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INSTITUTO UNIVERSITÁRIO DE LISBOA

A gamified digital platform for collaborative knowledge creation: Schoolpedia

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Master in Computer Engineering

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TECNOLOGIAS E ARQUITETURA

Department of Information Science and Technology

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"Dedico esta dissertação à minha esposa Joana e à minha filha Camila, que são minha maior fonte de inspiração e amor. Que este trabalho as encoraje a seguirem sempre os seus sonhos, sem jamais desistirem."

Agradecimento

Decorria o ano de 2018, quando iniciei esta jornada, com o objetivo de aprofundar os meus conhecimentos e expandir as minhas competências nas áreas de informática. Hoje, em 2024, estou próximo de concretizar esse sonho.

O caminho foi longo e ficou marcado por desafios significativos, começando, ainda em 2018, pela conversão da minha carreira para as áreas de informática. Em 2020 surge a pandemia COVID-19 e ao mesmo tempo sou abençoado pelo nascimento da minha filha Camila, tornando essa fase extremamente exigente e transformadora para nós. Já em 2021, o curso sofreu uma reestruturação que me trouxe dificuldades acrescidas nas inscrições anuais, levando-me quase à desistência do sonho, sentindo-me profundamente desmotivado.

No entanto, neste último ano letivo, fui buscar as últimas reservas de energia que tinha para concluir esta etapa, aproveitando aquela que seria a minha última oportunidade antes do término do plano de estudos, no qual me inscrevi inicialmente.

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A todos, o meu mais sincero obrigado.

Resumo

O projeto Schoolpedia, criado pela Associação de Jardins-Escolas João de Deus e o ISCTE, desenvolveu uma plataforma digital gamificada para promover a colaboração entre alunos e professores do ensino básico. A plataforma complementa o ensino tradicional, incentivando a pesquisa autónoma dos alunos através de uma enciclopédia digital, e foca-se em aumentar a motivação e participação dos estudantes, com os professores a mediar e validar os conteúdos produzidos.

A revisão da literatura destaca o impacto das tecnologias digitais na educação, focando-se na gamificação como forma de aumentar a motivação dos alunos e na Aprendizagem Baseada em Problemas (PBL) para promover autonomia. Também aborda o uso da Inteligência Artificial (IA) na personalização do ensino e avaliação automatizada, bem como os desafios e oportunidades dessas tecnologias.

A Schoolpedia é uma plataforma digital onde os alunos podem jogar STOP, criar artigos e explorar conteúdos de forma interativa e personalizada. O projeto segue uma metodologia de action research, envolvendo coordenadores, professores e alunos no seu desenvolvimento. O design foi elaborado com técnicas de Design-Thinking, e a plataforma inclui um agente de IA que analisa os artigos dos alunos e fornece feedback imediato.

Durante o desenvolvimento do projeto, foram feitas avaliações com professores e alunos para medir o impacto da plataforma na aprendizagem e motivação dos estudantes. Os questionários aplicados indicaram uma melhoria significativa na participação dos alunos e no desenvolvimento de competências digitais e científicas. Os professores também relataram maior facilidade em mediar e validar os conteúdos criados pelos alunos.

Palavras-chave: Gamificação; Educação Digital; Aprendizagem Colaborativa; Plataformas Educativas; Inteligência Artificial; Metodologias Ativas de Aprendizagem.

Abstract

The Schoolpedia project, created by the Associação de Jardins-Escolas João de Deus and ISCTE, has developed a gamified digital platform to promote collaboration between elementary school students and teachers. The platform complements traditional teaching, encouraging students' autonomous research through a digital encyclopedia, and focuses on increasing student motivation and participation, with teachers mediating and validating the content produced.

The literature review highlights the impact of digital technologies on education, focusing on gamification as a way of increasing student motivation and Problem-Based Learning (PBL) to promote autonomy. It also addresses the use of Artificial Intelligence (AI) in personalizing teaching and automated assessment, as well as the challenges and opportunities of these technologies.

Schoolpedia is a digital platform where students can play STOP, create articles and explore content in an interactive and personalized way. The project follows an action research methodology, involving coordinators, teachers and students in its development. It was designed using design-thinking techniques, and the platform includes an AI agent that analyzes the students' articles and provides immediate feedback.

During the project's development, evaluations were carried out with teachers and students to measure the platform's impact on student learning and motivation. The questionnaires applied indicated a significant improvement in student participation and the development of digital and scientific skills. Teachers also reported greater ease in mediating and validating the content created by the students.

Keywords: Gamification; Digital Education; Collaborative Learning; Educational Platforms; Artificial Intelligence; Active Learning Methodologies.

