finally, the instructor's role is critical, as teachers must balance autonomy and guidance to avoid disrupting the flow experience (Saggah et al., 2018).

In the current study, flow states were measured using the Dispositional Flow Scale-2 (DFS-2), validated in gamified contexts (Wang et al., 2009). Preliminary data revealed strong correlations between challenge-skill balance and quiz completion rates ($r = 0.71$), as well as weaker associations with time transformation ($r = 0.22$), which aligns with the goal-oriented nature of gamification (Hamari et al., 2014).

2.3.1 Gamification Across Educational Domains: Literacy in Context

Gamification has emerged as a prominent strategy for improving motivation and learning outcomes in educational settings, with literacy instruction presenting unique opportunities and challenges (Dichev and Dicheva, 2017; Li et al., 2023; Rodrigues et al., 2022). Although meta-analyses confirm its moderate to strong effects in STEM (Science, Technology, Engineering, and Mathematics) domains ($g = 0.82$), literacy applications require nuanced design to balance engagement with cognitive depth (Bai et al., 2020; Li et al., 2023).

Effective gamification in literacy education integrates a variety of cognitive and motivational strategies. This includes the use of narrative-driven challenges, which serve to contextualize inferencing and promote critical thinking, and reflective activities, such as journaling streaks, which are designed to improve metacognitive awareness (Li et al., 2023; WANG et al., 2024). A further key strategy is the implementation of adaptive comprehension quizzes that scaffold difficulty based on the performance and progression of the student, thus supporting a continuous state of optimal challenge (Pradnyadewi and Kristiani, 2021; Matyakhan et al., 2024).

The efficacy of these strategies is supported by recent empirical studies, which have documented a statistically significant improvement in reading comprehension, with an experimental group's mean test score increasing from 10.63 to 15.71 ($p < .001$) after a gamified intervention (Matyakhan et al., 2024). Other research has found a 2.5-fold increase in voluntary reading time through narrative-based strategies and a 19% increase in academic vocabulary retention through adaptive flashcard systems (WANG et al., 2024). These outcomes are consistent with the lexical threshold hypothesis, which posits that a substantial vocabulary base is essential for meaningful reading comprehension, a foundational challenge that gamification can effectively address through techniques such as spaced repetition and contextualized exposure (Schmitt, 2007; Yu, 2023).

Despite these promising outcomes, the implementation of widely used tools is not without its challenges. The decline in novelty effect is a well-documented phenomenon in which initial student engagement often declines by up to 58% within 12 weeks unless new content or dynamics are introduced (Dichev and Dicheva, 2017; Rodrigues et al., 2022). Furthermore, achieving cognitive-emotional balance is critical, as excessive focus on extrinsic rewards such as points and leaderboards can result in a decrease in intrinsic motivation for deep reading tasks (John et al., 2023; Dehghanzadeh et al., 2023).

To address these limitations and improve the long-term effectiveness of gamified reading environments, the literature points to several key areas for future research. There is a clear need for longitudinal studies that examine the effects of gamification over extended periods (6+ months), cross-cultural validations in underrepresented contexts, and mobile-first optimization strategies that balance engagement with cognitive depth on smaller devices (Rodrigues et al., 2022; Matyakhan et al., 2024; Li et al., 2023).

2.3.2 Comparative Effectiveness and Key Considerations

A synthesis of recent meta-analyses demonstrates that gamification exerts a moderate to strong positive effect on learning outcomes in educational contexts, with overall effect sizes reported between $g=0.50$ and $g=0.82$ (Bai et al., 2020; Li et al., 2023). However, its efficacy is profoundly mediated by several contextual factors, most notably the educational domain, the motivational architecture of the platform, and the temporal dynamics of the intervention, as summarized in Table 2.1.

The educational domain itself dictates the optimal gamification strategy, as different subjects benefit from different motivational approaches (Bai et al., 2020). Science education, for example, has been shown to produce a very large effect size ($g=1.28$) when gamified. In contrast, for literacy and reading ($g=0.49$), the literature suggests that a greater focus is required on intrinsic motivation, moving beyond simple points to implement mechanics such as narrative quests that foster a deeper connection to the content (John et al., 2023; WANG et al., 2024). Similarly, while language learning can benefit from gamified mechanics, care must be taken to avoid overreliance on rote drill-based systems.

Furthermore, the motivational architecture of the platform is a critical determinant of its success. The most effective implementations achieve a careful balance between extrinsic drivers, such as points and badges that promote initial engagement (Meng et al., 2024), and the deeper intrinsic nourishment that comes from satisfying the core psychological needs outlined in Self-Determination Theory. This involves providing *autonomy* through mechanics that offer meaningful choices, supporting *competence* with clear progress feedback, and fostering *relatedness* via collaborative features (Guthrie and Klauda, 2014; Bai et al., 2020). In fact, designs that align with SDT have been shown to be more effective in maintaining engagement than those that focus only on superficial rewards (Bai et al., 2020).

Finally, the temporal dynamics of the intervention must be considered. Although gamification can produce significant short-term effects, a sustained impact is not guaranteed. A key challenge is

the "novelty effect," where initial engagement often declines over time, with some studies noting a drop of up to 58% over 12 weeks (Dichev and Dicheva, 2017; Rodrigues et al., 2022). Interestingly, meta-analytic evidence suggests that the duration of the intervention is a significant factor, with studies lasting between one and three months showing a particularly strong positive effect ($g=0.906$) on learning outcomes compared to shorter and much longer interventions (Bai et al., 2020).

In summary, the evidence underscores that the effectiveness of gamification, particularly in literacy, depends on a sophisticated design that balances extrinsic motivators with intrinsic support aligned with SDT. Although certain STEM domains may thrive on competition, reading engagement requires mechanics that foster autonomy and deep reflection. These findings directly inform the grade-specific differentiation of this platform between competitive interfaces for older students and guided structured interfaces for younger learners.

Table 2.1: Cross-Domain Effectiveness of Gamification Elements

Domain	Optimal Mechanics	Effect Size (g)
Science	Leaderboards, challenges, points	1.28 (Bai et al., 2020)
Literacy / Language	Narrative quests, progress feedback, choice	0.49 (Li et al., 2023)
Computer	Badges, points, leaderboards	0.25 (Bai et al., 2020)

This comparative analysis underscores the importance of tailoring gamification strategies to disciplinary contexts. Although competitive elements can be effective in some domains, the literature suggests that literacy and reading require a greater focus on intrinsic motivation, framed through mechanics such as narrative quests and reflective journals that foster a deeper connection to the content (John et al., 2023; WANG et al., 2024). Successful gamification designs in all domains align with the core psychological needs outlined by self-determination theory: provide learner *autonomy* through meaningful choices, supporting *competence* via clear progress feedback, and fostering *relatedness* with social characteristics (Ryan, 2023; Bai et al., 2020).

2.3.3 Gamification and Reading Engagement: Evidence and Limitations

Empirical studies demonstrate gamification’s potential to enhance reading outcomes across educational levels, with notable domain-specific considerations.

Key Findings from Recent Research

Recent research highlights significant gains in both comprehension and student attitudes. For example, Matyakhan et al. (2024) documented a statistically significant improvement in reading comprehension, with their experimental group’s mean test score increasing from 10.63 to 15.71 ($p < .001$) after a gamified intervention. This aligns with the findings of Sánchez et al. (2021),

who also found a statistically significant improvement in the comprehension of the reading of primary students, particularly in literal and inferential understanding.

Beyond comprehension scores, studies show positive attitudinal shifts. The same research by [Matyakhon et al. \(2024\)](#) found that gamification increased student reading engagement, with mean scores on their Reading Engagement Questionnaire increasing from 2.12 (pretest) to 3.42 (posttest). Other longitudinal data reveals the capacity of targeted interventions to decrease reading avoidance, showing that instructional practices that support student choice and collaboration are negatively correlated with avoidance behaviors ([Guthrie and Klauda, 2014](#)). Furthermore, such interventions can improve self-efficacy and perceived competence by providing students with readable texts, teacher feedback on achievements, and guidance in setting realistic goals ([Klauda and Guthrie, 2015](#)).

Critical Implementation Factors

The successful implementation of gamified reading platforms requires careful attention to several critical factors that have emerged from extensive research.

Among the most crucial of these is the design of effective feedback mechanisms. Immediate quiz feedback, for example, addresses the zone of proximal development, with meta-analytic evidence showing medium effect sizes ($d = 0.48$) on student learning outcomes ([Wisniewski et al., 2020](#)). This approach is particularly effective for middle school learners, as critical feedback-seeking behavior remains stable and impactful from age 11 onward ([Cutumisu and Schwartz, 2021](#)). Feedback effectiveness is significantly enhanced when it contains high-information content rather than simple reinforcement, as this has been shown to produce very large effects on cognitive outcomes ([Wisniewski et al., 2020](#)).

Although feedback informs learning, the structure of balanced reward systems is equally essential to maintain sustained progress. Effective implementations require a multifaceted approach that blends different motivators. Equally important is the role of the teacher in mediating the reward system; Effective implementations require a careful alignment of instructional objectives with specific game elements, a process that is necessarily teacher-led to ensure students clearly understand the rules and purpose behind the gamified activities ([Huang et al., 2019](#)).

However, even with well-designed feedback and reward systems, a significant challenge remains in addressing the critical thinking gap. Current research indicates that only 18% of studies measure higher-order literacy skills, reflecting a larger tendency to prioritize short-term engagement metrics over long-term cognitive development ([Dichev and Dicheva, 2017](#)). Although game-based learning has shown strong positive effects on critical thinking ($g = 0.863$), many gamification implementations still focus on surface-level metrics ([Mao et al., 2021](#); [Huang et al., 2019](#)). This gap signals an urgent need for more robust assessment frameworks that can capture the full spectrum of cognitive gains possible through well-structured gamified learning environments.

2.3.4 The Role of Teacher Agency and Empirical Evidence

Effective implementation of gamified reading platforms requires teacher-centered adaptation, as educators play a critical role in mediating the student experience and aligning digital tools with pedagogical goals. The importance of this role is underscored by empirical studies that, while demonstrating the potential of gamification, also highlight the contextual nature of its success. A summary of key findings from recent research is presented in Table 2.2.

An analysis of these studies reveals consistent positive outcomes. For example, Matyakhan et al. (2024) found that the use of gamified platforms such as Quizizz and Kahoot led to a statistically significant improvement in reading comprehension among Thai students in EFL universities, with the mean test score of the experimental group increasing from 10.63 to 15.71. This aligns with the findings of Sánchez et al. (2021), who also reported a statistically significant improvement in reading comprehension of primary students using a gamified platform, along with notable improvements in student attitudes toward reading.

These results are situated within a supportive policy landscape. The European Union’s Digital Education Action Plan (2021–2027) European Commission (2021), for example, prioritizes such digital innovations in literacy education, although successful implementation remains a key challenge to be monitored. Evidence suggests that the success seen in these studies is not automatic; it is based on the teacher’s ability to integrate these tools effectively, guide student interaction, and create a supportive learning environment, reinforcing the centrality of teacher agency.

Table 2.2: Empirical Studies on Gamified Reading

Study	Methods	Key Verifiable Findings	Limitations
Sánchez et al. (2021)	Mixed-methods (n=85)	Statistically significant improvement in reading comprehension and attitudes.	No critical thinking metrics.
European Commission (2021)	Document analysis	Prioritizes digital innovation in literacy education.	Implementation tracking needed.

Critical Synthesis

The scholarly landscape surrounding gamification in education, particularly within the reading and literacy contexts, presents a complex interplay of empirical promise and persistent methodological challenges. A synthesis of recent meta-analyses reveals that gamification exerts a significant positive effect on learning outcomes, with one major study reporting an overall effect size of $g=0.822$, especially when integrating mechanics, dynamics, and aesthetics (Li et al., 2023; Rodrigues et al., 2022). In literacy education, targeted implementations, such as narrative-driven challenges and reflective journaling, have been shown to produce statistically significant improvements in comprehension scores (Matyakhan et al., 2024). These outcomes align with SDT, where autonomy-supportive designs and competence-enhancing feedback satisfy core psychological needs (Ryan, 2023; Reeve and Cheon, 2021).

However, the field remains constrained by several critical limitations that must be addressed for sustainable implementation. A primary concern is the temporal dynamics of the engagement. Although short-term spikes are well documented, longitudinal studies consistently report a significant decline in engagement over time without content iteration, a trend consistent with the "novelty effect" (Rodrigues et al., 2022; Dichev and Dicheva, 2017). There are also crucial motivational trade-offs, as overemphasis on extrinsic incentives such as leaderboards can trigger an over-justification effect, potentially reducing intrinsic motivation for deep reading tasks (John et al., 2023; Lepper et al., 1973). Finally, cultural and developmental specificity is paramount; adaptations for different cultural contexts and providing age-appropriate characteristics have been shown to significantly increase engagement, highlighting the need for tailored solutions, not one-size-fits-all (Matyakhan et al., 2024; WANG et al., 2024).

In addition, several underexplored frontiers demand urgent attention. Significant personalization gaps persist, with some reviews noting that many platforms do not adapt to both learner profiles and contextual factors (Smiderle et al., 2020; Waluyo and Leal, 2021). There are also equity risks, as mobile-first approaches can widen comprehension gaps despite increasing access (Plano Nacional de Leitura, 2017). The issue of teacher agency is also paramount, as many gamification initiatives fail without structured professional development, although evidence from the Portuguese context suggests that instructor-led customization can be highly effective (Teixeira and Vasconcelos, 2024; McClarty et al., 2012).

To advance the field, future research must prioritize longitudinal mixed methods designs to track literacy development beyond six-month intervals, establish co-creation frameworks that involve educators directly in the design process, and explore the ethical integration of AI to provide adaptive and personalized learning experiences (Rodrigues et al., 2022; Waluyo and Leal, 2021; Li et al., 2023).

In conclusion, gamification has transformative potential for literacy education. Its long-term efficacy depends on designs that harmonize extrinsic mechanics with intrinsic motivation, adapt to diverse contexts, and evolve through iterative feedback loops involving both educators and learners. This thesis contributes to this emerging paradigm by demonstrating how cloud-native architectures, age-adaptive interfaces, and teacher-driven analytics can sustain engagement without compromising cognitive depth, balance that research suggests is currently absent in a large portion of documented implementations.

Chapter 3

Methodology

3.1 Research Design Overview

This study used a comprehensive, multiphase research design that integrates agile software engineering practices with empirical validation in a real-world educational context. The methodology was structured to be compliant with industry standards, including ISO / IEC / IEEE 12207 [ISO12207](#) for system engineering, ensuring a rigorous and systematic approach from conception to deployment. The overall process, depicted in Figure 3.1, followed a structured but iterative flow, allowing continuous refinement based on stakeholder feedback and technical challenges encountered during implementation. This design was chosen to balance the formal requirements of academic research with the dynamic and adaptive nature of developing a user-centric application in partnership with an educational institution. The research paradigm is rooted in a mixed-methods approach, where quantitative data from system logs and surveys are triangulated with qualitative data from open-ended responses and teacher consultations to provide a rich, holistic understanding of the platform's impact.

3.2 System Development and Implementation Methodology

The development of the platform followed an Agile methodology, specifically the Scrum framework, to manage the complexities of the project and facilitate continuous collaboration with educational stakeholders. This iterative approach was organized into a series of two-week sprints, each representing a complete cycle from planning to a potentially shippable increment of the product, as illustrated in Figure 3.2. Sprint planning sessions utilized the MoSCoW (Must have, Should have, Could have, Won't have) method for prioritizing user stories, ensuring that development efforts remained focused on core functionalities essential for the pilot study.

Weekly progress meetings with Escola Global teachers, conducted via Microsoft Teams [Microsoft Corporation \(2024c\)](#), provided a consistent channel for stakeholder feedback and co-design. At the end of each sprint, a review session was held to demonstrate the latest functional increase in the platform to teachers, allowing immediate validation and adjustment of requirements.

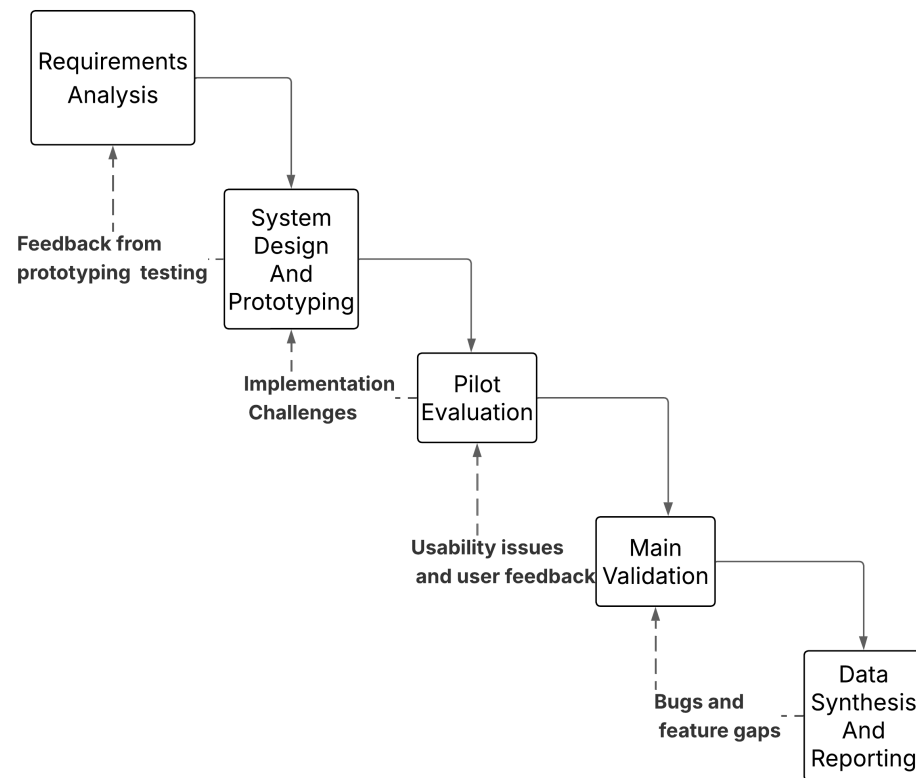


Figure 3.1: Research process following ISO/IEC/IEEE 12207 lifecycle stages

Following the review, a team retrospective was conducted to identify process improvements that were then incorporated into the subsequent sprint.

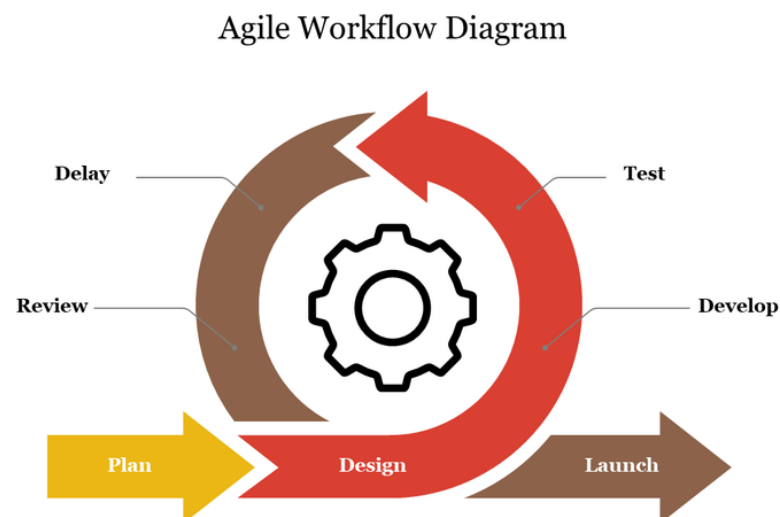


Figure 3.2: Sprint structure with XP technical practices

3.3 Requirements Engineering and Technology Stack

The requirements engineering phase adhered to ISO/IEC/IEEE 29148 [ISO29148](#) standards to ensure a systematic and thorough capture of user and system requirements. A mixed methods approach was used to generate requirements, as shown in Figure 3.3. This process included semi-structured meetings with participating teachers to understand the pedagogical needs, classroom constraints, and desired features for both student and teacher interfaces. In addition to this, a survey was distributed to students to gather information on their current reading habits, motivational preferences, and expectations for a gamified application.