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Abbreviations List

- AI Artificial Intelligence
- AJEJD Associação de Jardins-Escolas João de Deus
- **API Application Programming Interface**
- AR Augmented Reality
- CM Concept Mapping
- CRUD Create, Read, Update and Delete
- DDD Domain-Driven Design
- GenAI Generative Artificial Intelligence
- IoT Internet of Things
- JWT JSON Web Token
- LLMs Large Language Models
- MR Mixed Reality
- MVP Minimum Viable Product
- ORM Object Relational Mapper
- PBL Problem-Based Learning
- RAG Retrieval-Augmented Generation
- RDBMS Relational Database Management System
- REST Representational State Transfer
- SPA Single Page Application
- UDL Universal Design for Learning
- UI User Interface
- UX User Experience
- VR Virtual Reality

CHAPTER 1

Introduction

Contemporary educational systems are encountering progressively intricate obstacles, not only because of the rapid pace of technological advancements but also because society's demands on the role of schools in educating and equipping young individuals for the future have expanded, as mentioned,

"life is altered by technological advancements. The advent of virtual reality technology has opened up new avenues for traditional education" and "the most advanced technology should not be prohibitively expensive but rather should be accessible to the general public and seamlessly integrated into our daily lives" [1].

Consequently, the conventional educational system has faced substantial challenges in adjusting to modern requirements. This is evident as [2]

"traditional education is currently inadequate for the dynamic nature of our contemporary society because it often continues to preserve its focus on passive learning methodologies and extrinsic rewards on a periodic basis, which does not encourage the development of skills necessary for modern challenges" [2].

The level of competitiveness in any industry today requires the acquisition of a set of skills that go beyond those typically addressed in conventional education. According to the research,

"learners cultivate essential knowledge, hands-on competencies, adeptness in purposeful internet utilization, foundational grasp of office software, thereby equipping themselves to apply their fundamental scholastic grounding congruent with their chosen higher education domains" [2].

It is imperative to have people who possess a higher level of proficiency in innovation, collaboration and initiative-taking, as well as concerning creative approaches in the development, presentation, and execution of their own ideas. This reflects the necessity of integrating digital competencies, as highlighted:

"the extensive and cohesive integration of digital technologies aids educators in attaining objectives, notably in enhancing the depth of theoretical subject understanding and fostering the growth of digital technological skills" [2].

Conventional education is currently somewhat inadequate for the dynamic nature of our contemporary society because, in many situations [3], [4]:

- The technological gap towards current demands is evident.
- It continues to preserve its focus on passive learning methodologies.
- It maintains extrinsic rewards on a periodic basis.

- The model remains teacher-centered.
- And the content continues to be linear and limited.

1.1. Contextualization

Recognizing the importance of improving critical thinking and problem-based learning since the early years of education, Associação de Jardins-Escolas João de Deus (AJEJD) in partnership with ISCTE - Instituto Universitário de Lisboa launched the challenge of developing a gamified digital platform that promotes collaborative knowledge building among students through active research, leading to the creation of Schoolpedia which consists of an educational platform that functions as a digital encyclopedia, aimed at students and teachers. The term combines 'school' and 'pedia' (encyclopedia) and refers to a digital environment where articles can be created and read by students in an organized and accessible way.

This platform emerges as an innovative proposal with the primary objective of complementing the learning process for students in the school association, particularly in the context of elementary education. Conceived and inspired to promote knowledge building in an initiative-taking and personalized manner among students and teachers, this platform is based on the application of active and student-centered learning methodologies [5].

The Schoolpedia project aims not only to make learning more interesting but also to develop critical skills in students, such as analytical thinking, creativity, and digital literacy.

Additionally, it allows each student to create and develop their research at different paces and in different areas, depending on each student's capacity and interests, recognizing the importance of adapting education to current demands, promoting inclusion and equity, thus making this platform accessible to all students.

In this phase, the platform will be aimed at AJEJD's 1st cycle students, aged 5 to 10. In the future, there are plans to expand to include 2nd and 3rd cycle students, covering the age range of 9 to 16.

1.2. Objectives

The objectives of the Schoolpedia project are as follows:

 To develop a digital educational platform that promotes students' collaborative research for knowledge building among students and teachers, focused on personalized learning and the use of technology.

- To stimulate the creation of scientific content by students, which is subsequently validated by teachers and experts with the assistance of an AI agent.
- To encourage digital and scientific literacy by using innovative teaching methods that foster active student participation.
- To introduce gamification elements to motivate and engage students in their own learning while promoting research skills.

1.3. Research Questions

The following research questions will be directed the initiative's growth and assessment:

- What kind of influence (positive or negative) has the use of a collaborative digital platform on the way elementary students construct their scientific knowledge?
- How can gamification support student active participation in collaborative learning environments and motivation?
- How can teachers benefit from the aid of artificial agent to help validating and mediating the material produced by their students?

1.4. Research Methodology

The research method used was action research, as it best suits our context. This approach combines scientific investigation with practical action and was introduced by Kurt Lewin in 1946 [6]. It is an iterative method aimed at promoting experiences, integrating the socio-critical paradigm, and is quite popular in the fields of Social Sciences and Education. Its objective is to foster change and solve problems collaboratively and participatively among all stakeholders.