Figure 3.3: Requirements elicitation workflow

The functional and non-functional requirements derived from this process informed the architectural design and the selection of technologies. The platform was architected as a modern cloud-native application using React.js with the Microsoft Fluent UI library for the front-end, serverless Azure Functions [Microsoft Corporation \(2024a\)](#) for the back-end, and Azure Cosmos DB [Microsoft Corporation \(2024b\)](#) for data persistence. This technology stack was chosen to ensure scalability, maintainability, and seamless integration within the school’s existing Microsoft Teams ecosystem [Microsoft Corporation \(2024c\)](#).

3.4 Empirical Validation Methodology

To answer the research questions, a robust validation methodology was designed to collect and analyze data on the platform’s effectiveness. This involved a real-world deployment at Escola Global, targeting students from the 3rd to 8th grade, and employed several data collection instruments.

3.4.1 Data Collection Instruments

To investigate the research questions, three primary types of data were collected: automated system logs, student and teacher questionnaires, and qualitative feedback from regular stakeholder meetings.

To address RQ1 (Impact on Engagement and Comprehension) and RQ4 (Impact on Different Age Groups), quantitative data was collected through system logs. The platform was incorporated to automatically record all significant user interactions, recording events such as reading sessions, quiz submissions, points awarded, maintained streaks, and completed books. This provided a rich, objective dataset of behavioral engagement metrics that could be segmented by grade, time, and activity type.

To further investigate RQ1, RQ3 (Factors Affecting Teacher Adoption), and RQ4, pre- and postintervention questionnaires were administered to both students and teachers. Student surveys used items on the Likert scale to quantitatively measure changes in self-reported reading frequency, motivation, and self-efficacy. They also included open-ended questions to collect qualitative feedback on user experience. The teacher questionnaire captured perceptions of the impact, usability and barriers to the implementation of the platform, providing direct information on the factors that affect adoption.

Finally, to address RQ2 (Effective Teacher Involvement) and RQ3, qualitative data was collected through weekly co-design and feedback meetings with teachers. The notes from these sessions provided invaluable contextual information on how the platform was being integrated into classroom practice and what characteristics were most critical for empowering their pedagogical role.

3.4.2 Data Analysis

The data collected was analyzed using a mixed method approach to provide a complete understanding of the impact of the platform.

Quantitative data from system logs and closed-ended survey questions were analyzed using descriptive statistics (mean, median, standard deviation) and frequency analysis. This allowed for the identification of key trends, such as the average number of books completed per grade or the distribution of gamification points by activity type. Correlation analyzes were performed to explore the relationship between different engagement metrics, such as quiz participation and book completion rates. This quantitative analysis was the main method used to identify the different patterns of participation between age groups (RQ4) and to measure the overall change in activity (RQ1).

Qualitative data from open-ended survey responses and teacher meeting notes were analyzed using a thematic analysis approach. This involved systematically coding the text to identify recurring themes, patterns, and insights. This method was essential to understand the "why" behind the quantitative data, revealing student motivations, teacher concerns about classroom integration

(RQ3), and specific suggestions for improving the platform to better support their instructional goals (RQ2).

By triangulating the findings from both quantitative and qualitative analyzes, this study provides a validated and nuanced answer to the research questions, ensuring that the behavioral patterns observed in the data are contextualized by the real-world experiences of the users.

Chapter 4

Implementation

4.1 Overview

This chapter details the technical and pedagogical implementation of the gamified reading platform. Built using Microsoft Teams Toolkit [Microsoft Corporation \(2024c\)](#) and Azure Functions [Microsoft Corporation \(2024a\)](#), the system was designed to support scalable deployment in classroom settings, personalized learning experiences by grade, and teacher-led oversight. The architecture of the platform and the set of features reflect modern practices in software engineering.

4.2 Technical Implementation

4.2.1 Rationale for Platform and Feature Differentiation

The decision to implement the platform as a Microsoft Teams application [Microsoft Corporation \(2024c\)](#) was driven by both contextual and practical considerations. Microsoft Teams was already the standard digital environment in the participating Portuguese school, ensuring minimal disruption to existing workflows and maximizing teacher and student adoption. Furthermore, recent Portuguese educational policy prohibits student use of personal mobile devices during school hours ([Ministério da Educação, 2023](#)) which excludes the development of a standalone mobile app. Using Teams, the platform remains accessible on school-managed devices (laptops and tablets), aligning with policy and infrastructural realities.

4.2.2 Feature Development

This section details the technical implementation of the gamified reading platform, focusing on the architectural decisions, technology stack, and design principles.

4.2.2.1 Frontend: Microsoft Teams Integration

The front-end was developed in TypeScript using the Microsoft Teams Toolkit [Microsoft Corporation \(2024c\)](#). This choice facilitated seamless embedding within Microsoft Teams, the platform

already used by schools, and enabled the use of built-in UI (User Interface) components optimized for Teams environments. The Teams Toolkit also provided streamlined authentication and deployment pipelines to Azure Storage.

Figure 4.1 presents a simplified diagram of the C4 components of the front-end architecture, highlighting the main modules, their responsibilities, and their interactions with both the back-end API (Application Programming Interface) and the Microsoft Teams environment [Microsoft Corporation \(2024c\)](#).

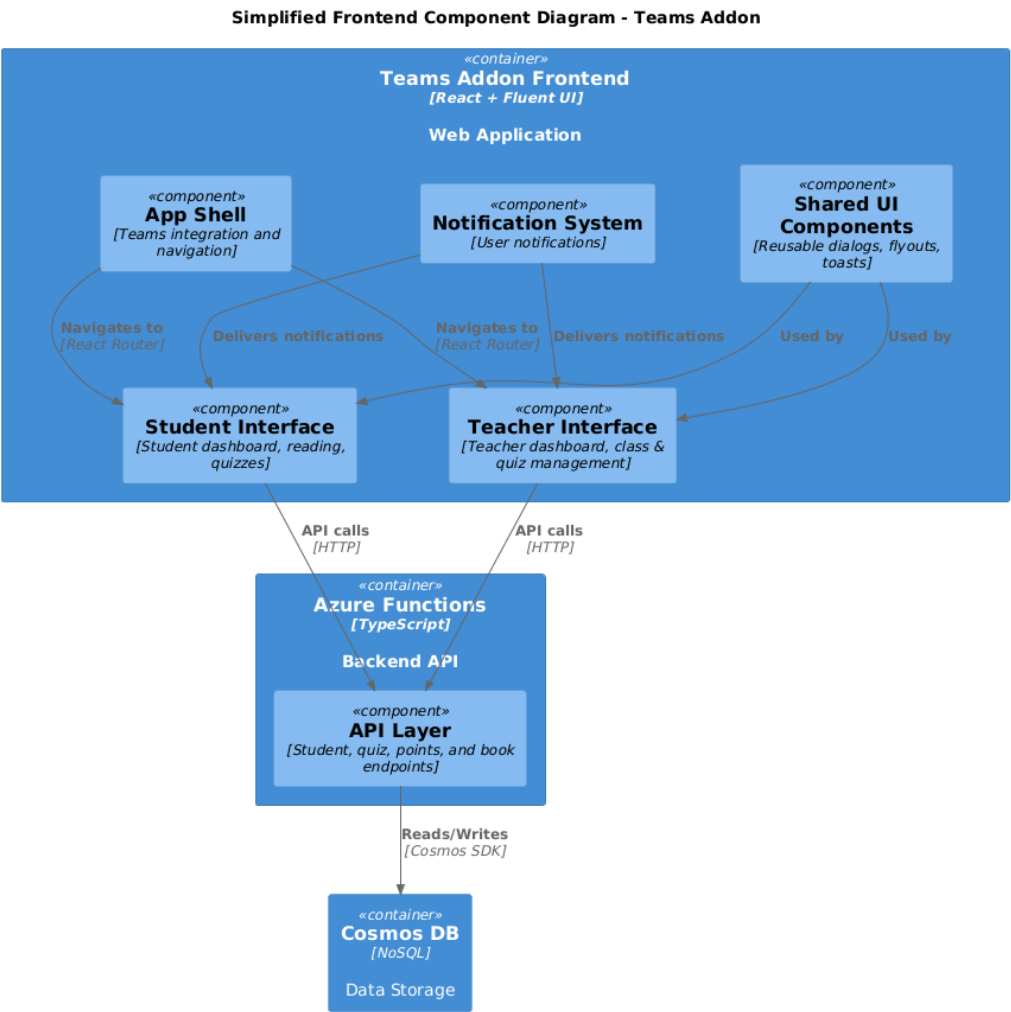


Figure 4.1: Frontend Component Diagram: Key Pages and UI Architecture

Main Components

- **App Shell:** Serves as the persistent structural layer of the application. Manages Teams integration (via the Teams SDK), global navigation, and layout, ensuring a consistent user experience and seamless context switching between student and teacher views.

- **Student Interface:** Provides students with access to their dashboard, reading progress tracker, quizzes, and points/achievements. This module is tailored to different grade levels, with simplified navigation and fixed book selections for younger students, and more autonomous features (such as book self-registration and streak tracking) for older students. The design supports both extrinsic and intrinsic motivational strategies, as recommended by recent meta-analyses on educational gamification.
- **Teacher Interface:** Offers teachers a dedicated dashboard for class management, quiz creation and grading, student progress monitoring, and analytics. The features are differentiated by grade, aligning with pedagogical best practices for developmental appropriateness and teacher agency.
- **Notifications System:** Delivers timely updates and reminders to both students and teachers, supporting engagement, and reducing the risk of missed tasks or deadlines. The notification system integrates with backend events (e.g., new quiz available, badge earned) and displays alerts via flyouts and toast messages.
- **Shared UI Components:** Includes reusable elements such as dialogs, modals, and notification banners, ensuring consistency and maintainability across the application.

4.2.2.2 Backend: Azure Functions and Gamification Engine

The backend services were developed as modular, serverless Azure Functions [Microsoft Corporation \(2024a\)](#) written in TypeScript. This approach allows for elastic scaling during peak usage and ensures a clear separation of responsibilities across different subsystems. The design reflects modern principles of cloud-native educational platforms, where scalability, reliability, and modularity are critical.

Figure 4.2 presents a C4 component diagram of the backend architecture, illustrating the interaction between core functional domains and the Cosmos DB (Database) data layer.

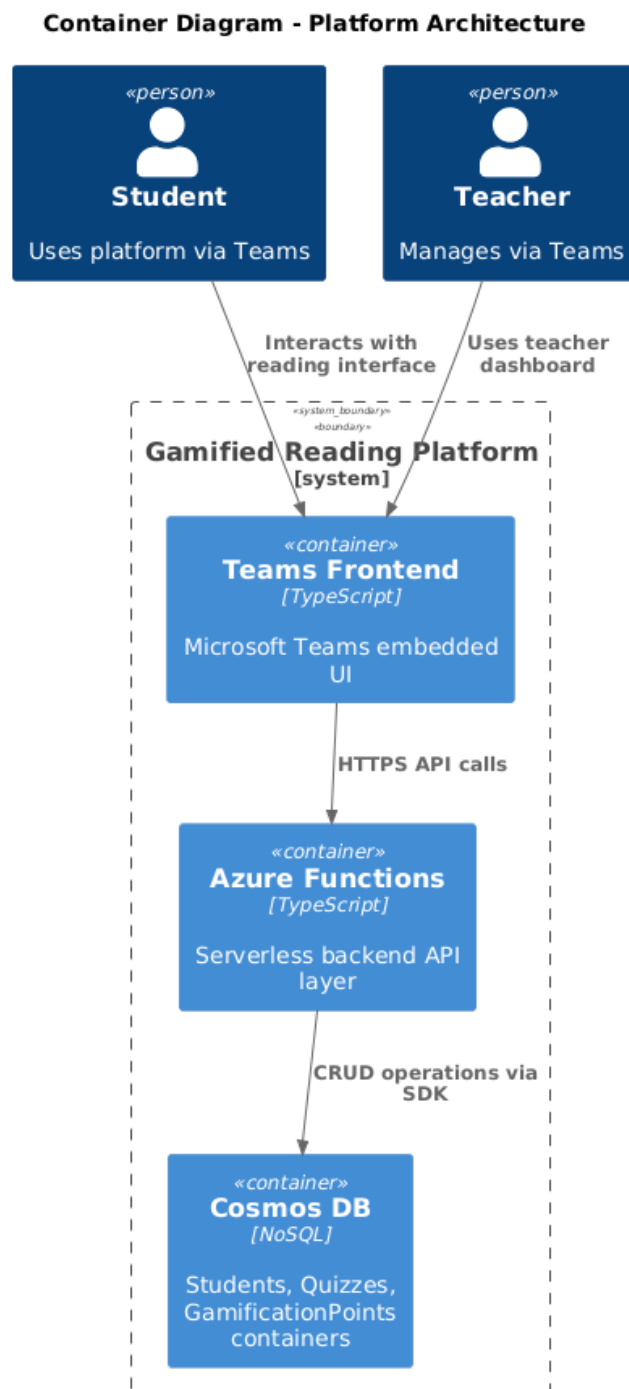


Figure 4.2: C4 Component Overview of Backend Azure Functions

Core Services

- **Gamification Engine:** The **Gamification Engine**, detailed in Figure 4.3, is a suite of event-driven functions that monitors student actions and awards points and badges, storing these events in the `GamificationPoints` container, supporting real-time dashboards and longitudinal analysis. The design is based on empirical evidence suggesting that real-time

context-sensitive rewards are effective in sustaining engagement, particularly between diverse age groups.

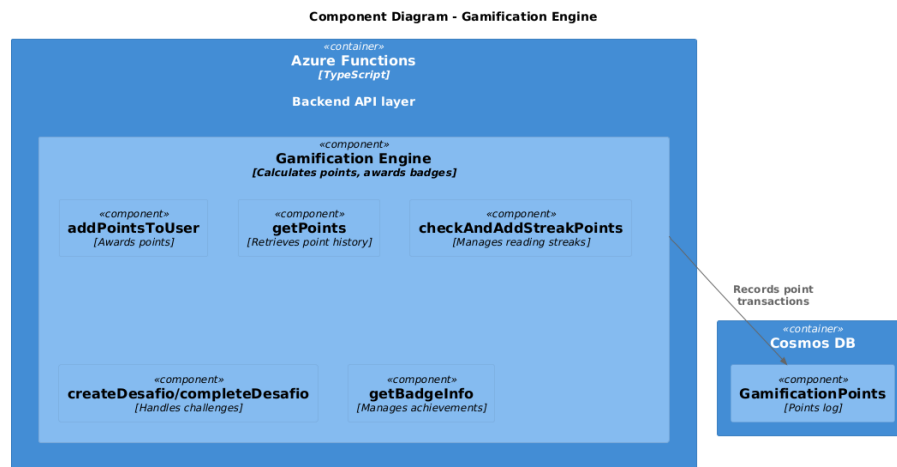


Figure 4.3: C4 Component Diagram: Gamification Engine

- **Quiz Management:** The Quiz Management component, shown in Figure 4.4, handles quiz submissions, scoring, and teacher-controlled availability. The enhancements introduced during the pilot test allowed teachers to unlock specific quizzes manually, ensuring that the assessments aligned with supervised classroom activities.

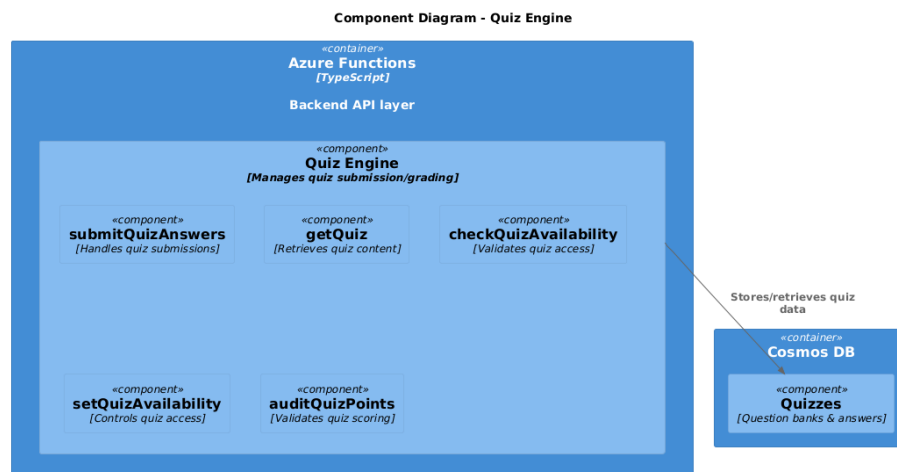


Figure 4.4: C4 Component Diagram: Quiz Management

- **Student Management:** Student Management, depicted in Figure 4.5, allows teachers to manage class rosters and student profiles. All operations follow idempotent design principles to preserve data integrity during concurrent updates, in accordance with secure data management practices.

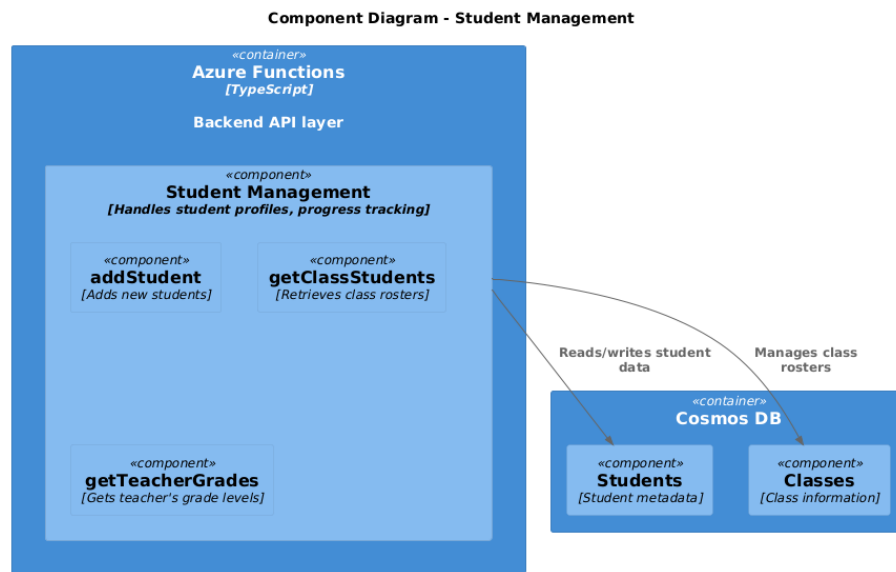


Figure 4.5: C4 Component Diagram: Student Management

- Notification System:** The Notification System, illustrated in Figure 4.6, is responsible for delivering timely and relevant updates to users—students and teachers—regarding platform events such as new quizzes, awarded badges, or administrative actions. Implemented as a dedicated set of Azure Functions, this system manages the creation, retrieval, and status tracking of notifications. All messages are persisted in the `Notifications` container, while UI-specific prompts are handled via the `Flyouts` container. This architecture ensures that notifications are both reliable and context-aware, supporting user engagement and reducing the risk of missed critical updates. The notification engine also supports marking notifications as read, allowing personalized and unobtrusive communication.