1.4.1. Key Features of the Method

- Active Participation: All stakeholders are actively involved in every phase of the research, as they have the best understanding of the problems.
- Action Research Cycle: It is cyclical and consists of the following phases:
 - Problem Identification
 - \circ Planning
 - o Implementation
 - o Evaluation

- \circ Reflection
- **Reflexivity**: encourages ongoing thought on the process and outcomes. Constantly assessing their behavior, stakeholders modify their approaches depending on results and acquired knowledge.
- **Change Goal**: emphasizes not only on knowing but also on changing reality. The theory is that the research process results in useful modifications enhancing the examined conditions.
- **Collaboration**: values teamwork and aims to empower every participant, so fostering the acquisition of ability to solve problems.
- **Flexibility**: fits conditions and settings. As necessary and as developments take place during the study, the research process can be changed.

1.4.2. Method Implementation

Along with using the action research approach, the process was carried out using Design-Thinking techniques to collect comments and modify developments accordingly:

- Problem Identification: AJEJD initiated the problem identification, recognizing the need to develop a digital platform, and the author enhanced it by introducing an AI agent into the platform.
- **Planning**: to track scientific advancements, regular meetings were scheduled and attended by all the interested parties (the author, teachers and coordinates).
- Implementation: a selected group of teachers and students tested Schoolpedia.
- **Evaluation**: students and teachers had the opportunity to test and experience Schoolpedia.
- **Reflection**: the findings indicated that some changes were required to be done.

The cycle was repeated twice. Tests were run, only with teachers in the first iteration and with both teachers and students in the second. The iterations occurred between November 2023 and September 2024

1.4.3. Advantages and Disadvantages

- Advantages:
 - All stakeholders the author, teachers and coordinates were involved, thereby increasing the relevance and effectiveness and acceptability of the developed solution.

- The solution was adapted over time based on ongoing feedback provided in stakeholder meetings.
- Disadvantages:
 - Time-consuming process and some difficulties in matching the availability of the entire team for regular sessions.
 - Some difficulties in maintaining objectivity regarding the solution's effectiveness given the limited time window available for its execution. For example, when we start to digress and want to implement functionalities beyond our current capabilities and such as the short time we had to test the Schoolpedia project and the difficulties we experienced with the Wi-Fi network during the tests.

1.5. Evaluations and Results

During the development of the Schoolpedia project, evaluations were conducted with teachers and students to assess the impact of the platform on learning and student motivation. The results indicated a significant improvement in student participation and the development of digital and scientific skills. Teachers reported greater ease in mediating and validating the content produced by students. The platform was also recognized at innovation events, receiving an award at FISTA 24 ISCTE-IUL, which provided initial funding for the project's incubation, highlighting the pedagogical and innovative value of the initiative.

1.6. Document Organization

This document is structured as follows:

- **Chapter 1:** Introduction presents the context, objectives, and research methodology of the.
- **Chapter 2:** Literature Review discusses the theoretical foundations and current practices related to the digitalization of education and the use of digital platforms.
- **Chapter 3:** Schoolpedia: The Project describes the process of designing and implementing the Schoolpedia platform.
- **Chapter 4:** Evaluation presents the main findings from user evaluations.
- **Chapter 5:** Conclusions and Future Work summarizes the main contributions of the project and proposes future directions for the development of the platform.

CHAPTER 2

Literature Review

2.1. Education Challenges

Conventional approaches to scientific education have been acknowledged as inadequate to attain the needs of the 21st century [7]. Influential groups like the National Academy of Sciences in Washington have lately released reports stressing the necessity of a paradigm change in science education [7], [8]. The basic idea is that scientific literacy among all students should be promoted in addition to training next generations of engineers and scientists.

Making wise decisions and active participation in contemporary society depend on scientific and technological knowledge as well as the capacity to solve related problems; hence, a change in educational focus is vital. As the authors of the book state:

"Some knowledge of science and engineering is required to engage with the major public policy issues today as well as how to make informed decisions, such as selecting among alternative medical treatments or determining how to invest public funds for water supply options." [7].

Along with knowledge transfer, the vision of science education has broadened to include active engagement of students for the purposes of exploration, reasoning, and use of scientific and engineering practices in the somewhat formalized processes of science [9].

Such a call for reform in education meets similar objectives to other efforts in some other parts of the world, the most prominent being the United Nations' Sustainable Development Goals (UN SDG's) [10], as mentioned,

"The 17 Global Goals for Sustainable Development (United Nations, 2015a) offer a starting point for educators to begin to collaborate with youth, schools, and communities and initiate a research agenda that should extend well beyond 2030 in order to ensure progress is made toward addressing and achieving the SDGs." [9].

As the world confronts increasingly nested and intricate problems, so it becomes ever more necessary that the youth become equipped to assist in materializing sustainable development.

In this regard, the objectives of science education should be redefined and made such that it becomes the foremost way of solving global problems, fostering independence and triggering social change [7]. This a model that fosters learning using culturally and contextually relevant content strategies that invite students to be part of the scientific process in a manner that equips them for world we live in [7], [9].

2.2. Digital Platforms in Education

The digitalization of education has been one of the central themes of educational reforms in recent decades, due to its potential to restructure how students learn and how teachers teach.

2.2.1. Digital Transformation in Education

Based on [5], the digitalization of education in the twenty-first century has been marked by the introduction of more flexibility and accessibility to teaching methods by digital platforms and virtual classrooms. But it has also presented several difficulties, the most important of which is the necessity to guarantee fair access to these technologies, particularly in situations when the digital divide is still rather noticeable.