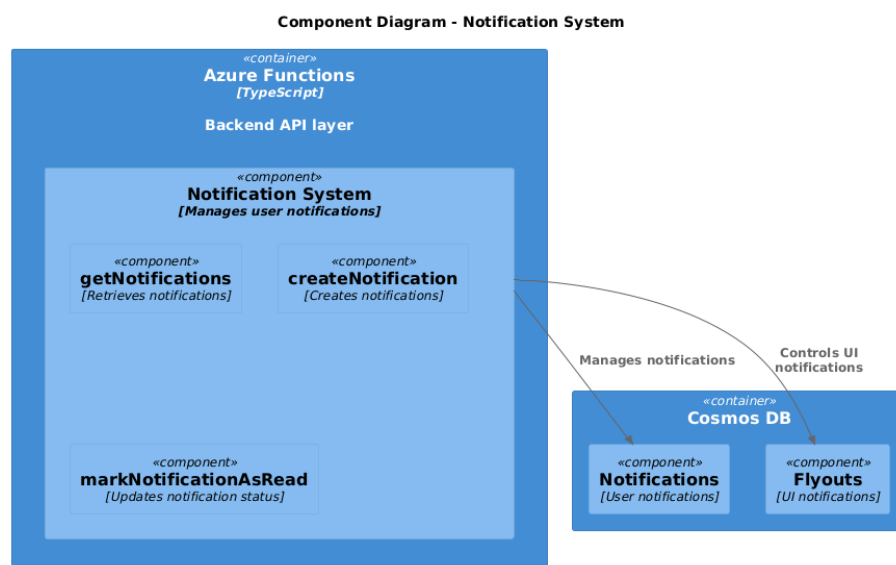


Figure 4.6: C4 Component Diagram: Notification System

Core Functionalities

- **Student and Teacher Dashboards:** Functions such as `getStudentDashboard.ts` and `getTeacherDashboard.ts` return customized progress summaries, gamification status, and quiz activity. These are optimized for high performance through partitioning on fields like `grade` and `studentId`.
- **Quiz Engine:** Functions like `submitQuizAnswer.ts` and `getQuizResponses.ts` validate, store, and evaluate student responses.
- **Gamification Engine:** A set of dedicated functions award points and badges based on event data, such as reading logs and quiz outcomes, logged by `submitReadingProgress.ts`. These events are stored in containers like `gamification-points`. This implementation supports research questions related to engagement (**RQ1, RQ4**) by enabling differentiated analysis across age groups and types of activity.
- **User Management:** Teachers and administrators manage users via secure CRUD operations, with access control handled through Azure Active Directory. Support modules like `students.ts` and `teachers.ts` handle validation, access control, and transactional logic.

Event-Driven Points Calculation

The points engine is implemented as an event-driven Azure Function that awards points to students based on a variety of actions, such as quiz completion, maintaining a reading streak, or finishing a book. Each action type is mapped to a specific point rule, supporting both fixed and dynamic calculations. For example, quiz points are determined by the number of correct answers, with deductions for incorrect responses. Notably, the engine incorporates a temporal multiplier: if a student submits a quiz response on the first day or shortly after the quiz is released (i.e., before the deadline), they receive a 1.5x points bonus. This design encourages timely participation and sustained participation, aligning with evidence that immediate feedback and reward can increase motivation and learning outcomes. All awarded points, along with contextual metadata, are recorded in the `GamificationPoints` container in Cosmos DB. This event-based, auditable approach allows for transparent tracking of student achievements and supports both real-time feedback and longitudinal analytics, as recommended in the literature on educational gamification. The following code in 4.1 illustrates the core logic of the points calculation engine, including the deadline-based multiplier for quizzes:

```
1 z
2
3
4
5
6
```

```

7  export const calculatePoints = async (context: Context, action: UserAction):
    Promise<void> => {
8      let points = 0;
9      switch (action.type) {
10         case 'QUIZ':
11             const pointsPerWrong = 25 / action.totalQuestions;
12             points = Math.max(0, Math.round(25 - (action.wrongAnswers * pointsPerWrong)));
13             // Apply deadline multiplier if applicable
14             if (action.deadline) {
15                 const multiplier = new Date() <= new Date(action.deadline) ? 1.5 : 1;
16                 points = Math.round(points * multiplier);
17             }
18             break;
19         case 'STREAK':
20             points = Math.min(action.streak, 10); // Cap at 10 points
21             break;
22         case 'COMPLETION':
23             points = 50; // Fixed points for completing a book
24             break;
25         case 'FIRST_PROGRESS':
26             points = 10; // Fixed points for first progress
27             break;
28         case 'CHOSEN QUIZ':
29             points = 25; // Standard points for quiz completion
30             break;
31     }
32     await CosmosClient.upsertDocument('gamification-points', {
33         userId: context.user.id,
34         points: points,
35         type: action.type,
36         description: action.description,
37         metadata: action.metadata,
38         earnedAt: new Date().toISOString()
39     });
40 };

```

Listing 4.1: Points Calculation

Scalability and Monitoring

The platform's scalability is achieved through the use of Azure Functions [Microsoft Corporation \(2024a\)](#), which automatically adjust computational resources in response to varying user demand. This elasticity enables the system to support thousands of concurrent users, a critical feature for classroom-wide or school-wide deployments. Real-time telemetry and monitoring are provided by Azure Application Insights, which captures detailed metrics on system performance, error rates, and user interactions. This observability enables rapid detection and resolution of issues, as well as the collection of custom analytics for research and reporting purposes. The underlying data layer,

built on Cosmos DB [Microsoft Corporation \(2024b\)](#), leverages a partitioned design that optimizes for high-throughput queries and efficient aggregation.

Integration Points

The backend exposes a set of RESTful APIs that deliver structured JSON data to the frontend, enabling seamless integration with dashboards and user interface components within Microsoft Teams [Microsoft Corporation \(2024c\)](#). All application entities and logs are stored in Azure Cosmos DB [Microsoft Corporation \(2024b\)](#), utilizing a denormalized schema to optimize for both read and write performance. Static assets, are served from Azure Storage, further decoupling the application logic from content delivery and supporting efficient caching and scalability.

4.2.3 Cosmos DB Schema Design

The database schema is organized into discrete containers, each representing a logical domain of the application, such as students, reading logs, gamification points, and quizzes. This separation of concerns supports both modular development and efficient querying.

The platform's backend is built upon Azure Cosmos DB, a globally distributed, multi-model NoSQL database optimized for high availability, horizontal scalability, and low-latency access. Its flexibility in handling schemaless document-based data made it a natural fit for an educational platform with evolving gamification features and diverse access patterns between students, teachers, and devices.

The serverless nature of Cosmos DB, automatic partitioning, and native support for JSON documents provided a seamless integration with the Azure Functions-based backend. It also ensured rapid development cycles without the overhead of rigid schemas or manual database maintenance.

The platform uses a denormalized structure with separate containers, each representing a logical domain. The detailed JSON representation of the Cosmos DB schema, including example documents for each major entity, is provided in [Appendix .1](#).

- **Students:** Stores student metadata (e.g. name, grade, currently reading, streaks, completed books).
- **ReadingLogs:** Tracks reading sessions, including time-stamped page updates and progress notes.
- **GamificationPoints:** Records all actions that generate points (e.g. quizzes, streaks, completions), with optional metadata.
- **Quizzes:** Contains teacher-defined quizzes, including questions, correct answers, and deadlines.
- **QuizAnswers:** Stores student quiz submissions, timestamps, and scores.

- **Challenges:** Represents challenges and badges, including scope, goal types, and reward structure.
- **ChallengeProgress:** Tracks each student's progress within specific challenges.
- **Notifications:** System messages and support alerts for students and teachers.
- **Support:** Logs student support requests for troubleshooting and feedback.
- **Classes:** Stores information about class groups, student–teacher associations, and assignments.

The database schema was intentionally designed in a denormalized, document-based format to accommodate the fluid and varied nature of classroom data. This structure offers the flexibility needed to store a wide range of information, from reading activity logs to gamification metrics, without being constrained by rigid schemas.

To ensure the system could scale efficiently while maintaining fast response times, data was organized around key dimensions such as `grade` and `studentId`. This approach reflects how the application is used in practice: teachers often need quick access to class-wide insights, while students benefit from real-time feedback on their individual progress.

4.3 User Experience Design

The platform's user experience (UX) was developed with a strong emphasis on accessibility, usability, and age-appropriate differentiation. Drawing on principles from Human-Computer Interaction (HCI) and best practices in educational UX, the frontend—built using Fluent UI—delivers a responsive, mobile-friendly interface tailored to the needs of both students and teachers across different grade levels.

4.3.1 Differentiated Interfaces by Age Group

To accommodate cognitive and motivational differences, the platform offers two distinct interface paradigms. For younger learners in Grades 3–4, a guided and structured experience was designed, featuring fixed navigation, clear visual progress indicators, and prominent gamification elements, as shown in Figure 4.7. For older students in Grades 5–8, a more autonomous and flexible experience was created, offering a customizable dashboard, student-driven book selection, and more competitive gamification features like social leaderboards, illustrated in Figure 4.8.

Grades 3–4: Guided and Structured Experience

- **Navigation:** Fixed navigation tree with clear, age-appropriate icons for books, quizzes, and progress tracking.

- **Progress Visualization:** Visual indicators such as “progress cupcakes” and chapter completion badges.
- **Gamification:** Prominent display of points, badges, and reading streak counters to encourage participation.
- **Quiz Access:** Chapter-based quiz buttons with clear visual indicators of completion status.
- **Accessibility:** Large touch targets, simplified language, and high-contrast visual themes for younger readers.

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Visualizando como: Lourenço Do Souto Teixeira Freitas

Olá, Lourenço Do Souto Teixeira Freitas

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O livro mágico do avô João
Hugo Rodrigues

Página atual: 0 / 64

Registrar Progresso

Capítulos

A Diana... Vai ter uma mana! (1–19)
Leitura: 14/05/2025 [Chegue até a página 19 para desbloquear o Quiz Final](#)

O Semedo... Tem um segredo! (20–35)
Leitura: 21/05/2025 [Chegue até a página 35 para desbloquear o Quiz Final](#)

A Belém... Não come bem! (36–49)
Leitura: 04/06/2025 [Chegue até a página 49 para desbloquear o Quiz Final](#)

O Martinho... Não quer dormir sozinho! (50–63)
Leitura: 11/06/2025 [Chegue até a página 63 para desbloquear o Quiz Final](#)

Quiz Final (–)
Leitura: 18/06/2025 [Chegue até a página para desbloquear o Quiz Final](#)

🔥 Streak de Leitura

Você está lendo há 0 dias seguidos!

Mantenha sua sequência de leitura para ganhar recompensas e medalhas!

🏆 Medalhas Conquistadas

Nenhuma medalha conquistada ainda.

🎯 Desafios Ativos

Quiz do Capítulo 1

Complete o quiz do capítulo 1 para ganhar pontos e medalhas!

Status: Quiz Pendente

Prazo: até 5/4/2025

📖 Leituras Ativas

Figure 4.7: Student dashboard for Grades 3–4: Book progress, chapter list, and gamification elements.

Grades 5–8: Autonomous and Flexible Experience

- **Navigation:** Customizable dashboard with quick links to book selection, quizzes, and rankings.

- **Book Selection:** Student-driven choices with visible progress bars and quiz status icons.
- **Gamification:** Social heatmaps, streak trackers, and competitive leaderboards.
- **Quiz Access:** Final quiz interface supporting both multiple-choice and open-ended questions.
- **Responsiveness:** Fully adaptive layout optimized for tablets, laptops, and smartphones.

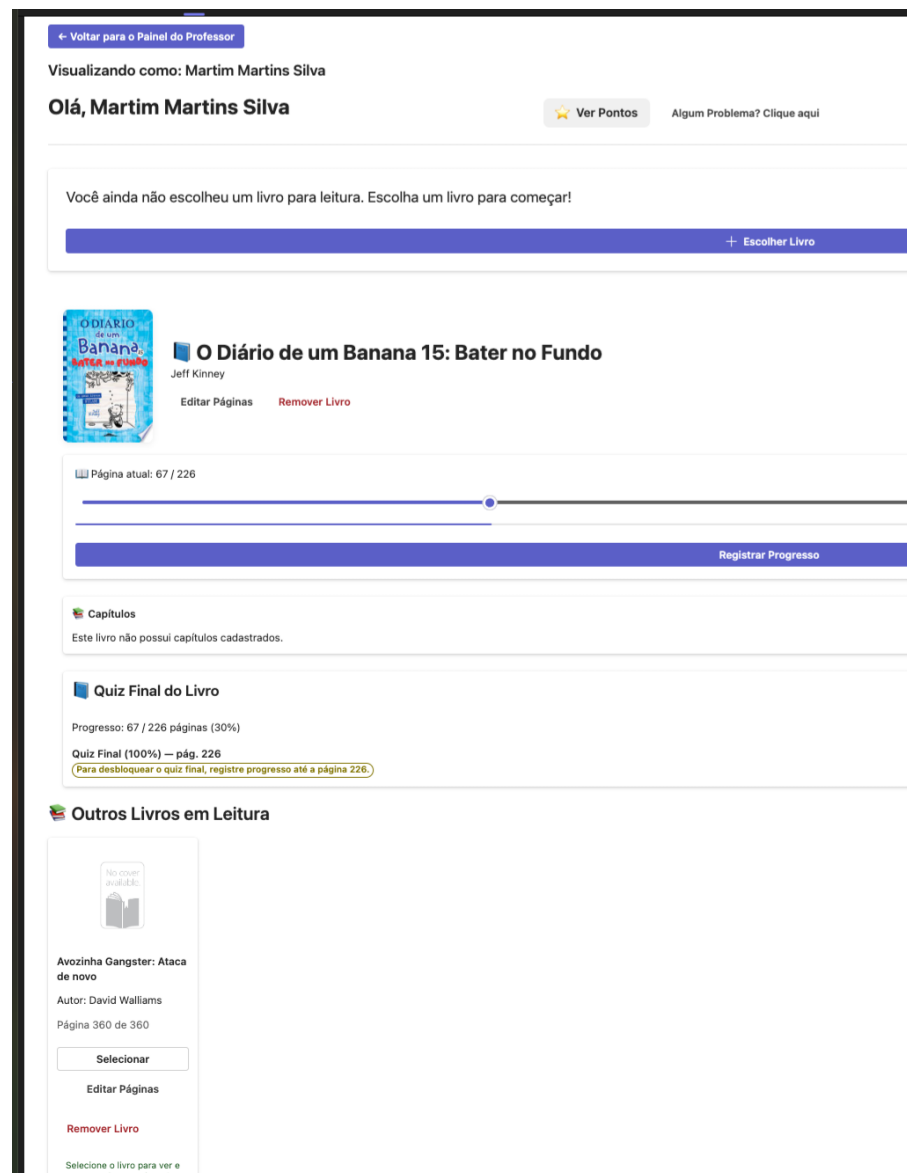


Figure 4.8: Student dashboard for Grades 5–8: Book selection, streaks, and social ranking.

4.3.2 Teacher Tools and Dashboards

The platform includes dashboards specifically designed for teachers, aligned with the needs of each instructional cycle. These tools provide real-time analytics and customizable challenge parameters, empowering educators to adapt gamification to their classroom needs. This feature was designed to answer **RQ2** by supporting teacher agency and customization. The dashboard for Grades 3-4 (Figure 4.9) focuses on class summaries and quiz management, while the dashboard for Grades 5-8 (Figure 4.10) includes a more advanced quiz editor and progress analytics. A consistent navigation bar and shared gamification section (Figure 4.11) ensure a coherent experience.

Grades 3–4 Teacher Dashboard

- **Class and Book Selection:** Dropdown filters for quick access to different class groups.
- **Class Summary:** Cards displaying class name, number of students, and average reading progress.
- **Leaderboard:** Dynamic ranking of students by points and reading achievements.
- **Quiz Management:** Toggle availability, view statistics, and access response review interfaces.
- **Student Management:** List of students with quiz status, reading progress, and point totals.

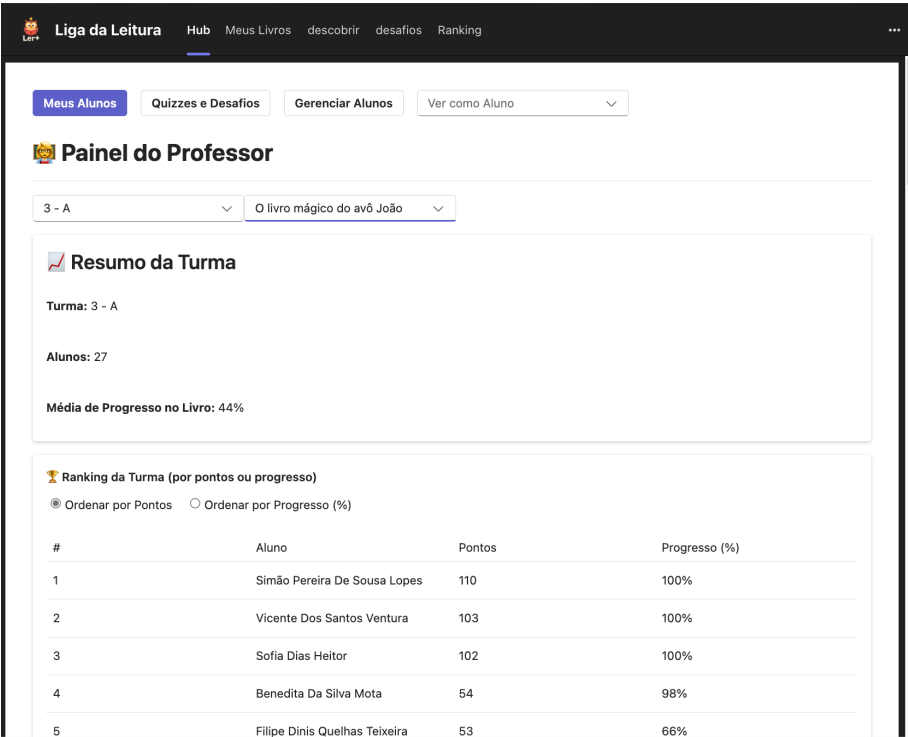


Figure 4.9: Teacher dashboard for Grades 3–4: Class summary, leaderboard, and quiz management.

Grades 5–9 Teacher Dashboard

- **Student List:** Overview of student book selections, reading progress, and quiz status.
- **Quiz Editor:** Interface to add or remove questions, publish quizzes, and grade responses.
- **Progress Analytics:** Visual graphs showing points earned, quizzes completed, and engagement trends.
- **Gamification Analytics:** Recent badges, rankings, and streak activity per class or student.

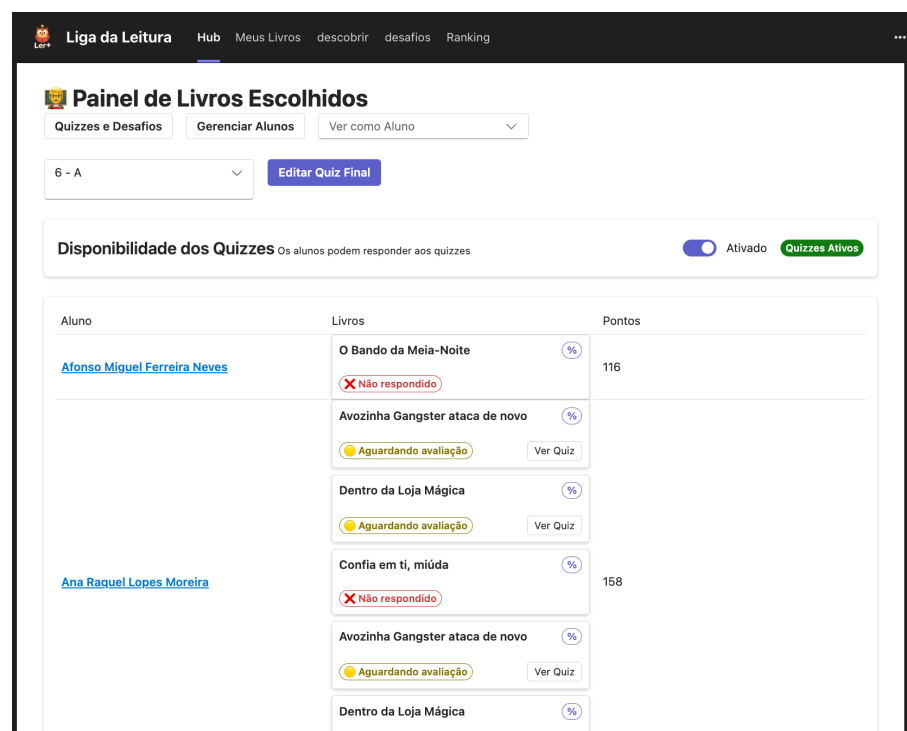


Figure 4.10: Teacher dashboard for Grades 5–8: Student progress, quiz editor, and analytics.

4.3.2.1 Accessibility and Responsive Design

- **Navigation Bar:** Consistent access to key sections such as *Meus Alunos*, *Quizzes e Desafios*, *Gerenciar Alunos*, and *Ver como Aluno*.
- **Gamification Section:** Shared views for both students and teachers, including rankings, badge progress, and activity graphs.
- **Accessibility:** Full support for keyboard navigation, screen readers, and both light and dark themes.

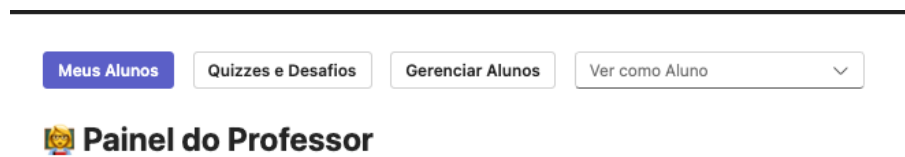


Figure 4.11: Navigation bar and gamification section: Points ranking, badges, and progress graphs.

4.3.3 Responsive and Adaptive Design

The platform was tested across a range of devices to ensure consistent interaction. Adaptive components were implemented using Fluent UI and CSS modules to ensure compatibility and touch accessibility, as demonstrated by the mobile view of the student dashboard in Figure 4.12. The key pedagogical and functional differences between the grade levels are summarized in Table 4.1. This structured differentiation ensures that the platform's feature set aligns with both curricular objectives and the developmental needs of students at each educational stage, directly addressing RQ4.

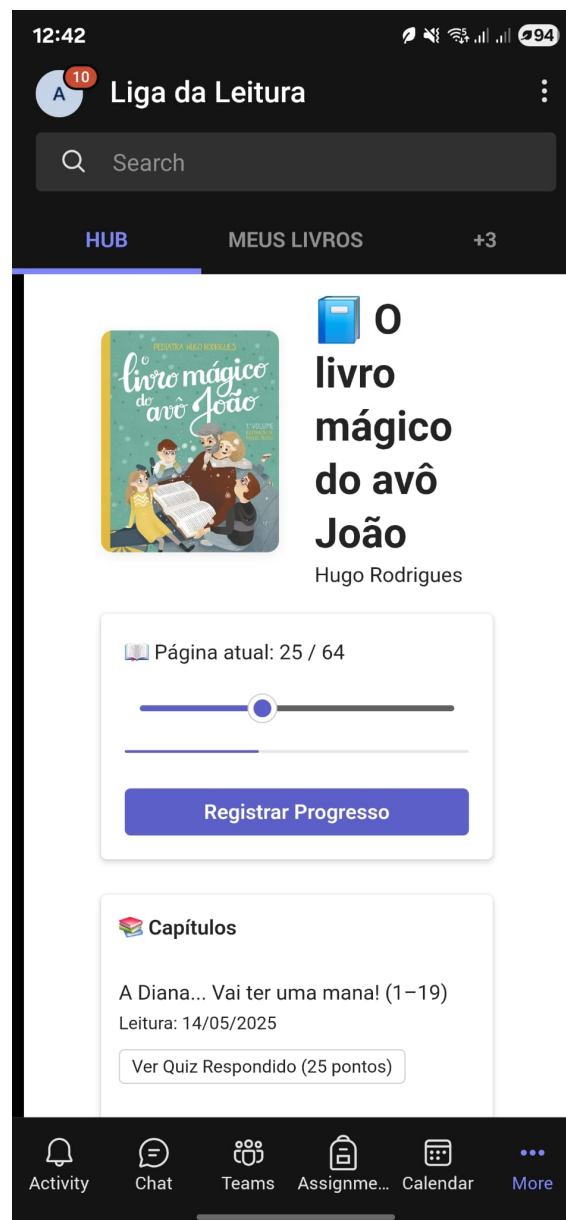


Figure 4.12: Responsive design example: Mobile view of the student dashboard.

Table 4.1: Pedagogical and functional differences between grade levels

Feature Area	Grades 3–4 (First Cycle)	Grades 5–8 (Second/Third Cycles)
Quiz Structure	Chapter-based, multiple choice	Final quiz, open-ended questions
Quiz Management	Enable/disable, grade only	Create/edit questions, enable/disable, grade
Book Selection	Fixed, teacher-assigned	Student choice
Progress Tracking	By chapter and quiz completion	By book completion and final quiz
Gamification	Points for chapter quizzes and reading progress	Points for book completion and final quiz

This structured differentiation ensures that the platform’s feature set aligns with both curricular objectives and the developmental needs of students at each educational stage. It also supports teachers in delivering targeted instruction and formative assessment, leveraging data-driven insights to adapt their pedagogical strategies. This directly addresses RQ4 by allowing analysis of age-specific responses to gamification elements.

4.4 Technical Challenges and Solutions

The development and deployment of a scalable, gamified reading platform in a real-world school environment involved addressing several significant technical challenges. These were met through a combination of cloud-native architectural decisions, and continuous iteration based on monitoring data and pilot feedback.

4.4.1 Cross-Device Compatibility

Given the diversity of school-issued devices and browsers, it was necessary to guarantee consistent functionality and usability across platforms, including support for both keyboard and touch interaction. All user interface components were developed using Fluent UI and subjected to comprehensive testing across major devices and operating systems. A progressive enhancement strategy was adopted, ensuring that core features remained accessible even on lower-specification hardware. Table 4.2 summarizes the compatibility results across the primary device types used in the pilot deployment.

Table 4.2: Device Compatibility Matrix

Device	OS	Status
Samsung S7 FE	Android	Full
Mac Mini M4	MacOS	Full
Windows Laptop	Windows 11	Full
iPad 10th Gen	iPadOS	Full

4.5 Pedagogical Validation

This section describes the process and results of pedagogical validation for the gamified reading platform. Details the context, the collaborative involvement of teachers in co-design, and the mixed-method approach used to evaluate both technical and educational effectiveness.

4.5.1 Pilot Design and School Context

The pedagogical validation of the gamified reading platform was carried out at Escola Global, a private institution in Portugal that serves hundreds of students at primary and secondary levels of education. The school was strategically selected due to its openness to educational innovation projects and its established digital infrastructure, with Microsoft Teams [Microsoft Corporation \(2024c\)](#) already integrated as the primary learning management system.

The pilot study included students from grades 3 through 8, representing both the first cycle (grades 3-4) and the second / third cycles (grades 5-8) of Portuguese basic education. The participation involved 127 students distributed in 8 classes, with 12 teachers actively involved in the implementation process. The school's curriculum-aligned approach to reading instruction provided an authentic educational context, where the platform could be integrated with existing literacy objectives and assessment practices.

This pilot design directly supports **RQ1** and **RQ4** by providing a real-world context to observe how gamified interventions impact reading engagement across different age groups.

4.5.2 Teacher Involvement and Co-Design

The teacher agency emerged as a fundamental component of the platform's development and validation process. The co-design methodology involved three distinct phases of educator engagement, ensuring that pedagogical expertise informed both technical implementation and classroom integration strategies.

The participation of the teacher in the co-design process ensured that the features of the platform were relevant and adaptable to real classroom contexts. This approach directly addresses **RQ2** by investigating how teacher agency can be integrated into the design and sustained use of gamified reading interventions.

Pre-Implementation Session

Initial participation included four meetings in which teachers collaboratively defined reading engagement challenges and identified specific curricular integration points. These sessions revealed critical insights on grade-specific learning objectives, and teachers emphasize the need for differentiated assessment approaches between younger and older students. These meetings established clear pedagogical requirements, including the importance of teacher-controlled quiz availability and customizable challenge parameters.

Iterative Feedback Cycles

Throughout the eight-week pilot period, weekly feedback sessions enabled continuous platform refinement based on classroom observations and student interactions. Teachers provided detailed input on interface usability, student response patterns, and effectiveness of curriculum alignment. This iterative approach resulted in mid-implementation adjustments, including the introduction of teacher-mediated quiz unlocking features and enhanced progress visualization tools.

The platform's classroom deployment followed a phased integration approach, beginning with pilot classes and gradually expanding to full implementation across participating grades. Real-world usage patterns demonstrated the platform's capacity to support diverse pedagogical approaches while maintaining alignment with Portuguese national curriculum standards.

Curricular Integration Examples

First Cycle Implementation (Grades 3-4): Teachers used the platform's chapter-based quiz system to reinforce comprehension of prescribed reading materials, with students earning points for completing assessments tied to specific curriculum objectives. Reading progress tracking allowed teachers to identify students requiring additional support and adjust instruction accordingly.

Second/Third Cycle Implementation (Grades 5-8): Older students engaged with the platform's autonomous book selection features, choosing from the entire available literature while participating in comprehensive open questions final assessments after finishing each book. The social ranking system promoted healthy competition, as the students could see where they were in the rankings and the explanation of points.

4.5.3 Data Collection Instruments

The validation study adopted a comprehensive mixed methods approach, integrating quantitative and qualitative data sources to evaluate the technical performance and pedagogical effectiveness of the platform.

Quantitative data were derived primarily from automated system logs that captured detailed user interaction metrics throughout the 8-week deployment. In total, the platform recorded 3,078 reading sessions, 402 quiz submissions, and 2,190 gamification events. These logs allowed a granular analysis of daily reading frequency, session duration, quiz completion rates, and point accumulation patterns at different grade levels.

Both students and teachers completed structured electronic questionnaires before and after the intervention. The student survey included validated closed-ended items to measure constructs such as intrinsic motivation, reading self-efficacy, and attitudes toward digital learning tools, as well as open-ended prompts to obtain qualitative feedback on user experience and perceived impact. The teacher questionnaire was designed to capture both quantitative and qualitative data on previous experience with digital and gamified platforms, perceptions of impact, usability, barriers encountered, and suggestions for improvement. Teachers were also asked about their autonomy in customizing activities, observed differences between age groups of students, the effectiveness of

specific gamification elements, and the perceived influence of the platform on reading habits and motivation. Both instruments were adapted for the appropriate language for the age and administered electronically using Microsoft Forms.

This mixed methods data collection strategy, which combines behavioral analysis with stakeholder perceptions, was designed to fully address the research questions (RQ1, RQ2, and RQ3) by triangulating system usage data, student experiences, and teacher perspectives.

Summary

This chapter has detailed the comprehensive implementation of a gamified reading platform, emphasizing both technical robustness and pedagogical alignment. The system was architected using the Microsoft Teams Toolkit [Microsoft Corporation \(2024c\)](#) for seamless integration into existing school workflows, Azure Functions [Microsoft Corporation \(2024a\)](#) for scalable, event-driven backend logic, and Cosmos DB [Microsoft Corporation \(2015\)](#) for flexible, high-performance data management. These choices ensured compliance with institutional policies, maximized adoption, and supported differentiated user experiences for both students and teachers.

A key strength of the implementation lies in its modular architecture, which separates core services such as gamification, quiz management, student management, and notifications. Each subsystem was designed for scalability, security and maintainability, with real-time feedback and event-driven points calculation grounded in evidence-based gamification strategies. The front-end delivers age-appropriate interfaces and empowers teachers with actionable analytics and customizable management tools, directly addressing research questions related to engagement, differentiation, and teacher agency.

The development of the platform was guided by continuous feedback from educators, ensuring that the technical features were responsive to the real needs of the classroom. Challenges such as device compatibility, real-time scalability, and data integrity were systematically addressed through iterative testing and cloud-native engineering practices.

In summary, the implementation establishes a solid foundation for empirical evaluation, enabling a rigorous assessment of the impact of the platform on reading engagement, learning outcomes, and teacher workflow. The next chapter presents the results and analysis of the classroom deployment, providing critical insights into the effectiveness and practical value of the proposed solution.

Chapter 5

Results and Analysis

This chapter presents a comprehensive analysis of the data collected during the 8-week validation study of the gamified reading platform at Escola Global, a private school in Santa Maria da Feira. The results are based on system analytics, pre and post-questionnaires from students in grades 3 to 8, and teacher feedback, addressing research questions through quantitative, qualitative and mixed methods triangulation.

5.1 Overview

A total of 320 students (grades 3 to 8) and 12 teachers participated in the study, covering both the first cycle (grades 3 to 4) and the second / third cycles (grades 5 to 8) of Portuguese basic education. Data sources included automated system logs (capturing reading sessions, quiz submissions, and gamification events), pre- and post intervention student questionnaires (Likert and open-ended items) and teacher questionnaires. Quantitative analyzes focused on behavioral engagement, reading and quiz activity, and motivational changes, while qualitative analyzes synthesized open-ended feedback to identify emergent themes. By triangulating these data, the chapter addresses RQ1–RQ4, evaluating both the technical and the pedagogical outcomes of the platform.

5.2 Quantitative Analysis

This section presents a quantitative evaluation of the use and impact of the gamified reading platform.

5.2.1 Reading Activity and Engagement Patterns

The system recorded a total of 5,670 events, comprising 3,078 reading sessions, 402 quiz submissions, and 2,190 gamification events. These figures provide a high-level overview of the platform's usage. To visualize the overall system activity, Figure 5.1 depicts the total number of log events recorded per day, highlighting the general trends of daily and weekly engagement.

To gain a deeper understanding of student participation, the number of unique students interacting with the platform was analyzed each day. This metric provides a more precise picture of the active participation of the student population than session counts alone, which could be skewed by a small number of highly active users. The analysis was carried out over a 8-week period. During this time, a total of 247 unique students engaged with the platform, demonstrating a significant reach within the target user base at Escola Global.

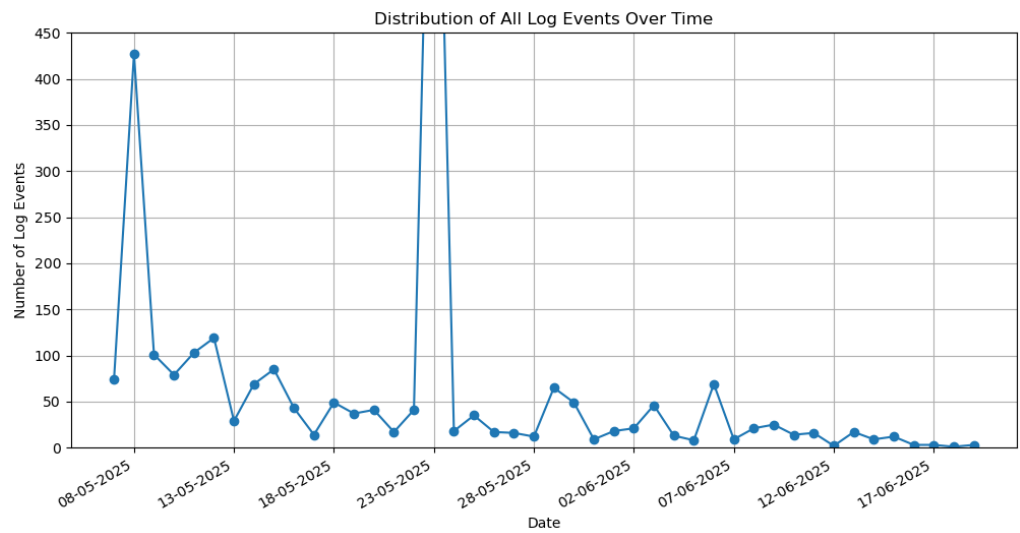


Figure 5.1: Distribution of All Log Events Over Time

Figure 5.2 illustrates the daily count of unique students throughout this period, with overlays for the mean and median values to better visualize the central trend of engagement.

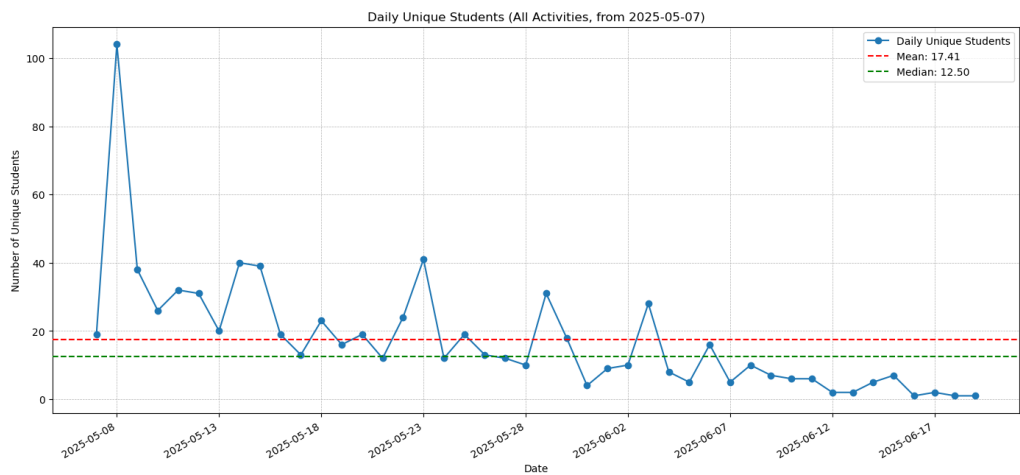


Figure 5.2: Daily Unique Students (All Activities), with Mean and Median Engagement.

A descriptive statistical analysis of these data yielded key insights into engagement patterns. During the 44-day period, an average of 17.4 unique students interacted with the platform daily. The median, representing the typical daily value, is visually close to the mean, suggesting that, while there are peaks, there is a consistent level of daily interaction.

A critical finding is the standard deviation of 17.66. The fact that the standard deviation is almost identical to the mean indicates a very high degree of variability in daily activity. This pattern strongly suggests that student participation is not uniform day-to-day but occurs in concentrated bursts. These bursts are likely influenced by external factors central to the educational context, such as specific classroom activities, homework assignments, or weekly academic schedules.

The range of activity further supports this conclusion. Daily engagement ranged from a minimum of only one student on the quietest day to a remarkable peak of 104 unique students on the most active day. This maximum value represents a significant engagement event in which approximately 42% of the entire active user base (104 of 247 students) accessed the platform on a single day. Such an event likely corresponds to a coordinated school-wide action such as the presentation of the application or a deadline, demonstrating the platform's capacity to support and drive focused, high-traffic educational activities.

In conclusion, the analysis of unique daily students reveals an engagement model characterized by consistent baseline activity punctuated by significant curriculum-driven peaks. The high variability is not a sign of inconsistent appeal of the platform, but rather an indicator of its successful integration into the academic rhythm of Escola Global. These findings validate the effectiveness of the platform as a tool for facilitating coordinated reading activities and managing engagement at both an individual and a cohort level.

5.2.2 Grade-Level Differentiation

An analysis of engagement metrics, summarized in Table 5.1, reveals significant and insightful differences in platform interaction between the two primary grade-level cohorts. These variations highlight distinct engagement patterns that align with the developmental stages and educational structures of each group.

A striking initial observation is that the younger cohort (3rd-4th grade) completed significantly more books on average (3.74) than their older counterparts (1.55). This higher volume is likely attributable to several factors. First, the reading materials targeted at younger students are typically shorter. Second, their engagement appears to be more structured and curriculum-driven, potentially involving a series of required readings within the "special" book programs that a large portion of the 105 students in this cohort participated in.

Conversely, the older students (5th-8th Grade), while completing fewer books, demonstrated a markedly higher Quiz Attempt Rate (53.29% vs. 41.71%). This suggests a different mode of engagement: while they may read a lower volume of books, which are likely longer and more complex, they show a greater propensity to complete the associated assessment activities. This may be linked to a greater sense of academic responsibility, intrinsic motivation to test their comprehension, or the "quiz-escolhido" format being more appealing to their autonomous learning style.

The most telling metric for differentiating engagement patterns is the Average Streak Duration. The older cohort maintained streaks for nearly four times as long as the younger group (4.55 days vs. 1.22 days). This is a strong indicator of habitual, self-directed use of the platform.

A multi-day streak requires consistent, conscious effort and planning, suggesting that the older students have internalized the gamification mechanics and are engaging autonomously to maintain their progress. The shorter streak duration for the younger group implies that their usage is more sporadic and likely dependent on direct, daily prompts from educators, rather than forming a self-sustained habit.

In summary, the data points to two distinct but equally valuable engagement profiles. The 3rd–4th grade group exhibits high-volume, event-driven engagement, likely guided by structured, teacher-led initiatives. The 5th–8th grade group demonstrates a more autonomous and in-depth engagement pattern, characterized by lower volume but higher consistency and a greater focus on assessment. This differentiation suggests that the platform’s gamification strategies are effective for both cohorts, yet are utilized differently in alignment with their respective developmental and pedagogical needs.