The author also underlines that digital transformation in education entails empowering teachers with digital pedagogies in addition to offering technological tools. This method allows to create significant and successful learning opportunities in the digital environment.

2.2.2. Digital Platforms and the Promotion of Digital Competence

Digitalization of education is one of the determinants of educational change, which has achieved significant mass in recent years. Modern technologies are introduced not only to upgrade school subjects but also to enhance students' abilities to use different digital tools, which nowadays is considered necessary. The current section provides a review of empirical and theoretical studies to describe learning impact of these platforms and development of digital skills.

Concepts and Practices:

Digital competence or the ability to apply information and communication technologies purposefully and innovatively is a hallmark of our time and empowers learners to effectively engage in a digitally driven society. Recent literature has addressed which digital resources and technologies can enhance these competencies in educational contexts. The study [11], realized in Latvia, notes the specific role of interactive platforms in History and Culturology teaching. The researchers created a teaching website to provide the students with effective, interactive, and interesting historical and cultural information. The platform not only enhanced the learning of content but also helped in developing the digital skills of the students. As it provided the use of multimodal technologies in accessing and comprehending information both individually and as a group. The research emphasizes that digital competence should not only be defined as the ability to work with technologies but rather the ability to think critically and creatively while leveraging the available resources.

Also, [12] employed the technique with an objective of orienting first-year students into the school by utilizing digital storytelling. Here, the students had the opportunity to narrate their own stories, practices which were essential for grasping the behavioral etiquette and rules in school. The picturebook digital storytelling interventions, implemented in the classroom with teacher-support, not only provided an avenue of acquiring skills, but also enhanced social and emotional well-being of the participants' demonstrating the importance of modern-day practices in the proper development of children.

Impact on the Learning Process:

The use of digital tools in teaching seems to make students more interested in the matter presented to them and is helpful for better understanding of the same. Research in Latvia displayed that 98% of the students in the research adequately achieved better improvement of the learning process using computers whereas 100% of the research participants in Latvia used the interactive platform to take tests [11]. It implies that, to a reasonable extent, digital platforms have the potential to be used as enhancers to the traditional methodologies making them emanate more from the learners that in the normal way.

In study, [13], when observing the digitalization literacy practices with the focus on Sweden, a great transformation in students' writing was encountered. The use of new technology made it possible to produce extensive and complex texts consisting of pictures and sound. At the same time, there was a decrease in the use of narrative writing with more factual texts which points out a shift in the ways knowledge is learnt and expressed by students.

Obstacles to the Adoption of Digital Technology:

While one can clearly see the advantages of the digital available platforms, there are also some certain barriers regarding how they are executed. For teacher lack of training is one of the issues that has been mentioned a few times. In study [14], carried out in Portugal, it is mentioned that more than half of the teachers do not use the technological devices skilfully and purposefully yet. Professional development in this regard is essential as failure to do this limits the extent to which the teachers can use the digital platforms to foster creative and exciting learning.

Also, the research [15] mentioned in the effect of Ukraine discusses the necessity of keeping a combination of digital and non-digital approaches to avoid an overload on one end. The author suggests a 12-step plan of incorporating the use of interactive technologies claiming that for effective adoption of the technologies more than just the physical presence of the required sisterhood orchestration is needed, pedagogical changes must be entailed for the use of the technologies to be beneficial.

Implications for Educational Practice:

To implement digital platforms in teaching successfully, it is important that all the students and all the teachers make use of the said technologies responsibly. Continuous professional development of teachers should not be restricted to technical training only but should also include the integration of technology in teaching and learning within different instructional settings [14].

Furthermore, it is imperative that all students, including those with disabilities and from low socioeconomic locales, are reached and included in the use of digital platforms. As noted by [11], such platforms can only be effective in their use if they allow language variations and classroom-friendly features are included as well.

2.2.3. Ethical Challenges and Opportunities

The prospect of improvement with digital transformation in education due to the changes brought by this shift raises questions of ethics and issues of privacy related to the collection, use, and security of student data. This new situation holds out threats and/or opportunities that call for a compromise to be reached by educators, regulators, and developers [5].

Ethical Challenges:

- With the use of technologies in teaching, the question of student data safety and protection emerges. As the use of digital platforms advances, there is an expansion and deepening in the retrieval of the students' sensitive information. This involves not only the academic records, but the behavioral and psychometric dimensions of the students, which can be used to customize learning. However, the inadequate use or poor protection of this information generates privacy violations, with dire repercussions such as discrimination, stigma and mistrust towards the education system [5], [16].
- Complex data management of substantial amounts of data creates problems of equity and justice in education. Algorithms for customized education are prone to biases and discrimination, and disrespect. And the monitoring and evaluation of their use is currently absent. Besides, the increasing dependence on online services owned and operated by corporations poses risks regarding the control and ownership of educational content and data and might enable abusive business practices [5].