Metric	3 rd –4 th Grade	5 th –8 th Grade
Avg. Books Completed	3.74	1.55
Quiz Attempt Rate	41.71%	53.29%
Avg. Streak Duration (days)	1.22	4.55

Table 5.1: Engagement Metrics by Grade Level

5.2.3 Book Completion and Reading Outcomes

A granular analysis of reading outcomes on a grade-by-grade basis reveals a complex and varied landscape of student engagement, challenging initial broader assumptions. While the grouped data provided a high-level overview, this detailed breakdown, visualized in Figure 5.3, uncovers specific patterns of participation and performance within each academic year.

The most striking feature of the data is the exceptional performance of the 4th-grade class, which dramatically surpasses all other grades with an overall average of 7.31 books completed per student. This figure, significantly higher than any other cohort, points towards a highly effective and well-adopted mandatory reading program. The high participation rate within this grade, where 42 out of 51 students completed at least one book, confirms the program’s widespread success.

To further dissect these outcomes, a second metric was calculated: the average number of books completed by only the active students (those who completed at least one book). By comparing this to the overall average, we can identify the "engagement gap" within each grade.

The 6th-grade class, for example, demonstrates the most uniform participation. With an overall average of 1.97 books and an active-student average of 2.11, the small gap between these numbers indicates that engagement is broad-based. A vast majority of the students in this grade (54 out of 58) participated in reading, each contributing at a similar, consistent level.

In stark contrast, several grades exhibit a significant gap between the two averages, suggesting that reading activity is driven by a smaller subgroup of highly engaged students. In the 8th grade, the overall average is modest 1.14 books; however, the active cohort of 23 students read an average

of 3.17 books each. A similar and even more pronounced pattern is visible in the 3rd grade (0.37 overall vs. 1.25 for active students) and 7th grade (0.59 overall vs. 1.86 for active students). In these grades, a significant portion of the student body did not complete any books, placing the onus of the reading statistics on a dedicated minority.

This detailed analysis provides critical information for the pedagogical strategy. It refutes a simplistic view of age-related participation and instead highlights the profound impact of specific programs, as seen in the 4th grade. Furthermore, by quantifying the engagement gap, it equips educators with the data needed to tailor interventions, recognizing uniform participation in the 6th grade while developing strategies to broaden participation and motivate less active students in grades where participation is more concentrated.

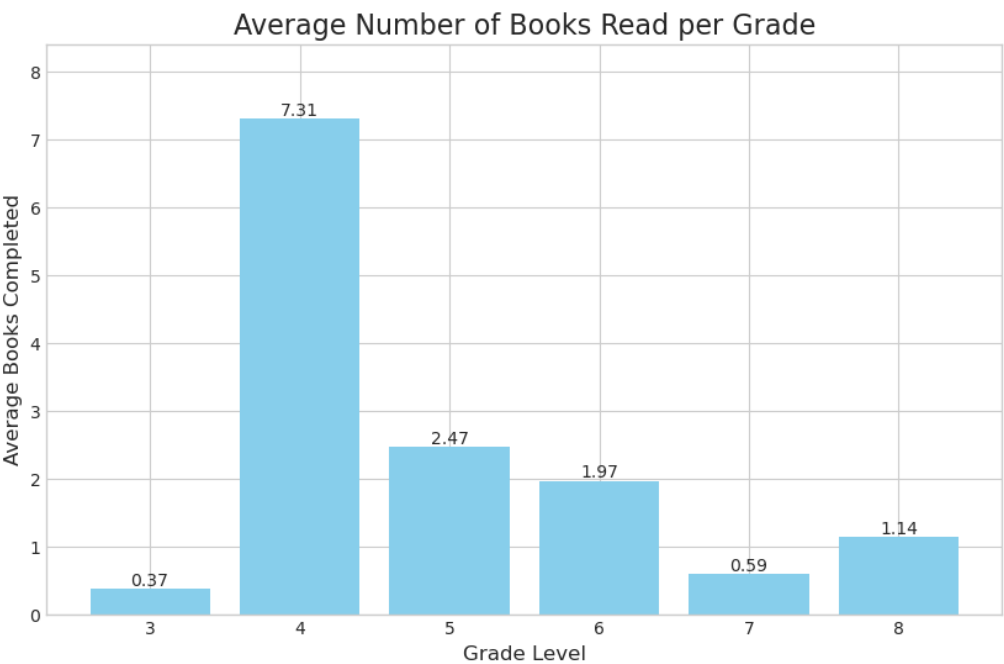


Figure 5.3: Average Number of Books Read per Grade

5.2.4 Quiz Participation and Comprehension

The quiz feature was designed to improve both engagement and reading comprehension. An analysis of its usage reveals distinct patterns of interaction between younger (3rd–4th Grade) and older (5th–8th Grade) cohorts, necessitating a separate examination of each to fully understand the feature’s impact.

For the 3rd and 4th-grade students, whose activity was primarily centered around the structured reading of "O livro mágico do avô João," the quiz feature saw remarkable initial adoption. An impressive 89.5% of the 105 students in this cohort participated in at least one quiz, signaling a high level of appeal and successful integration into classroom activity. The average score of 23.55 points among these participants further suggests that those who participated in the study understood the material effectively.

However, while initial engagement was high, a detailed analysis of the progression through the book's quizzes reveals a significant challenge in sustained participation. As illustrated in Figure 5.4, there was a consistent drop-off in the number of unique students completing the quiz for each subsequent chapter. For example, while 50 students of the 4th grade completed the first test, only 3 attempted the fourth test, and just one completed the final test. This steep decline suggests that, while the format is initially engaging, maintaining momentum over a multiweek program is a primary hurdle for this age group.

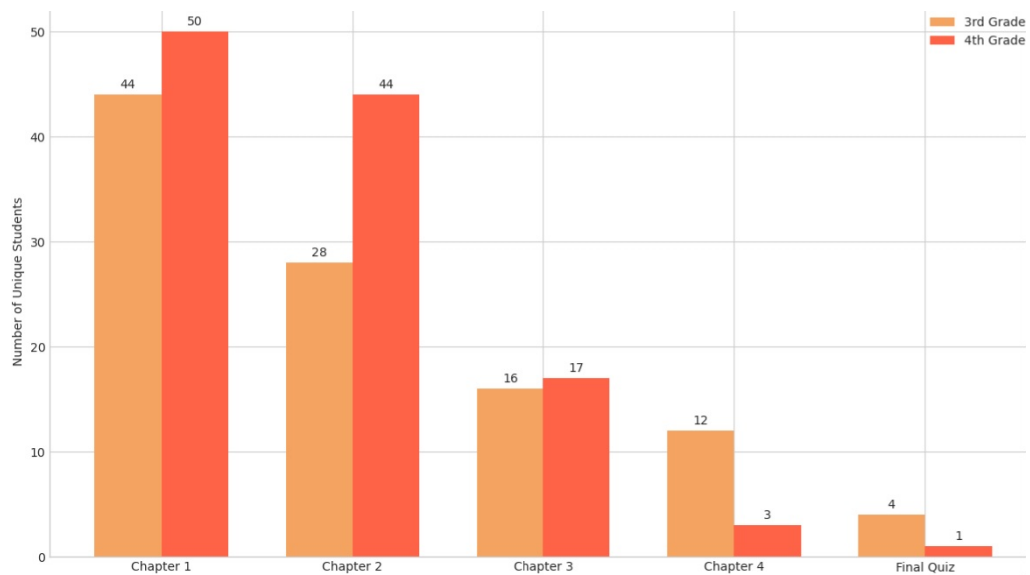


Figure 5.4: Student Drop-off in Quiz Completion per Chapter for "O livro mágico do avô João".

This finding is further illuminated by the book's overall completion statistics. Of the 95 students who started the book, 55 successfully completed it, resulting in a completion rate of 57.89%. The critical question becomes: where did the other 40 students stop? The distribution of drop-off points, shown in Figure 5.5, indicates that the largest group of students (13 students) stopped reading after completing between 50 and 60% of the book. This corresponds directly to the period after the second or third quiz, aligning perfectly with the quiz participation drop-off and pointing to this midpoint as a critical attrition zone.

In contrast, the 5th–8th grade cohort exhibited a more autonomous engagement model. As these students chose their own books, the most relevant metric is the ratio of quizzes attempted to books completed. The data show that for every 100 books completed by this group, 53.3 quizzes were attempted. This rate indicates a healthy and consistent, albeit not universal, adoption of the optional assessment feature. It suggests that more than half of the time students are intrinsically motivated to verify their own comprehension after reading. This self-directed behavior highlights the platform's success in supporting independent learning for older students, where the quiz serves as a valuable tool for self-assessment rather than a mandatory checkpoint.

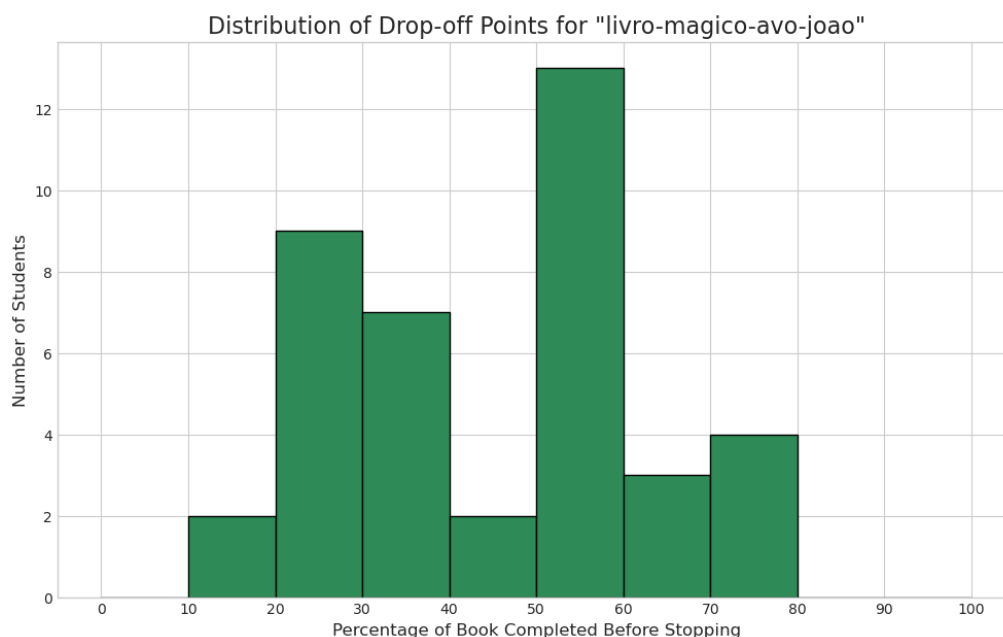


Figure 5.5: Distribution of Drop-off Points for "O livro mágico do avô João".

5.2.5 Completion vs. Quiz Correlation

An essential aspect of the platform's design is ensuring that gamified incentives, such as points for finishing a book, correspond to genuine academic effort. To prevent students from superficially marking books as "complete" simply to accumulate points, the quiz system was implemented as a validation mechanism. The relationship between book completions and quiz participation was therefore analyzed to determine the effectiveness of this approach.

For the younger cohort (3rd–4th Grade), this analysis focused on the case study of the mandatory reading, "O livro mágico do avô João." The data indicates a perfect implementation of this validation rule. Among the students in this group, 54 were credited with completing the book. Crucially, 100% of these 54 students also attempted at least one quiz associated with the book. This one-to-one correspondence confirms that, for this structured activity, the system successfully prevented completions without corresponding quiz engagement, ensuring the integrity of the completion metric.

For the older cohort (5th–8th Grade), who engaged in more autonomous reading, a correlation analysis was performed per student basis. Each student was plotted on a scatter graph based on the number of books they completed versus the number of end-of-book quizzes they took. The results, shown in Figure 5.6, reveal a strong positive correlation between the two activities.

As the plot illustrates, students who completed more books also tended to take more quizzes. The most prolific readers, who completed ten or more books, were also the most active quiz-takers. Critically, the lower-right quadrant of the graph is empty; there are no instances of students completing a large number of books while taking zero or very few quizzes. This pattern confirms the successful implementation of the quiz-as-validation strategy. It effectively prevented students from

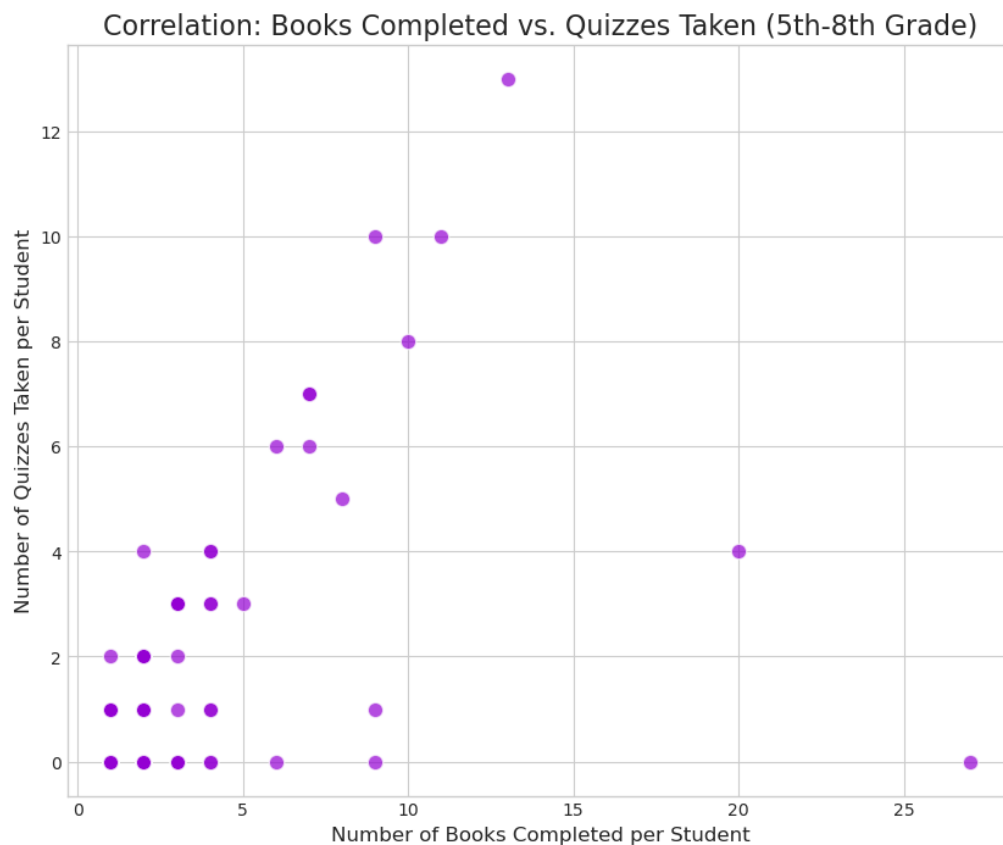


Figure 5.6: Correlation: Books Completed vs. Quizzes Taken (5th-8th Grade)

gaming the system by rewarding only those completions that were accompanied by a corresponding effort to engage with the assessment content, thereby ensuring that the platform's gamification elements remained tied to genuine reading engagement.

5.2.6 Gamification Points and Engagement Archetypes

The platform's gamification system generated 2,196 distinct events, which were categorized into engagement archetypes to understand the primary drivers of student motivation. The distribution of points among these archetypes, Task Completers, Quiz Optimizers, and Streak Seekers, reveals the practical impact of the system's design and weighting. Figure 5.7 illustrates the breakdown of the total points earned.

The analysis reveals that the Task-Completers archetype was overwhelmingly dominant, accounting for 75.3% of all points awarded. This category includes points for both completing a book and making initial progress. The significant weight of this archetype reveals a potential flaw in the initial design, where the intention to reward the final achievement of finishing a book inadvertently overshadowed other forms of engagement. The high point values for these tasks made them the most efficient path to rewards, thus becoming the central focus of student effort.

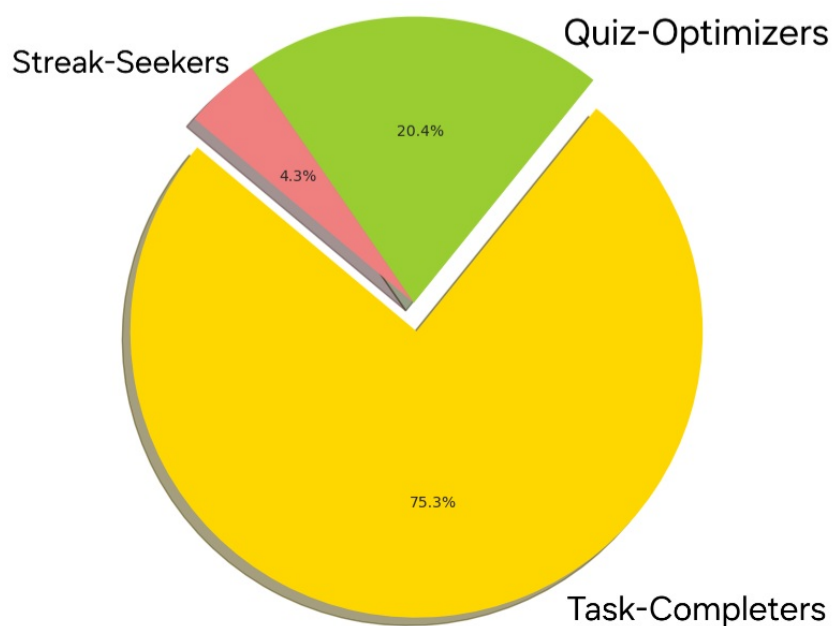


Figure 5.7: Gamification Points Distribution by Type

The Quiz-Optimizers represent the second largest group, responsible for 20.4% of the points. This shows that the quizzes served as a substantial secondary motivator. For a significant number of students, the points awarded for demonstrating comprehension were a worthwhile incentive, reinforcing the link between reading and assessment.

In contrast, the Streak Seeker archetype, associated with habit formation through daily reading, represented only 4.3% of the total points. This low figure suggests that, while streaks may have encouraged consistent daily logins for some, the point reward was not substantial enough to make it a primary motivational driver compared to the high-value, one-off tasks like book completion. This finding indicates an opportunity for future iterations to rebalance the incentive structure, potentially increasing the rewards for sustained daily habits to foster more consistent long-term engagement.

5.2.7 Points and Streaks by Grade

An examination of the gamification metrics on a per-grade basis reveals distinct patterns in how students accumulated points and formed reading habits. The data suggests that engagement strategies resonated differently between various age groups, with younger students excelling in point accumulation through structured activities and older students demonstrating a greater propensity for habitual use.

As shown in Figure 5.8, the average number of points earned per student varied significantly between grades. The fourth-grade class stands out as a dramatic outlier, with students earning an average of 416 points each. This is more than double the next highest group (5th grade, with 183 points) and is directly attributable to their deep engagement with the highly structured "O livro

mágico do avô João" program, which included numerous opportunities to earn points through chapter quizzes and completion bonuses. In contrast, seventh grade students earned the lowest average points (35), indicating lower participation in point-generating activities.

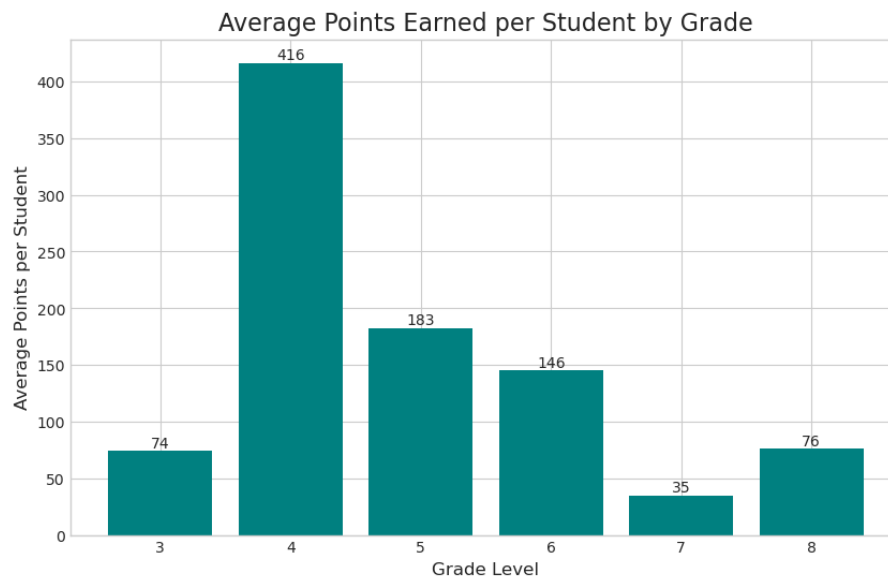


Figure 5.8: Average Points Earned per Student by Grade

Although points reflect the completion of high-value tasks, reading streaks are a more direct measure of consistent daily habit formation. The distribution of the lengths of the streaks, visualized in the box plot in Figure 5.9, provides a different perspective on engagement. Here, the fifth grade students distinguish themselves significantly from all other cohorts. Their median streak length is the highest, and the interquartile range (the height of the box) is considerably larger, indicating that a substantial portion of these students maintained longer, more consistent reading habits. Furthermore, the fifth grade produced the longest streaks overall, with some students maintaining their engagement for more than a month.