Opportunities:

While there are ethical issues to be considered, we must not forget the fact that digitalization
also opens new avenues in the enhancement of education. Employing data, advanced
technologies such as AI, machine learning, and interactive tools helps providing learnercentered approaches, aided by adaptive systems that offer suitable content for students
according to their needs and capabilities. This can transform the educational experience into
a more interesting and efficient one, hence improving it [5].

• In addition, the elimination of geographical barriers of education can be facilitated using technology by allowing students in the hinterlands or those in disadvantaged situations access to better quality information related to their studies as well as organizing their content in a manner that suits different learning preferences. A more important dimension to the increased access to technology is that an institution can periodically gather quantitative and qualitative evidence and assess whether the effects of certain educational practices are positive and then make changes where appropriate [5].

2.2.4. Education 5.0

Education 5.0 is seen as an advancement from an earlier evolution of the concept of education, this evolution starting from Education 1.0 to Education 4.0. Every evolutionary period is distinct by the emergence of added information communication technologies and corresponding pedagogy [16]:

- Education 1.0: In this concept there is only passive learning, which is typically mostly in speaking and reading, or rote memorization of facts with little or no technology implemented.
- Education 2.0: The era which enables active learning to take place assisted by technology such as computers and the internet within the boundaries of collaborative learning, although still low on personalized learning.
- Education 3.0: Provides a more student-centered approach using technology tools which aid in providing more active learning, incorporating the flipped classrooms, the One-to-one learning and the use of big data analytics.
- Education 4.0: Students have access to and can utilize Artificial Intelligence (AI), Virtual Reality (VR), Internet of Things (IoT), Big Data and other relevant devices, hence learning is highly customized and addresses the mental and healthy wellbeing of a student.

All these phases are geared towards Education 5.0, which aim is to achieve the most efficient, effective and equitable educational systems: deploying latest technologies such as AI and blockchain to enhance delivery of education in new environments such as Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), Metaverse and others.

2.3. Gamification and Motivation in Learning

Gamification is the use or introduction of game principles in non-gaming realms, especially education. Most often, these components are encouraged by such methods as points scoring and other external rewards with a competitive added value to the users [16], [17], [18], [19], [20]. Considering the use of gamification in education, one of the main advantages is the improvement of students' engagement levels and rising their motivation for better results. This is the trend that has been steadily rooting on within the educational world.

2.3.1. Practical Cases of Implementation in Educational Environments

Using technologies such as VR and AR, gamification can also be modified to enhance the impact of the process, thus enabling the individualization of learning, allowing the learner to learn at his/her stroke pace and giving every learner personal touch on the instructional need [16].

- In the process of foreign language studies, gamification made a positive contribution in the areas of writing and conversation skills respectively. One such case is the Duolingo app, in which end users display high motivational level [19].
- In the University of Glasgow, a complementarity Moodle plug-in 'Level Up!' was added. The gamification to induce students to take the quizzes ratings and pre-class activities was instrumental in increasing the degree of participation by students [20].
- Other example is the use of the classroom management tool where leaderboards and badge systems are implemented and how that has changed student motivation expressions over time.

2.3.2. Impact on Motivation and Engagement

The above studies have produced results that focused on motivation and engagement. Two studies have also been conducted that aimed at effects over the longer term.

In the studies [16], [18], [19], [20], all practical applications and investigations showed that students, in general, increased their motivation and engagement in learning, which was evidenced in better academic performance. Also, in other studies [16], fostering problem solving and critical thinking skills were noted as well.

In Long-Term Effects, studies that investigated long-term motivation trends on the subjects faced different difficulties. In the study by [20], where the University of Glasgow implemented the Moodle's 'Level Up!' plug-in, it was reported that there were higher levels of student engagement, particularly within the pre-class activities. But adverse effects were caused regarding the competition that students were stimulated to create, and the level of diligence needed to follow up disengagement on the gamified system. A study [17] where students were given badges and where progress through leader boards was implemented noted that although there was increased engagement among students at the beginning, their intrinsic motivation decreased with time because of the over-competition associated with leader boards.

2.3.3. Results Analysis

Gamification, coupled with the latest technologies, has been helpful in improving the comprehension of complex materials and data, especially in the fields of science and mathematics [16].

Studying Duolingo app has shown that the preferred training of most of the students was in the gamified way of doing things, more than the conventional way. However, some activities were not effective and there was a more frequent call for help [19].

A gamification approach studied with young children had exemplary results of participation and motivation but made sure to stress the importance of playful-lead practices [18].

However, in this study [17], which contrasted gamified and non-gamified classrooms, one of the notable perils identified was a decrease in intrinsic motivation. This decline, paired with emerging academic challenges, points to the potential risks associated with the use of gamification systems, where external rewards may undermine students' inherent interest in learning.

Gamification in flipped classrooms resulted in more active participation and better grades of students, problems also included increased competitiveness, and some disengaged students risked being demotivated [20].

These studies were conducted with adolescent students. We will explore this aspect with firstgrade children in our application.

2.4. Student-Centered Learning Methodologies

Schoolpedia establishes a research learning environment which is centered in the students, where active education is promoted using technology, aspiring to the individualization of learning through gamification.

Centralized learning approaches, meanwhile, enhance the level of autonomy, cooperation and individualization of each learner which is in tandem with the goals of Schoolpedia initiative. Education today has gone through several radical transformations which encompass combining these forms of learning and teaching with active knowledge building and digital literacy.

2.4.1. The Role of the Teacher

In this paradigm, it is evident that the teacher's role is shifting considerably from that of a knowledge bearer to a manager or facilitator in the process of education [21]. In this collaborative process, the teacher takes on the role of a guide who provides motivation and assistance to students in the development and evaluation of scientific ideas.

The importance of this new positioning supports collaborative knowledge-building, where teachers provide continual expert input and structural support while students are placed at the center of the process. [22].

2.4.2. Activity-Based and Collaborative Learning

One of the methodologies that can be applied for student-centered learning is Problem-Based Learning (PBL), which involves seeking instructional methods that encompass autonomous learning where students are provided with challenging and complex problems, and learning through self-discovery, PBL Faculty [22].

In PBL, a problem is considered the beginning of the cycle and the students have to investigate how to solve the problem they were posed. Concept Mapping (CM) which incorporates brainstorming, organization, layout and linking, can be adopted at some stage of this process [22]. Such advances are possible because of the disregarded flowcharts employed in the usual ways of teaching.

2.4.3. Technology and Gamification

The role of technology and gamification will be pivotal and evident, as outlined by the principles in the study [23]. The introduction of digital platforms and AI agents can enhance teaching personalization and pacing, adapting to each student's individual needs. Additionally, gamification has been evaluated as an effective approach to maintain student engagement and promote active participation in lessons.

The study [23] also emphasizes the importance of creating flexible, accessible, and interactive learning environments through tools like virtual classrooms and mobile technologies. It also advocates for continuous assessment and personalized feedback to monitor progress and provide support, aligning with the broader goal of fostering a dynamic, student-centered educational experience.

2.5. Inclusion and Multimodality in Digital Platforms for Education

The meaning of inclusion and multimodal interaction also applies when developing educational environments or platforms for the different categories of students, especially the ones with special needs in learners' education, where digital education is. Multimodality means the use of different presentation and interaction resources like text, audio, video, graphics, and others that suit a given student's mode of learning. This methodology is especially important in designing learning spaces, which do not exclude any of the students on the basis of their level of abilities or challenges.

The adoption of multimodality in digital education platforms enables students with different needs to have equal access to content and to interact in a way that feels most comfortable and effective for them. For example, tools such as 'Speech-to-Text' and 'Text-to-Speech' are integrated to support students with reading and writing difficulties, and the use of assistive devices ensures that those with physical disabilities can fully engage in learning activities [24].

Additionally, and applying the Universal Design for Learning (UDL) principles is beneficial in creating an environment where content and evaluation can be done using multiple means and offering students diverse ways of active engagement. UDL promotes flexible teaching methods that consider the rate, preferences and needs of every student in order to achieve effective learning outcomes.

To foster intensive learning processes among learners of all abilities, UDL ideals are employed within educational practice. It presents some opportunities of the understanding of the rationale with a number of assistive technologies for text and voice-enhancement targeted communication to target users and the incorporation of AI tools in education [5], [24].

Multimodality is fundamental in developing adjustable learning settings where the students will select the manner in which they would like to engage with the instructional materials, based on their needs and preferences. This not only enhances educators' effectiveness but also improves learning. Employing instructional techniques that are student-centered works best to improve the students' performance rates especially those who are less able or have additional needs.

2.6. Generative AI in Education

The radical shift that generative AI can enable in the ways of teaching and learning is immense. It stands for the systems of AI that generate unique content by processing substantial amounts of data, in this case texts, images, sounds and others for many contexts in education.

2.6.1. Personalized Teaching and Teacher Support

The process of teaching can also be enhanced since Generative AI (GenAI) can help make the process of preparing necessary materials with respect to each learner's personal characteristics such as the level of knowledge about a certain subject, the pace of learning, and diverse learner interests. This technology also aids teachers in preparing content for lessons as well as reducing inefficient time in undertaking paperwork in which case students critical and creative aspects development will be given undivided attention [25].

This notion is supported as mentioned by [26], which provides examples of Large Language Models (LLMs) usage, such as ChatGPT, designed for an educational platform where the students would receive quick answers to any questions that were being explained in class that would enhance the learning process but in form of technology.

2.6.2. Collaborative Learning and Content Creation

GenAI enhances learner's collaboration in generating educational content and this alters the group processes influencing how more active learning is achieved.

GenAI allows students to collaborate with each other in work conducted with virtual assistants and interactive platforms sharing ideas and developing projects even providing automatically generated content for discussions [25].

Platforms like RiPPLE use GenAI and crowdsourcing to engage students in creating and evaluating educational content, turning them from consumers into active creators of study materials [21].

VR and AR and GenAI technologies help students perform authoring of active simulations and other simulation models with virtual experiments done together making understanding complex constructs easier to [27].

Collaborative learning with GenAl enhances student participation, promotes critical thinking, and develops social skills such as communication and problem-solving [27].

Platforms like Coursera and Duolingo adapt collaborative activities to each student's level, using AI to personalize tasks and provide instant feedback, encouraging cooperation and healthy competition [26].