Together, these two analyses paint a nuanced picture. The 4th grade's success in accumulating points highlights the effectiveness of a guided, curriculum-driven approach where rewards are clearly tied to assigned tasks. In contrast, the 5th grade's success in maintaining long streaks suggests a more developed sense of self-directed, habitual engagement. This indicates that while younger students respond well to extrinsic motivation within a structured program, older students are more capable of forming lasting reading habits, a key goal of the gamification system.

5.2.8 Survey Results: Quantitative Items

To evaluate the impact of the gamified platform on students' reading attitudes and behaviors, pre- and post-intervention questionnaires were administered. The surveys measured three central constructs on a Likert scale: self-reported Reading Frequency, a composite Motivation Score, and academic Self-Efficacy in reading. The aggregated results, including the means and standard deviations for both intervention cycles, are summarized in Table 5.2.

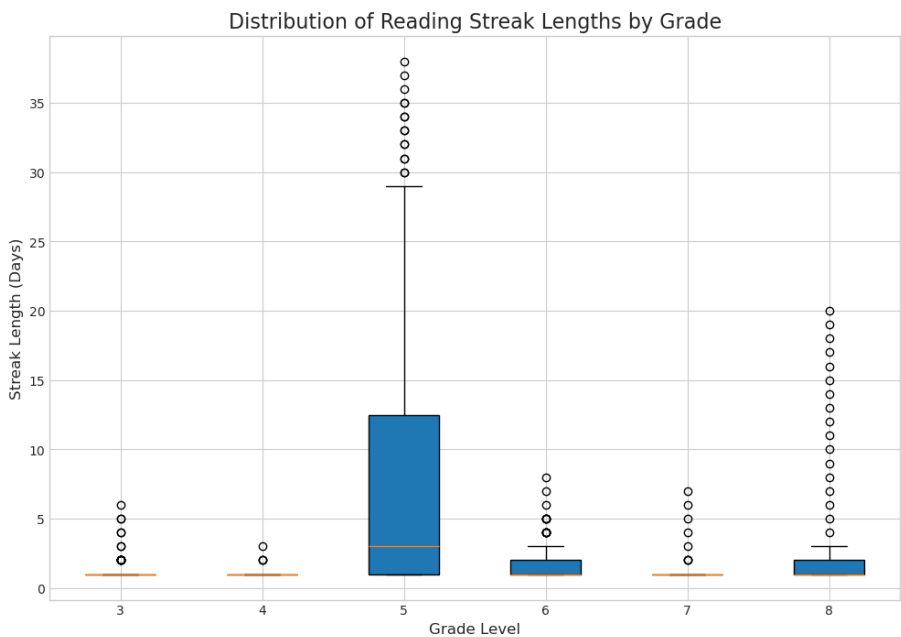


Figure 5.9: Distribution of Reading Streak Lengths by Grade

Metric	Pre 1st Cycle	Post 1st Cycle	Pre 2nd/3 rd Cycle	Post 2nd/3 rd Cycle
Reading Frequency	2.87 (±0.69)	2.93 (±0.73)	2.82 (±0.85)	2.71 (±0.72)
Motivation Score	3.29 (±0.72)	3.21 (±0.69)	3.01 (±0.84)	3.00 (±0.73)
Self-Efficacy	2.63 (±0.61)	2.83 (±0.58)	3.25 (±0.69)	2.80 (±0.70)

Table 5.2: Summary of Pre- and Post-Questionnaire Results (Mean ± Standard Deviation).

The analysis of the quantitative data reveals nuanced insights into the impact of the intervention across the different age cohorts.

For the first cycle (grades 3-4), the data show a positive, albeit modest, improvement in two key areas after the intervention. The self-reported self-efficacy of the students saw the most notable increase, rising from a mean of 2.63 to 2.83. This suggests that the experience of successfully completing books and quizzes within a structured environment tangibly increased the confidence of younger students in their own reading abilities. A slight increase in the reading frequency was also observed (2.87 to 2.93). However, the motivation score remained relatively stable (3.29 to 3.21), indicating that while the platform boosted confidence and slightly impacted behavior, it did not dramatically alter the students’ preexisting motivational attitudes in the short term.

For the 2nd and 3rd cycles (Grades 5-8), the analysis presents a different pattern. These older students began with a significantly higher baseline for Self-Efficacy (3.25) compared to the younger group, which is expected for their age. Their post-intervention scores, which measured their perceived change, indicate a positive impact. The average scores of 2.71 for the change in reading frequency, 3.00 for motivation, and 2.80 for self-efficacy are all close to "3" on the 4-point scale (representing "a little more" or "a little better"). This suggests that older students perceived a modest but consistently positive improvement in all areas. The application appears

to have been successful in slightly increasing motivation and the perception of competence, even among a cohort that already had a higher initial self-efficacy.

Overall, the descriptive data indicates a positive, age-differentiated impact of the gamified intervention on the students' reading experience.

5.3 Qualitative Analysis

This section explores the qualitative dimension of platform evaluation.

5.3.1 Student Survey: Open-Ended Responses

To complement the quantitative data, the post-intervention questionnaire included open-ended questions inviting students to share their personal experiences, criticisms, and suggestions. A thematic analysis of these responses revealed three primary themes: Positive Reception of Core Gamification Loops, Desire for Greater Rewards and Customization, and Usability and Technical Feedback.

5.3.1.1 Positive Reception of Core Gamification Loops

A significant portion of the feedback was overwhelmingly positive, confirming that the core gamification mechanics were well received and engaging. Students frequently cited the elements of progression and competition as their favorite aspects of the application. The desire to earn points and compete with friends was a powerful motivator, as one student articulated:

"A parte que eu gostei mais foi de poder competir com amigos."

"The part I liked most was being able to compete with friends."

Another student highlighted the satisfaction derived from seeing tangible evidence of their work, stating they most enjoyed being able to "Ver o meu progresso e os desafios" ("See my progress and the challenges"). This feedback aligns with the quantitative data, suggesting that the systems for tracking progress and providing rewards were central to the platform's motivational appeal. When asked what they would change, a large number of students simply responded with "Nada" ("Nothing") or "Nada está ótimo" ("Nothing, it's great"), indicating a high level of overall satisfaction.

5.3.1.2 Desire for Greater Rewards and Customization

A second prominent theme revolved around the platform's reward system. While students enjoyed earning points, many expressed a desire for those points to have a greater impact. This feedback suggests that while the current system was motivating, its potential could be further unlocked by enhancing the value and variety of the rewards. One student offered a direct suggestion for improvement:

"Acho que cada vez que somássemos pontos, poderia dar mais prêmios."

"I think that every time we added points, it could give more prizes."

This sentiment points toward a desire for a more robust in-app economy where points could be redeemed for more significant virtual or tangible goods. Suggestions often involved greater customization options, implying that students were seeking more ways to express their identity and achievements within the platform.

5.3.1.3 Usability and Technical Feedback

A smaller but important set of responses provided specific usability feedback. Some students mentioned minor technical issues or points of confusion, such as difficulties with quizzes. One student noted a specific request related to the reading experience itself: "Poderia haver uma opção para a aplicação ler o livro para nós" ("There could be an option for the application to read the book to us"), indicating a desire for text-to-speech or audiobook functionality. Another mentioned wanting to see the "número de páginas" (page numbers) more clearly. This type of feedback is invaluable for future development, as it highlights specific, actionable areas for improving the user interface and overall accessibility of the application.

In conclusion, the qualitative feedback strongly corroborates the quantitative findings. Students were clearly motivated by the gamified elements of competition and reward. The analysis also provides clear directions for future work, emphasizing the need to expand the reward system and refine the user experience to better support the diverse needs of the student readers.

5.3.2 Teacher Survey: Open-Ended Responses

To understand the pedagogical impact and practical utility of the platform from the educators' perspective, open-ended feedback was collected from the participating teachers. The thematic analysis of their responses revealed three key themes: **(1) Acknowledgment of Increased Student Motivation**, **(2) Challenges in Classroom Integration and Time Management**, and **(3) Suggestions for Enhanced Teacher-Facing Features**.

5.3.2.1 Acknowledgment of Increased Student Motivation

The most consistent theme emerging from the teacher feedback was the platform's positive impact on student motivation. Teachers unanimously observed a notable increase in engagement, particularly among students who were previously reluctant readers. The gamified elements were cited as a primary facilitator, transforming reading from a passive, solitary activity into a more dynamic and interactive experience. One teacher noted:

"Foi notável ver o entusiasmo dos alunos menos participativos. A competição saudável dos rankings e o objetivo de ganhar pontos transformaram a leitura numa atividade mais dinâmica e apelativa para eles."

"It was remarkable to see the enthusiasm of the less-participative students. The healthy competition from the rankings and the goal of earning points transformed reading into a more dynamic and appealing activity for them."

This feedback confirms that the platform served as an effective catalyst for engagement, leveraging extrinsic motivators to foster interest in reading tasks.

5.3.2.2 Challenges in Classroom Integration and Time Management

While positive about the student response, teachers also identified practical barriers to implementation. The primary challenge revolved around the integration of the platform into an already crowded curriculum and the management of class time. Monitoring individual student progress, providing technical support, and linking platform activities to formal assessment requirements were noted as time-consuming tasks. As one educator explained:

"A principal dificuldade foi encontrar tempo na aula para garantir que todos estavam a acompanhar. Integrar o progresso da plataforma com a nossa avaliação formal também exigiu um esforço extra de planeamento."

"The main difficulty was finding time in class to ensure everyone was keeping up. Integrating the platform's progress with our formal assessments also required extra planning effort."

This highlights a critical facilitator for success: the need for dedicated time and clear strategies for embedding such digital tools within existing pedagogical workflows.

5.3.2.3 Suggestions for Enhanced Teacher-Facing Features

The third theme centered on actionable suggestions for improving the platform's utility for educators. Teachers expressed a strong desire for more detailed and insightful analytics on the teacher dashboard. While they could track completions, they sought deeper data to inform their instruction. A representative suggestion was:

"Gostaria de ter um painel de controlo mais detalhado, onde pudesse ver não só quem terminou, mas quais as perguntas do quiz em que a turma teve mais dificuldade. Isso seria muito útil para planear as aulas de remediação."

"I would like to have a more detailed dashboard, where I could see not only who finished, but which quiz questions the class struggled with the most. That would be very useful for planning remediation lessons."

This feedback underscores the potential of the platform not only as an engagement tool but also as a formative assessment instrument. Providing teachers with more granular data on student comprehension would significantly enhance its pedagogical value, allowing them to tailor their teaching to address specific learning gaps identified by the platform.

5.3.3 Emergent Themes

The comprehensive analysis of the platform's implementation reveals several cross-cutting themes that provide a holistic understanding of its impact. These themes synthesize the quantitative data, log analysis, and qualitative feedback from both students and teachers, highlighting the complex interplay between gamification, pedagogy, and student development.

5.3.3.1 The Dichotomy of Engagement: Structured vs. Autonomous Learning

A primary theme is the profound difference in engagement patterns based on age and pedagogical approach. The younger cohort (3rd–4th Grade) thrived within a highly structured environment. The exceptional success of the "O livro mágico do avô João" program, evidenced by the 4th grade's high average for book completions and points earned, underscores the efficacy of a guided, curriculum-driven model for this age group. Their engagement was high-volume and event-driven, but also more susceptible to drop-offs over time, as seen in the quiz progression data.

Conversely, the older cohort (5th–8th Grade) demonstrated a more autonomous and habitual form of engagement. While they completed fewer books on average, their significantly longer reading streaks and consistent, self-directed use of the end-of-book quizzes point to a more internalized and self-regulated motivation. This suggests that as students mature, the platform's role shifts from a direct driver of tasks to a supportive tool for independent learning habits.

5.3.3.2 Teacher Agency as a Critical Success Factor

The data consistently shows that the teacher's role is not merely supplementary but central to the platform's success. The teacher survey highlighted that while the platform was a powerful tool for motivating students, its effective implementation demanded significant effort in classroom integration, time management, and alignment with formal assessments. This "teacher agency" is the bridge between the platform's potential and its actual pedagogical impact. The success of the structured program for younger students was directly tied to the teacher's ability to facilitate it. This finding suggests that for gamified educational tools to be effective, they must be designed not only for the student but also with features that empower and support the teacher, such as the requested advanced analytics dashboard.

5.3.3.3 The Nuances of Gamification: Extrinsic Triggers vs. Intrinsic Habits

The analysis of gamification points revealed that the system was overwhelmingly successful at rewarding task completion, which accounted for the vast majority of points earned. This design effectively motivated students to complete high-value activities. However, it inadvertently de-emphasized the reward for forming daily habits, as evidenced by the relatively low percentage of points derived from streaks.

This highlights a key tension in gamification design. While extrinsic rewards (points for completion) are powerful triggers for action, the ultimate goal is to foster intrinsic motivation and

lasting habits. The data from the older students' longer streaks suggests that habit formation is possible, but the overall points economy was not optimized to encourage it. Future iterations should consider rebalancing the system to place greater value on consistency, thereby better supporting the transition from extrinsically motivated task completion to intrinsically driven daily reading.

5.3.3.4 The Quiz as a Mechanism of Academic Integrity

A final, crucial theme is the role of the quiz system as more than just an assessment tool—it functioned as a mechanism for academic integrity. The correlation analysis demonstrated that book completions were strongly tied to quiz participation. For the younger cohort, 100% of students who completed the structured book also engaged with its quizzes. For the older cohort, there was a clear positive correlation between the number of books completed and quizzes taken. This shows that the platform successfully prevented a common pitfall of gamification: students "gaming the system" by claiming rewards without performing the underlying work. By linking the high-value completion reward to a validation activity, the system ensured that the gamified incentives remained aligned with the primary educational goal of meaningful reading engagement.

5.4 Triangulation and Synthesis

This section serves to integrate the various data sources and emergent themes, creating a unified interpretation of the findings. By triangulating the quantitative results from system logs and surveys with the qualitative feedback from students and teachers, we can directly address the research questions that guided this study.

5.4.1 Integration of Quantitative and Qualitative Findings

The convergence of quantitative and qualitative data provides a robust validation of the study's conclusions. The emergent themes discussed previously are not isolated observations but are consistently supported across different data types, directly answering the core research questions.

RQ1: How do gamified interventions impact student reading engagement and comprehension?

Both data types converge to show a positive, albeit nuanced, impact. Quantitatively, the platform generated thousands of engagement events (reading sessions, quiz attempts), and the survey data indicated a perceived increase in motivation and self-efficacy. This is supported by the "Dichotomy of Engagement" and "Nuances of Gamification" themes. Qualitatively, students explicitly stated in open-ended responses that competing for points and seeing their progress motivated them. The analysis of quiz scores and completion rates provides a proxy for comprehension, suggesting that for engaged students, the platform supported positive learning outcomes.

RQ2 & RQ3: How can teacher involvement be effectively incorporated, and what factors affect teacher adoption?

The "Teacher Agency as a Critical Success Factor" theme directly addresses these questions. Quantitatively, the most successful program in terms of per-student engagement (points, book completions) was the highly structured, teacher-led initiative for the 4th grade. This demonstrates that effective incorporation involves teachers actively facilitating and integrating the platform into their curriculum. Qualitatively, the teacher survey feedback corroborates this. Teachers identified "time" and "curriculum integration" as primary barriers (factors affecting adoption) and requested more detailed analytics to better support their instructional role, highlighting how their involvement could be made more effective.

RQ4: How do gamification elements impact students of different age groups?

The "Dichotomy of Engagement: Structured vs. Autonomous Learning" theme is central to answering this question. The quantitative data clearly shows different primary outcomes for each group: younger students (3rd-4th Grade) excelled in high-volume, task-based metrics within a guided program, while older students (5th-8th Grade) demonstrated more consistent, habitual engagement, evidenced by their significantly longer reading streaks. This quantitative split is explained by qualitative developmental differences; younger students thrive on clear, extrinsically motivated tasks, while older students are more capable of forming self-directed habits. This confirms that gamification is not one-size-fits-all and its design and implementation must be adapted for different age groups.

Finally, the "Quiz as a Mechanism of Academic Integrity" theme is a finding supported across all data, demonstrating that the system's design successfully linked rewards to genuine effort, a critical aspect of effective educational gamification.

5.4.2 Comparison with Previous Work

The findings of this study both align with and extend existing literature in the fields of educational technology and motivational psychology. The observed effectiveness of points and leaderboards in boosting engagement aligns with foundational research on extrinsic motivation. Similarly, the desire for autonomy expressed by older students, and their subsequent success in forming habits, supports the principles of SDT, which posits that autonomy is a key psychological need for fostering intrinsic motivation.

The novelty and significance of this research lie in three specific areas. First, it provides a detailed, mixed-methods case study within the specific context of the Portuguese educational system, contributing valuable data to a region often underrepresented in gamification literature. Second, the direct comparison between a highly structured, teacher-led implementation for younger students and an autonomous model for older students provides a clear, evidence-based framework for age-differentiated design. Finally, the identification and validation of the quiz system as an explicit mechanism to ensure academic integrity offers a practical solution to a common problem in gamified systems, providing a model that can be adopted by future researchers and practitioners.

5.5 Discussion

5.5.1 Implications for Practice and Research

The results of this study offer several practical implications for educators, instructional designers, and school administrators. For teachers, it highlights the importance of actively integrating digital tools into their pedagogy rather than using them as passive supplements. For platform designers, the findings underscore the need for age-appropriate design and robust, teacher-facing analytics. For future research, this work opens avenues for longitudinal studies on the transition from extrinsic to intrinsic motivation and the long-term impact of gamified reading on academic performance.

5.6 Summary

In summary, this research demonstrates that a well-designed gamified platform can significantly enhance reading engagement in an educational setting. The study successfully identified different patterns of engagement between different age groups, underscored the critical role of teacher agency, and validated a mechanism to ensure academic integrity within a gamified system. These findings contribute valuable and actionable insights for the design and implementation of future educational technologies.

Chapter 6

Conclusion

6.1 Summary of Research

This thesis involved the design, implementation and evaluation of a gamified reading platform native to the cloud, with the aim of addressing the challenge of declining reading engagement in a real-world educational setting. Developed in partnership with Escola Global in Portugal, the platform was integrated directly into the school's existing Microsoft Teams ecosystem [Microsoft Corporation \(2024c\)](#), leveraging Azure Functions [Microsoft Corporation \(2024a\)](#) and Cosmos DB [Microsoft Corporation \(2024b\)](#) to ensure scalability and reliability. The research was grounded in motivational psychology, applying principles from SDT and Flow Theory to create an engaging and pedagogically sound user experience.

A central focus of the study was to investigate how different gamification mechanics could motivate diverse student populations. The platform was specifically designed with differentiated interfaces and features for two distinct age cohorts: a structured teacher-led experience for younger students (Grades 3–4) and a more autonomous, choice-driven model for older students (Grades 5–8). Through a mixed-method approach that combined system log analysis, quantitative survey data, and qualitative feedback from both students and teachers, this research evaluated the impact of the platform on reading habits, comprehension, and motivation.