2.6.3. Automated Assessment and Interactivity

GenAI can change the concept of educational assignment by giving feedback as well as automating the grading of workplaces and any other free form responses such as essay writing. Quick personalization of assessment is made possible allowing identification of knowledge deficits which enhance learning [25].

Students work on their responses almost directly on the platform, returning positive feedback with directions to improve the coherence of their writings. Students or learners in this case have specific skills and knowledge gaps which are often identified using AI based applications as in the case with Khan Academy [26].

GenAI also evaluates oral and video presentations in addition to written texts and customizes activity difficulty to the learner's level. Systems like RiPPLE use a crowdsourcing approach, allowing students to create and evaluate content, thereby increasing interactivity and engagement [27].

On the other hand, objective testing permits a decrease of the time employed by teachers in performing undemanding equivalent functions and greater consideration of the views pertaining to the assessment process hence enabling more important learning functions from the educators [26].

Platforms that are innately adaptive like RiPPLE have also designed system based on GenAI that suggests activities to students depending on their performance increasing students learning experience [27].

2.6.4. Challenges and Ethical Considerations

Nonetheless, existing studies emphasize the positive aspects, but they also outline the ethical and technical hitches in the adoption and application of GenAI within Education. Among the issues addressed are the concerns over student data privacy and algorithm discrimination bias [26].
There is also an acknowledgment of the 'black box' view of automated systems and the lack of explainability of some AI models as major barriers to development. Internally set tasks for teaching and learning achievements seek the assistance of students and teachers but their demands reasonably exceed to what is practical due to difficulties in perceiving what is required of AI in an education setting and how exactly these should be used. This challenge is especially serious because such systems cannot be trusted, and therefore it is hard to say how the decisions that have been made were reached, and this could alter the educational results that have been sought after. [28].

There is also a debate on the need to conduct further studies aimed at understanding how generative AIs can be implemented with consideration of ethical responsibilities with the goal of serving all students without discrimination [29].

CHAPTER 3

Schoolpedia: The Project

As mentioned in Chapter 1, the action research method was applied in this solution which incorporates Design-Thinking methods for the problem already identified. The use of this complimentary approach can strengthen the implementation of the Schoolpedia project, fostering the design which is iterative and includes all stakeholders of the process.

In the activities outlined below, the first phase was done by the team from the AJEJD and the rest phases were done in collaboration with the author from ISCTE.

3.1. Planning and Problem Identification

At this section, AJEJD identified the central problem, which is the reason for the existence of Schoolpedia: educational processes and education for preschool and the primary school children, suffering from students' little participation and personalization.

The purpose is to enhance collaborative, active learning by providing a digital platform where students can create a personalized scientific dictionary according to their needs. Moreover, all the teachers, experts, and partner institutions which were analyzed and identified also play a critical role, in the sense that they assist in the construction of students' knowledge.

As mentioned in chapter 1, we used Design-Thinking methods coordinated with action research methodology to develop this project. The methods are divided into Empathize, Define, Ideate, Prototype and Test organized in the sequence described and executed iteratively until we obtain the expected result (see Figure 1).



Figure 1 – Design-Thinking methodology [30]

The stage of the planning embraced the establishment of a specific policy of action for the building of a digital platform that would encourage knowledge co-construction. The plan involved also making personas depicting the different users and carrying out an empathy phase to carry out a needs assessment of these groups (see Appendix A and Appendix B).

A stakeholder analysis was also performed, including in its scope teachers and coordinators, to identify the ways that technology could help provide for the students' individual learning preferences.

Sheltered by the empathy phase, the definition phase was finally executed, and during this phase, the problem compiling and reframing sprung-from collected the data, to bring up a concrete problem statement:

How might we complement traditional education in a way that captivates and motivates students in a world of constant technological evolution?

With this question in mind, and following the predetermined methodology, there was a practical investigation issue to be solved by a heuristic path of action.

3.2. Action and Observation

Based on the definition of the problem, an array of creative solutions was generated to solve the problem of non-engagement and absence of individualization in studies. These solutions were then expanded and materialized to be tested, with the creation of a prototype.

3.2.1. Ideate

During the ideation phase, brainstorming sessions were conducted during the initial periodic meetings. Among the ideas developed, the most notable include the implementation of the "STOP" game as a playful learning mechanism, the integration of AI to guide students in creating scientific content, the possibility for students to create their own content to be subsequently validated by their teachers, and the development of a rewards system, such as virtual currency, assessments, and rankings, to increase students' intrinsic motivation.

The following solution was ideated: 'Development of a gamified digital platform that promotes collaborative knowledge-building among students, using GenAI to assist them in a personalized way.'

The following objectives were set to be achieved:

 Introduction of Technology: integrating modern and innovative technologies into the educational process, aiming to make learning more accessible, interactive, and efficient for all students.