6.2 Key Findings

The empirical evaluation of the platform yielded several key findings that directly answer the initial research questions:

- **Gamification Positively Impacts Engagement, with Nuances:** The platform successfully increased engagement, evidenced by thousands of reading and quiz events. However, the nature of this engagement differed significantly by age. Younger students responded to high-value, task-oriented rewards (points for quizzes and completions), while older students were more influenced by mechanics fostering habit and autonomy (streaks and book choice).

- **Teacher Agency is a Critical Mediator of Success:** The most effective implementation, in terms of per-student engagement, was the highly structured program for the 4th grade, which was actively facilitated by the teacher. This finding, supported by teacher feedback on the importance of integration and analytics, confirms that teacher involvement is not supplementary but essential for translating a digital tool's potential into pedagogical success.
- **Gamification Design Must Be Developmentally Appropriate:** The study provides clear evidence that a one-size-fits-all approach to gamification is ineffective. The "dichotomy of engagement" between the younger, extrinsically motivated cohort and the older, more autonomous cohort highlights the necessity of designing age-differentiated features that align with students' developmental stages.
- **The Quiz System Serves a Dual Role:** Beyond measuring comprehension, the quiz system functioned as a crucial mechanism for ensuring academic integrity. The strong correlation between book completions and quiz attempts confirmed that students could not simply "game the system" for points, thereby preserving the educational value of the rewards.

6.3 Contributions

This research offers several significant contributions to the fields of educational technology and software engineering.

First, it establishes a clear, evidence-based framework for age-differentiated gamification. By designing, implementing, and evaluating two distinct engagement models—a structured, teacher-led model for younger students and an autonomous, choice-driven model for older students—this study moves beyond generic gamification principles. It provides actionable insights into how specific mechanics align with the developmental needs of different age groups, demonstrating that younger learners thrive on extrinsic rewards within guided tasks, while older learners are more motivated by features that support autonomy and habit formation, such as streaks and self-selection of reading material.

Second, the study presents a validated model for teacher-centric design in educational technology. The research foregrounds the concept of "teacher agency," showing that the most successful educational outcomes were achieved when teachers were empowered as active facilitators, not passive supervisors. This contribution is made concrete through the platform's teacher-facing dashboards and analytics, which provide a practical model for how to equip educators with the tools they need to monitor progress, differentiate instruction, and seamlessly integrate digital activities into their existing pedagogical workflows.

Third, this work serves as a valuable case study within a specific and underrepresented context. By conducting the research within the Portuguese educational system, this thesis contributes important mixed-methods data to a geographical and cultural context often overlooked in mainstream gamification literature. This enhances the cross-cultural understanding of these interventions and

provides a crucial data point for researchers comparing the implementation of educational technology across different national systems.

Finally, the research delivers a replicable technical architecture for scalable and integrated educational tools. The cloud-native platform, built on Azure and embedded within Microsoft Teams [Microsoft Corporation \(2024c\)](#), serves as a modern technical blueprint for other institutions. It demonstrates how to leverage existing, widely adopted enterprise ecosystems to lower the barrier to adoption for new educational technologies, ensuring security, scalability, and maintainability without requiring schools to invest in separate, standalone infrastructures.

6.4 Limitations

While this study provides valuable insights, it is important to acknowledge its limitations to ensure a balanced interpretation of the findings. First, the research was conducted within the context of a single private school. This environment may possess unique characteristics, such as student demographics, access to technology, and levels of parental involvement, that differ from public schools or other educational systems. Consequently, the generalizability of the findings to a broader population should be approached with caution. Second, the two-month duration of the main intervention, while sufficient to capture initial engagement trends and novelty effects, is not long enough to draw definitive conclusions about the long-term sustainability of the observed reading behaviors. A longer study would be required to determine whether the increased engagement translates into lasting reading habits once the initial novelty of the platform has diminished.

Third, the small sample size ($n = 41$) for the second and third cycle postintervention questionnaire limits the statistical power of any significance tests (e.g., paired-sample t-tests), meaning that while trends can be observed, broader statistical claims must be made with care.

6.5 Future Work

The findings and limitations of this study suggest several promising directions for future research. Longitudinal studies, extending beyond a single academic year, are needed to investigate the long-term effects of gamification on intrinsic motivation and to track the evolution of reading habits over time. Expanding the research to include a more diverse range of schools, including public institutions, would test the generalizability of the age-differentiated model. From a technical perspective, future work could explore the use of machine learning to create adaptive challenges that personalize the learning experience based on individual student performance and progress, further enhancing the platform's pedagogical efficacy.

6.6 Closing Remarks

This thesis confirms that thoughtfully designed gamification can be a powerful tool for addressing the persistent challenge of declining reading engagement. By grounding technical innovation

in sound pedagogical theory, prioritizing the active involvement of teachers, and respecting the developmental needs of students, it is possible to create digital learning environments that are both motivating and meaningful. The success of this platform in fostering engagement, validating effort, and supporting both structured and autonomous learning offers a replicable model for educational innovation. As technology becomes ever more integrated into the classroom, the insights from this research provide a clear path forward for developing effective, engaging, and equitable educational tools for the 21st century.

Chapter 7

Alignment with the Sustainable Development Goals

7.1 Introduction

This final chapter reflects on the contributions of this dissertation in the broader context of the United Nations' Sustainable Development Goals (SDGs). The work undertaken in the development and validation of a gamified reading platform not only addresses specific pedagogical challenges but also aligns with global goals for a more equitable, inclusive, and sustainable future. The following analysis details how this project directly contributes to several SDGs, with a particular emphasis on Quality Education (SDG 4).

7.2 SDG 4: Quality Education

The most direct and impactful alignment of this work is with SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. The developed platform addresses the core of this objective by focusing on literacy, a fundamental skill for academic success and personal development.

The contribution is manifested in several ways. Firstly, by combating the decline in reading interest, the platform directly aims to improve learning outcomes (Target 4.1). By making reading a more dynamic and motivating activity, especially for previously disengaged students, the project helps more young people acquire essential literacy skills. Secondly, the system promotes equity (Target 4.6). Its digital and scalable nature allows it to be implemented in diverse contexts, with the potential to support students with different learning paces and motivational needs. The qualitative feedback from teachers, which highlighted increased enthusiasm among “less participative” students, validates this potential. Finally, the platform fosters skills relevant for the 21st century (Target 4.4), such as digital literacy, by integrating reading into technological ecosystems (Microsoft Teams) that are already part of daily school life.

7.3 SDG 10: Reduced Inequalities

This project also contributes to SDG 10: Reduce inequality within and among countries. In the educational context, inequalities often manifest in access to quality resources and in different levels of student engagement. The platform addresses this issue by offering a low-cost and highly accessible tool. By being integrated into Microsoft Teams [Microsoft Corporation \(2024c\)](#), an existing infrastructure at the partner school, the solution avoids the need for additional hardware or software investments, reducing the barrier to access. Additionally, the teacher dashboard, which allows for monitoring individual progress, empowers educators to identify and support students who are falling behind, enabling a more targeted and, consequently, more equitable pedagogical intervention.

7.4 SDG 9: Industry, Innovation and Infrastructure

The technical dimension of the project aligns with SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. The development of the platform as a cloud-native solution, using modern technologies like Azure Functions [Microsoft Corporation \(2024a\)](#) and Cosmos DB [Microsoft Corporation \(2024b\)](#), represents an innovation in the field of software engineering applied to education. The work demonstrates how to build a resilient, scalable, and easily maintainable technological infrastructure capable of serving a school community. This project serves as a replicable model for the development of other digital educational tools, promoting innovation within the educational technology sector.

7.5 SDG 17: Partnerships for the Goals

Finally, the work methodology adopted in this dissertation exemplifies the spirit of SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development. The project's success was intrinsically dependent on the partnership established between academia (FEUP) and civil society (Escola Global). Through a co-design process that actively involved teachers, it was possible to develop a solution that is not only technically robust but also pedagogically relevant and aligned with the real needs of a classroom. This multi-stakeholder collaboration is a model of how research and development can be conducted to ensure that technological innovation translates into positive and sustainable social impact.

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.1 NoSQL Database JSON Schema

The following JSON structure represents the main collections and documents used in the gamified reading platform. Example documents are provided for each entity.

```

1  {
2    "Students": [
3      {
4        "id": "stu_001",
5        "name": "Alice Silva",
6        "email": "alice.silva@email.com",
7        "grade": "4",
8        "class": "A",
9        "cycle": "2",
10       "booksRead": ["bk_101", "bk_102"]
11     }
12   ],
13   "Logs": [
14     {
15       "id": "log_1001",
16       "email": "alice.silva@email.com",
17       "bookId": "bk_101",
18       "pageNumber": 20,
19       "status": "completed",
20       "timestamp": "2025-03-10T17:45:00Z",
21       "details": "Finished chapter 1"
22     }
23   ],
24   "GamificationPoints": [
25     {
26       "id": "gp_001",
27       "email": "alice.silva@email.com",
28       "type": "reading",
29       "points": 50,
30       "description": "Read 20 pages",
31       "earnedAt": "2025-03-10T18:00:00Z",
32       "metadata": {
33         "bookId": "bk_101",
34         "streak": 3,
35         "date": "2025-03-10",
36         "pagesRead": 20
37       }
38     }
39   ],
40   "Quiz": [
41     {
42       "id": "quiz_001",
43       "bookId": "bk_101",
44       "chapter": 1,
45       "questions": [

```

```

46      {
47        "statement": "What is the main theme of chapter 1?",
48        "alternatives": [
49          "Friendship",
50          "Adventure",
51          "Magic",
52          "Science"
53        ],
54        "correct": [0]
55      }
56    ],
57    "deadline": "2025-03-15T23:59:59Z"
58  }
59 ],
60 "QuizAnswers": [
61   {
62     "id": "qa_001",
63     "email": "alice.silva@email.com",
64     "bookId": "bk_101",
65     "chapter": "1",
66     "answers": ["Friendship"],
67     "type": "multiple-choice",
68     "submittedAt": "2025-03-12T20:00:00Z",
69     "quizId": "quiz_001",
70     "score": 100
71   }
72 ],
73 "Challenges": [
74   {
75     "id": "ch_001",
76     "title": "Read 50 Pages",
77     "description": "Complete reading 50 pages in a week",
78     "type": "reading",
79     "bookId": "bk_101",
80     "grade": "4",
81     "class": "A",
82     "dateBegin": "2025-03-01",
83     "dateEnd": "2025-03-07",
84     "meta": {
85       "type": "reading",
86       "points": 100,
87       "quiz": {
88         "type": "chapter",
89         "bookId": "bk_101",
90         "chapter": 1,
91         "part": 1
92       }
93     },
94     "badge": {

```

```
95     "id": "b001",
96     "name": "50 Pages Champion"
97   },
98   "createdBy": "teacher_001",
99   "earnedAt": "2025-03-07T18:00:00Z",
100   "status": "active"
101 }
102 ],
103 "ChallengeProgress": [
104   {
105     "id": "cp_001",
106     "email": "alice.silva@email.com",
107     "challengeId": "ch_001",
108     "progress": 50,
109     "status": "completed",
110     "finished": true,
111     "dateFinished": "2025-03-07T18:00:00Z"
112   }
113 ],
114 "Notifications": [
115   {
116     "id": "not_001",
117     "email": "alice.silva@email.com",
118     "title": "New Challenge Available!",
119     "message": "Try to read 50 pages this week.",
120     "type": "challenge",
121     "isRead": false,
122     "createdAt": "2025-03-01T09:00:00Z",
123     "ticketId": "tick_001"
124   }
125 ],
126 "Suporte": [
127   {
128     "id": "sup_001",
129     "email": "alice.silva@email.com",
130     "name": "Alice Silva",
131     "message": "Cannot access the quiz.",
132     "timestamp": "2025-03-12T19:00:00Z",
133     "status": "open",
134     "createdAt": "2025-03-12T19:00:00Z"
135   }
136 ],
137 "Classes": [
138   {
139     "name": "4A",
140     "teachers": ["teacher_001"],
141     "students": ["stu_001", "stu_002"],
142     "assignments": []
143   }
```

```
144     ]  
145 }
```

Listing 1: Example NoSQL Database JSON Representation

Appendix A: Pre-Intervention Questionnaire (1st Cycle) in Portuguese

Questionário sobre Hábitos de Leitura e Compreensão - 1.º CICLO

Introdução Olá! O meu nome é José Assunção e estou a desenvolver a minha tese de mestrado em Engenharia de Software na FEUP (Faculdade de Engenharia da Universidade do Porto). O meu projeto pretende incentivar a leitura entre os alunos através de uma aplicação gamificada, tornando a experiência mais envolvente e interativa.

Este formulário tem como objetivo compreender os hábitos de leitura e a forma como as crianças interpretam os textos antes da utilização da aplicação. Com estes dados, será possível comparar os resultados no final do estudo e avaliar o impacto da solução.

Todas as respostas são confidenciais e utilizadas exclusivamente para fins académicos. A participação é voluntária, mas muito importante para o sucesso do projeto. Obrigado pelo apoio!

Questões

1. Quantas vezes por semana costumavas ler um livro ou uma história fora da escola?

- Todos os dias
- Algumas vezes por semana
- Quase nunca
- Nunca

2. O que te faz querer ler um livro? (Podes escolher mais do que uma)

- Gosto porque aprendo coisas novas
- Gosto porque as histórias são divertidas
- Leio apenas porque a escola pede
- Prefiro jogar ou ver vídeos
- Outra

3. O que gostas mais de ler? (Podes escolher mais do que uma)

- Contos infantis
- Banda desenhada (Turma da Mónica, Astérix, Tio Patinhas)
- Livros de aventuras (Diário de um Banana, Clube das Chaves, Harry Potter)
- Revistas e jornais infantis
- Outra

4. Quem costuma escolher os livros que lêes? (Podes escolher mais do que uma)

- Eu escolho

- Os meus pais ou familiares sugerem
- O professor(a) recomenda
- Os meus amigos dão sugestões

5. Onde costumavas ler com mais atenção e sem distrações?

- Na escola, quando a professora pede
- Em casa, no meu quarto ou na sala
- Em qualquer sítio, sempre que tenho um livro
- Tenho dificuldade em concentrar-me na leitura

6. Costumas ler histórias ou livros sem que seja obrigatório na escola?

- Sim, adoro ler!
- Às vezes, se a história for interessante.
- Só quando preciso para a escola.
- Não gosto de ler.

7. Quando lêes um livro, costumavas terminá-lo ou ficas pelo início?

- Leio até ao fim porque gosto de saber o que acontece.
- Depende do livro, às vezes perco o interesse.
- Normalmente não termino os livros.

8. Costumas lembrar-te de onde paraste num livro ou precisas de ajuda?

- Lembro-me sempre onde parei.
- Às vezes esqueço-me e tenho de voltar a reler.
- Nunca me lembro e começo do início.

9. Os teus amigos mais próximos costumam ler livros?

- Sim, muitos dos meus amigos gostam de ler
- Alguns dos meus amigos leem, mas não todos
- Quase nenhum dos meus amigos lê livros
- Nenhum dos meus amigos gosta de ler

10. Quando lêes um livro, qual o formato que mais gostas? (Podes escolher mais do que uma)

- Livro em papel
- Livro digital (tablet, computador ou telemóvel)

- Audiolivro
- Banda desenhada
- Não gosto de ler

11. Gostarias de ler mais histórias se pudesses ganhar pontos e prémios por isso?

- Sim, seria muito divertido!
- Talvez, se os desafios forem fáceis
- Talvez, se os desafios forem interessantes
- Não
- Outra

12. Que tipo de prémios gostarias de ganhar por leres mais? (Podes escolher mais do que uma)

- Medalhas virtuais e troféus
- Personagens ou avatares personalizados na app
- Desbloquear novas histórias ou missões secretas
- Poder desafiar amigos para ver quem lê mais

13. Se pudesses escolher um tipo de desafio de leitura, qual preferias?

- Desafios individuais para alcançar objetivos pessoais
- Competições para ver quem lê mais
- Desafios em equipa, onde todos ajudam
- Não gosto de desafios de leitura
- Outra

14. Gostarias que a aplicação acompanhasse quantos livros ou páginas já leste e te mostrasse o teu progresso?

- Sim, adorava ver o meu avanço e tentar ler mais!
- Talvez, mas não gosto muito de ser acompanhado.
- Não acho que isso seja importante para mim.

15. Costumas participar em desafios de leitura na escola ou em casa?

- Sim! Já fiz desafios e gostei muito.
- Já fiz, mas não gostei muito.
- Nunca participei, mas gostaria de experimentar.
- Nunca participei e não tenho interesse.

Appendix B: Pre-Intervention Questionnaire (2nd Cycle) in Portuguese

Questionário sobre Hábitos de Leitura e Compreensão - 2.º CICLO

Introdução Olá! O meu nome é José Assunção e estou a desenvolver a minha tese de mestrado em Engenharia de Software na FEUP (Faculdade de Engenharia da Universidade do Porto). O meu projeto pretende incentivar a leitura entre os alunos através de uma aplicação gamificada, tornando a experiência mais envolvente e interativa.

Este formulário tem como objetivo compreender os hábitos de leitura e a forma como as crianças interpretam os textos antes da utilização da aplicação. Com estes dados, será possível comparar os resultados no final do estudo e avaliar o impacto da solução.

Todas as respostas são confidenciais e utilizadas exclusivamente para fins académicos. A participação é voluntária, mas muito importante para o sucesso do projeto. Obrigado pelo apoio!

Questões

Hábitos de Leitura e Motivação

1. Quantas vezes por semana costumas ler um livro ou uma história fora da escola?

- Todos os dias
- Algumas vezes por semana
- Quase nunca
- Nunca

2. Costumas ler livros por iniciativa própria ou apenas quando é obrigatório?

- Leio porque gosto, mesmo quando não é obrigatório.
- Leio às vezes, mas só se a história for interessante.
- Leio apenas quando é pedido na escola.
- Evito ler sempre que posso.

3. O que gostas mais de ler? (Podes escolher mais do que uma)

- Livros de aventura e fantasia (ex: Harry Potter, O Diário de um Banana)
- Banda desenhada (Turma da Mónica, Astérix, Tio Patinhas)
- Mangá (ex.: My Hero Academia, Dragon Ball)
- Mistérios e suspense (ex.: Goosebumps, Sherlock Holmes, histórias de detetives)
- Histórias curtas e contos
- Histórias digitais (Wattpad, fanfics, blogs de histórias)
- Prefiro ver séries, jogar videojogos ou estar nas redes sociais

- Outra

4. Onde costumás descobrir novos livros ou histórias? (Podes escolher mais do que uma)

- Em bibliotecas ou livrarias.
- Em redes sociais (TikTok, Instagram, YouTube).
- Em plataformas digitais (ex: Wattpad, Kindle, sites de fanfics).
- Nas aulas, através dos professores.
- Através de amigos ou familiares.

5. Quando precisas de escolher um livro para ler, quem toma a decisão?

- Eu escolho sozinho.
- Não costumo escolher livros para ler.
- Escolho apenas o que é pedido pela escola.
- Os meus pais ou professores sugerem.
- Outra

6. Onde costumás ler com mais atenção e sem distrações?

- Na escola, quando a professora pede
- Em casa, no meu quarto ou na sala
- Em qualquer sítio, sempre que tenho um livro
- Tenho dificuldade em concentrar-me na leitura

7. Costumas ler histórias ou livros sem que seja obrigatório na escola?

- Sim, adoro ler!
- Às vezes, se a história for interessante.
- Só quando preciso para a escola.
- Não gosto de ler.

8. Quando lêes um livro, costumás terminá-lo ou ficas pelo início?

- Leio até ao fim porque gosto de saber o que acontece.
- Depende do livro, às vezes perco o interesse.
- Normalmente não termino os livros.

9. Os teus amigos mais próximos costumam ler livros?

- Sim, falamos sobre livros e trocamos sugestões.
- Alguns dos meus amigos leem, mas não todos.

- Quase nenhum dos meus amigos lê livros.
- Nenhum dos meus amigos gosta de ler.

10. Costumas ler conteúdos em formato digital?

- Sim, leio frequentemente em telemóvel, tablet ou computador.
- Às vezes, mas prefiro livros físicos.
- Raramente leio em formato digital.
- Nunca leio em formato digital.
- Não gosto de ler.

11. Que tipo de conteúdos digitais costumavas ler?

- E-books ou livros digitais.
- Notícias ou artigos online.
- Histórias em plataformas como Wattpad ou sites de fanfics.
- Posts e comentários em redes sociais.
- Não costumo ler nada digital.

Gamificação e Acompanhamento do Progresso

12. Gostarias de ler mais histórias se pudesses ganhar pontos e prémios por isso?

- Sim, seria muito divertido!
- Talvez, se os desafios forem interessantes.
- Não
- Outra

13. Que tipo de prémios gostarias de ganhar por leres mais? (Podes escolher mais do que uma)

- Medalhas virtuais e troféus
- Personagens ou avatares personalizados na app
- Desbloquear novas histórias ou missões secretas
- Poder desafiar amigos para ver quem lê mais

14. Gostarias que a aplicação acompanhasse quantos livros ou páginas já leste e te mostrasse o teu progresso?

- Sim! Gostava de ver o meu avanço.
- Talvez, mas não gosto muito de ser acompanhado.

- Talvez, se fosse útil para melhorar.
- Não acho que isso seja importante para mim.

15. Preferias que os desafios de leitura fossem individuais ou em grupo?

- Individuais, gosto de competir sozinho.
- Em grupo, gosto de colaborar com amigos.
- Não gosto de desafios de leitura.

16. Se pudesses ver quanto tempo passas a ler por dia, achas que isso te ajudaria a ler mais?

- Sim! Gostava de saber quanto tempo leio.
- Talvez, se pudesse comparar com amigos.
- Não, prefiro não pensar nisso.

17. Que tipo de desafios preferias? (Podes escolher mais do que uma)

- Pequenos desafios diários (ex.: ler 10 minutos por dia).
- Desafios mais longos (ex.: ler um livro inteiro num mês).
- Prefiro escolher o que ler sem desafios.
- Outra

Livros Curriculares e Leitura na Escola

18. A escola incentiva a leitura de uma forma que te motiva?

- Sim, as atividades na escola motivam-me a ler mais.
- Mais ou menos, algumas atividades são interessantes.
- Não, acho as atividades de leitura na escola aborrecidas.
- Outra

19. Se a escola usasse mais tecnologia na leitura, achas que lerias mais?

- Sim! Se fosse mais interativo, eu teria mais vontade de ler.
- Talvez, mas depende do tipo de tecnologia usada.
- Não, prefiro ler de forma tradicional.

20. Gostas dos livros que são pedidos para ler na escola?

- Sim, gosto da maioria dos livros.
- Alguns são interessantes, mas outros não.

- Não gosto da maioria dos livros escolares.
- Nunca li nenhum livro que a escola pediu.

21. Quando tens de ler um livro para a escola, consegues acompanhar bem a leitura?

- Sim, leio no ritmo certo e compreendo tudo.
- Consigo acompanhar, mas às vezes tenho dificuldades.
- Acho difícil ler no ritmo pedido e fico atrasado.
- Normalmente não leio os livros até ao fim.

22. O que tornaria a leitura dos livros escolares mais interessante para ti? (Podes escolher mais do que uma)

- Poder escolher entre diferentes livros.
- Ter mais tempo para ler na escola.
- Discutir os livros de forma mais interativa, como jogos ou desafios.
- Ter resumos ou vídeos explicativos antes da leitura.
- Não acho que nada tornaria os livros mais interessantes.

Tecnologia e Redes Sociais na Leitura

23. Costumas ver recomendações de livros em redes sociais?

- Sim, sigo páginas ou perfis sobre livros (ex.: TikTok, BookTok, Instagram, YouTube).
- Às vezes vejo, mas não me influenciam muito.
- Não, nunca presto atenção a isso.

24. Se um livro fosse popular nas redes sociais, terias mais vontade de o ler?

- Sim, se toda a gente estivesse a falar sobre ele.
- Talvez, se o tema me interessasse.
- Não, não escolho livros por influência das redes sociais.

25. Gostarias de participar no teste da aplicação?

- Sim! Quero experimentar a aplicação e ajudar!
- Não, prefiro não participar.
- Outra

Appendix C: Pre-Intervention Questionnaire (3rd Cycle) in Portuguese

Questionário sobre Hábitos de Leitura - 3.º CICLO

Introdução Olá! O meu nome é José Assunção e estou a desenvolver a minha tese de mestrado em Engenharia de Software na FEUP (Faculdade de Engenharia da Universidade do Porto). O meu projeto pretende incentivar a leitura entre os alunos através de uma aplicação gamificada, tornando a experiência mais envolvente e interativa.

Este formulário tem como objetivo compreender os hábitos de leitura e a forma como as crianças interpretam os textos antes da utilização da aplicação. Com estes dados, será possível comparar os resultados no final do estudo e avaliar o impacto da solução.

Todas as respostas são confidenciais e utilizadas exclusivamente para fins académicos. A participação é voluntária, mas muito importante para o sucesso do projeto. Obrigado pelo apoio!

Questões

Hábitos de Leitura e Motivação

1. Quantas vezes por semana costumas ler um livro ou uma história fora da escola?

- Todos os dias
- Algumas vezes por semana
- Quase nunca
- Nunca

2. Costumas ler livros por iniciativa própria ou apenas quando é obrigatório?

- Leio porque gosto, mesmo quando não é obrigatório.
- Leio às vezes, mas só se a história for interessante.
- Leio apenas quando é pedido na escola.
- Evito ler sempre que posso.

3. O que gostas mais de ler? (Podes escolher mais do que uma)

- Livros de aventura e fantasia (ex.: Harry Potter, O Diário de um Banana, O Clube das Chaves)
- Banda desenhada e mangá (ex.: Turma da Mónica, Astérix, One Piece, Naruto)
- Mistérios e suspense (ex.: Goosebumps, Sherlock Holmes, histórias de detetives)
- Ficção científica ou distopia (ex.: Jogos Vorazes, Maze Runner)
- Romance e dramas juvenis
- Histórias digitais (Wattpad, fanfics, webnovels)
- Revistas e jornais infantis

- Notícias e artigos informativos
- Prefiro ver séries, jogar videojogos ou estar nas redes sociais
- Outra

4. Onde costumavas descobrir novos livros ou histórias? (Podes escolher mais do que uma)

- Nas aulas, através dos professores.
- Em bibliotecas ou livrarias.
- Através de amigos ou familiares.
- Em redes sociais (TikTok, Instagram, YouTube).
- Em plataformas digitais (ex.: Wattpad, Kindle, sites de fanfics).

5. Quando precisas de escolher um livro para ler, quem toma a decisão?

- Eu escolho sozinho.
- Os meus pais ou professores sugerem.
- Escolho apenas o que é pedido pela escola.
- Não costumo escolher livros para ler.
- Outra

6. O que te impede de ler mais? (Podes escolher mais do que uma)

- Falta de tempo.
- Prefiro ver séries, jogar ou estar no telemóvel.
- Não encontro livros interessantes.
- Acho a leitura cansativa ou difícil.
- Outra

7. Onde costumavas ler com mais atenção e sem distrações?

- Na escola, quando a professora pede
- Em casa, no meu quarto ou na sala
- Em qualquer sítio, sempre que tenho um livro
- Tenho dificuldade em concentrar-me na leitura

8. Costumas ler histórias ou livros sem que seja obrigatório na escola?

- Sim, adoro ler!
- Às vezes, se a história for interessante.
- Só quando preciso para a escola.

- Não gosto de ler.

9. Quando lêes um livro, costumás terminá-lo ou ficas pelo início?

- Leio até ao fim porque gosto de saber o que acontece.
- Depende do livro, às vezes perco o interesse.
- Normalmente não termino os livros.

10. Porque gostas (ou não gostas) de ler?

Resposta aberta

11. O que melhor descreve a tua relação com a leitura?

- Adoro ler e faço-o regularmente.
- Gosto de ler, mas nem sempre tenho tempo.
- Só leio quando preciso para a escola.
- Não gosto de ler e evito sempre que posso.
- Outra

12. Os teus amigos falam sobre livros ou recomendam-te leituras?

- Sim, falamos e trocamos sugestões.
- Às vezes, mas não é algo frequente.
- Não, quase ninguém no meu grupo de amigos lê.
- Não sei, nunca falamos sobre isso.

13. Costumas ler conteúdos em formato digital?

- Sim, leio frequentemente em telemóvel, tablet ou computador.
- Às vezes, mas prefiro livros físicos.
- Raramente leio em formato digital.
- Nunca leio em formato digital.
- Não gosto de ler.

Gamificação e Desafios

14. Gostarias de ganhar pontos e prémios ao ler mais histórias?

- Sim, seria muito divertido!
- Talvez, se os desafios fossem interessantes.
- Não gosto de desafios ou prémios na leitura.

- Outra

15. Que tipo de desafios preferias? (Podes escolher mais do que uma)

- Pequenos desafios diários (ex.: ler 10 minutos por dia).
- Desafios mais longos (ex.: ler um livro inteiro num mês).
- Prefiro escolher o que ler sem desafios.
- Outra

16. Que tipo de prémios gostarias de ganhar por leres mais? (Podes escolher mais do que uma)

- Medalhas virtuais e troféus
- Personagens ou avatares personalizados na app
- Desbloquear novas histórias ou missões secretas
- Poder desafiar amigos para ver quem lê mais

17. Se houvesse um desafio de leitura com os teus colegas, tentarias ler mais para ganhar?

- Sim, gosto de competir e tentar ganhar.
- Talvez, se fosse uma competição amigável.
- Não gosto de desafios de leitura.

18. Gostarias que a aplicação acompanhasse quantos livros ou páginas já leste e te mostrasse o teu progresso?

- Sim! Gostava de ver o meu avanço.
- Talvez, mas não gosto muito de ser acompanhado.
- Talvez, se fosse útil para melhorar.
- Não acho que isso seja importante para mim.

19. Se pudesses escolher um tipo de desafio de leitura, qual preferias?

- Desafios individuais para alcançar objetivos pessoais.
- Competições para ver quem lê mais.
- Desafios em equipa, onde todos contribuem para um objetivo.
- Não gosto de desafios de leitura.

20. Se pudesses ver quanto tempo passas a ler por dia, achas que isso te ajudaria a ler mais?

- Sim! Gostava de saber quanto tempo leio.
- Talvez, se pudesse comparar com amigos.
- Não, prefiro não pensar nisso.

Tecnologia e Leitura Escolar

21. Já usaste alguma aplicação para acompanhar os teus hábitos de leitura?

- Goodreads
- StoryGraph
- Kindle Reading Tracker
- Já ouvi falar, mas nunca usei.
- Não, nunca usei nenhuma app para isso.
- Nunca usei.

22. Se já usaste alguma app, o que mais gostaste nela?

- Registrar os livros lidos
- Definir metas de leitura
- Receber recomendações personalizadas
- Partilhar progresso com amigos
- Não usei nenhuma, mas gostava de experimentar.
- Nunca usei.

23. A escola incentiva a leitura de uma forma que te motiva?

- Sim, as atividades na escola motivam-me a ler mais.
- Mais ou menos, algumas atividades são interessantes.
- Não, acho as atividades de leitura na escola aborrecidas.

24. Se a escola usasse mais tecnologia na leitura, achas que lerias mais?

- Sim! Se fosse mais interativo, eu teria mais vontade de ler.
- Talvez, mas depende do tipo de tecnologia usada.
- Não, prefiro ler de forma tradicional.

25. Gostas dos livros que são pedidos para ler na escola?

- Sim, gosto da maioria dos livros.
- Alguns são interessantes, mas outros não.
- Não gosto da maioria dos livros escolares.
- Nunca li nenhum livro que a escola pediu.

26. Quando tens de ler um livro para a escola, consegues acompanhar bem a leitura?

- Sim, leio no ritmo certo e compreendo tudo.

- Consigo acompanhar, mas às vezes tenho dificuldades.
- Acho difícil ler no ritmo pedido e fico atrasado.
- Normalmente não leio os livros até ao fim.

27. O que tornaria a leitura dos livros escolares mais interessante para ti? (Podes escolher mais do que uma)

- Poder escolher entre diferentes livros.
- Ter mais tempo para ler na escola.
- Discutir os livros de forma mais interativa, como jogos ou desafios.
- Ter resumos ou vídeos explicativos antes da leitura.
- Não acho que nada tornaria os livros mais interessantes.
- Outra

28. Costumas ver recomendações de livros em redes sociais?

- Sim, sigo páginas ou perfis sobre livros (ex.: TikTok, BookTok, Instagram, YouTube).
- Às vezes vejo, mas não me influenciam muito.
- Não, nunca presto atenção a isso.

29. Se um livro fosse popular nas redes sociais, terias mais vontade de o ler?

- Sim, se toda a gente estivesse a falar sobre ele.
- Talvez, se o tema me interessasse.
- Não, não escolho livros por influência das redes sociais.

30. Gostarias de participar no teste da aplicação?

- Sim! Quero experimentar a aplicação e ajudar!
- Não, prefiro não participar.

Appendix D: Post-Intervention Questionnaire (2nd & 3rd Cycles) in Portuguese

Questionário Final sobre Leitura e Aplicação Gamificada – 2.º e 3.º Ciclo

Introdução Olá! O meu nome é José Assunção e estou a terminar a minha tese de mestrado em Engenharia de Software na FEUP. Agora que já usaste a aplicação de leitura, quero saber como foi a tua experiência, o que mudou nos teus hábitos de leitura e o que achaste da app. As tuas respostas são muito importantes e vão ajudar a melhorar a aplicação para outros alunos. Todas as respostas são confidenciais e só serão usadas para fins académicos. Obrigado pela tua participação!

Questões

Mudanças nos Hábitos de Leitura e Motivação

1. Achas que começaste a ler mais depois de usar a aplicação?

- Sim, leio muito mais agora
- Leio um pouco mais
- Leio igual a antes
- Leio menos
- não quero responder

2. Sentiste-te mais motivado(a) para ler por causa dos pontos, prémios ou desafios da aplicação?

- Sim, muito mais motivado(a)
- Um pouco mais motivado(a)
- Igual a antes
- Menos motivado(a)

3. Achas que a aplicação ajudou-te a compreender melhor os textos que leste?

- Sim, muito melhor
- Um pouco melhor
- Igual a antes
- Pior

4. Agora, costumavas escolher os teus livros ou desafios de leitura com mais autonomia?

- Sim, escolho mais sozinho(a)
- Às vezes escolho sozinho(a)

- Continuo a escolher com ajuda dos professores ou familiares
- Não escolho livros sozinho(a)

5. Achas que agora lembras-te melhor das histórias ou do que leste?

- Sim, muito melhor
- Um pouco melhor
- Igual a antes
- Pior

6. Achas que os teus amigos também ficaram mais interessados em ler por causa da aplicação?

- Sim, muitos ficaram
- Alguns ficaram
- Não notei diferença
- Não

7. Achas que a aplicação ajudou-te a participar mais em quizzes e desafios de leitura?

- Sim, muito mais
- Um pouco mais
- Igual a antes
- Menos

Experiência com a Aplicação

8. Gostaste de usar a aplicação de leitura?

- Gostei muito!
- Gostei
- Foi mais ou menos
- Não gostei

9. O que mais gostaste na aplicação? (podes escolher mais do que uma)

- Ganhar pontos e prémios
- Ver o meu progresso e os desafios
- Fazer quizzes sobre os livros
- Escolher livros diferentes
- Competir com amigos

- Outra

10. O que menos gostaste ou o que mudarias na aplicação?

Resposta aberta

11. Achaste fácil usar a aplicação?

- Sim, foi muito fácil
- Foi fácil, mas precisei de ajuda às vezes
- Tive algumas dificuldades

12. Gostavas de continuar a usar a aplicação para ler mais no futuro?

- Sim, adorava!
- Talvez
- Não

Uso de Tecnologia e Redes Sociais

13. Preferes desafios individuais ou em grupo?

- Individuais
- Em grupo
- Não gosto de desafios

14. Achas que os teus amigos também ficaram mais interessados em ler por causa da aplicação?

- Sim, muitos ficaram
- Alguns ficaram
- Não notei diferença
- Não

15. Como reagiste ao sistema de pontos, badges e rankings?

- Gostei muito, motivou-me
- Gostei, mas não mudou muito
- Não gostei
- Não percebi bem

16. Costumas usar aplicações ou redes sociais para descobrir livros?

- Sim, frequentemente

- Às vezes
- Raramente
- Nunca

17. Se um livro for popular nas redes sociais, isso aumenta a tua vontade de o ler?

- Sim, muito
- Um pouco
- Não

18. Queres deixar algum comentário ou sugestão sobre a tua experiência com a aplicação?

Resposta aberta

Appendix E: Teacher Perception Questionnaire in Portuguese

Percepção dos Professores sobre a Plataforma Gamificada de Leitura

Introdução Avaliação do impacto, usabilidade e sugestões de melhoria para a integração da gamificação na promoção da leitura escolar.

Questões

Experiência e Contexto

1. Já utilizou outras ferramentas digitais ou plataformas gamificadas antes desta experiência?

- Sim
- Não

2. Há quanto tempo leciona?

- Menos de 2 anos
- 2-5 anos
- 6-10 anos
- Mais de 10 anos

3. Em que anos de escolaridade leciona atualmente? (Pode escolher mais do que uma)

- 1.º ano
- 2.º ano
- 3.º ano
- 4.º ano
- 5.º ano
- 6.º ano
- 7.º ano
- 8.º ano
- 9.º ano

Usabilidade e Integração Curricular

4. Quão fácil foi integrar a aplicação nas suas práticas pedagógicas diárias?

- Muito fácil
- Fácil

- Neutro
- Difícil
- Muito difícil

5. Que barreiras ou desafios encontrou ao usar a aplicação com os seus alunos?

Resposta aberta

6. A aplicação ajudou a alinhar os objetivos de leitura com o currículo?

- Sim, totalmente
- Sim, em parte
- Não ajudou
- Não tenho a certeza

7. Quão útil foi o dashboard do professor para acompanhar o progresso dos alunos?

- Muito útil
- Útil
- Pouco útil
- Inútil

8. Sentiu que tinha autonomia suficiente para personalizar os desafios e quizzes?

- Sim, total autonomia
- Tinha alguma autonomia, mas queria mais
- Não, senti-me limitado(a)

9. Acha que a aplicação é adequada para os diferentes anos de escolaridade em que leciona?

- Sim, para todos
- Apenas para os mais novos
- Apenas para os mais velhos
- Não é adequada para nenhum

10. A integração com o Microsoft Teams facilitou a adoção e o uso da plataforma?

- Sim, muito
- Sim, um pouco
- Não fez diferença
- Não, complicou

Impacto nos Alunos

11. **Notou diferenças no envolvimento dos alunos com a leitura após a introdução da aplicação?**

Resposta aberta

12. **Observou diferenças na forma como os alunos mais novos (3º/4º ano) e os mais velhos (5º ao 8º) interagiram com a aplicação?**

Resposta aberta

13. **Qual foi o impacto que a aplicação teve nos hábitos de leitura dos alunos?**

Resposta aberta

14. **Quais mudanças notou na compreensão leitora dos alunos (não apenas na frequência, mas na qualidade das respostas e discussões)?**

Resposta aberta

15. **De que forma a aplicação influenciou a motivação intrínseca (gosto pela leitura) e extrínseca (recompensas, pontos) dos alunos?**

Resposta aberta

16. **Como descreveria a reação dos alunos ao sistema de pontos, badges e rankings?**

Resposta aberta

Sugestões e Comentários Finais

17. **Que tipo de melhorias ou funcionalidades adicionais considera importantes para a aplicação?**

Resposta aberta

18. **O que mais gostou na implementação da app em contexto de sala de aula?**

Resposta aberta

19. **Quais foram os principais desafios ou limitações que identificou durante o uso da aplicação?**

Resposta aberta

20. **Que sugestões tem para integrar ainda melhor a aplicação com as práticas pedagógicas e o currículo?**

Resposta aberta

21. Os alunos demonstraram maior autonomia ou iniciativa na escolha de livros e desafios?

Resposta aberta

22. O que facilitaria a adoção sustentável da aplicação na sua prática?

Resposta aberta