- Active Learning: Promoting a learning environment where students are the protagonists of their own educational process, actively participating in knowledge-building through practical and collaborative activities.
- Intrinsic Motivation: developing strategies and tools that increase students' internal motivation, stimulating a natural desire to learn and explore new content without relying solely on external rewards.
- **Personalized and Student-Centered Model:** Create an educational model that is responsive to the need of each learner's learning speed, likes and types, providing a truly personalized teaching experience.
- Encouragement of Exploration and Discovery: Create an environment that appreciates students' intellectual development and allows them to explore new ideas and discover knowledge acquisition by trying out their ideas.
- **Technological Preparation for the Future:** Equipping students with digital literacy skills enough to face future challenges, ensuring they are prepared to cope and live in a changing world.

3.2.2. Prototype

Next, we began the process of developing the prototype, starting with imagining the user's task profiles and the basic features sufficient to fulfill the definition of the Minimum Viable Product (MVP). The prototype was developed through the utilization of the *Figma* platform (see Figure 2 and for a more complete view refer to Appendix C) which clearly enhances the interactive visualization of the intended functions.

We developed three core user profiles which contain the major activities and roles:

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Figure 2 – Figma prototype

Student Profile:

- Login: all students aged between 5 and 10 years are required to log into the platform.
- Main Menu: after logging on, the student gets to see three main items in the menu:
 - 'Play' option:
 - The students' action in this case will be the joining the 'Stop' game.
 - After that they are taken to the area where they are supposed to select the relevant category they would like to develop.
 - The students create content related to the selected category and sends it for approval.
 - The submitted content is in the first instance evaluated by an AI agent.
 - 'Study' option:
 - The students choose the topic which they want to learn more about.
 - After this they are redirected to a search for articles which are relevant to the chosen topic.
 - The student can read the articles and learn.
 - 'Manage' option:
 - The students can access the articles previously created for management and editing purposes.
 - They are also able to see the fate of articles by querying for those awaiting approval, and those deemed to have already been turned down.

Manager Profile:

• Login: The manager also has the obligation to access the platform by logging in.

- Main Menu: Once the manager logs in, he is directed to a menu that has two main items:
 - 'Approve' option:
 - The manager can approve, reject, or request changes to the articles submitted by students.
 - 'Manage' option:
 - There is also a category for submission such that the manager is allowed to see and remove articles that are already submitted by other students.

Administrator Profile:

 With regard to functionalities of the different types of profiles, the administrator profile has the same role as a manager, but this time is more advanced as it can control the how the managers behave in the platform.

This detailed design seeks to make sure that every profile present on the platform is utilized according to its intended purpose with respect to each respondent's set of roles and obligations, which will enhance individualization and hence effectiveness of the digital in the interaction in the network (see Appendix C).

3.2.3. Prototype Acceptance

The design and model of the prototype was demonstrated to the group of stakeholders, as mentioned earlier in this chapter in the Empathize and Define phase, during the periodic meetings and it was accepted. Additionally, it was also displayed in the innovation and entrepreneurship section of FISTA 24 ISCTE-IUL¹, held on 29 February wherein it was awarded, at the end of the session. This made it also possible to acknowledge the innovative and pedagogical value being delivered by the current Schoolpedia project in the context of current education. (see Appendix D and Appendix E).

¹ Forum of Iscte School of Technology and Architecture, an event organized by students for students, focused on bridging between students and the labour market, that includes conferences, workshops, contests, IT speed talks, speed interviews and various companies stands.

3.3. Platform Technologies

In this section, we will cover the technology used, the architectural design of the platform, integration with third-party service providers as well as the application's infrastructure and deployment. Each of these has been organized and executed to ensure that Schoolpedia is robust, scalable and responsive to the education needs that were outlined during project development, using state-of-the-art technology.

3.3.1. Technology Stack

For the development of the platform, frontend, backend and database technologies were used.

The frontend of the platform was implemented using Angular 16 because it is a web framework that supports the development of modern and interactive user interfaces. The reason Angular 16 was favored was because of its great maintainability and scalability as its rich structure can adapt large projects. This is coupled with the fact that the Angular framework has good support for integration with additional tools and libraries, such as Bootstrap 5 for design and responsiveness of the hosted applications, and PrimeNG 16 for development of rich reusable User Interface (UI) components with additional support for advanced features as data binding.

The backend was developed using .NET 6, which is an open source and cross platform application framework that delivers high performance, security and reliability. C# 10 which is within .NET 6 was chosen due to its modern features and syntax since .NET 6 supports a few languages. Furthermore, Entity Framework 6 was utilized as the Object Relational Mapper (ORM) technology while Identity Framework 6 was implemented for authentication and authorization management, where the authentication process with JSON Web Token (JWT) was implemented for protected exchanges between the client and the server over secure transport.

Frontend Architecture:

The frontend architecture was acting on the Single Page Application (SPA) model with a great focus on Angular 16. With the adoption of Angular, it becomes possible to create a site in a modular way, where each functionality or the section of the platform is treated as an independent block.

These blocks are also quite manageable and can be used more than once, thus making it easier to handle the future evolution of the project.

Moreover, to say the application is completely responsive and adjusts to different screen sizes & devices thanks to Bootstrap 5, the application of PrimeNG 16 offers functional components as tables, panels and charts that enhance the user experience.

Backend Architecture:

The development of the backend architecture was according to Domain-Driven Design (DDD) model (see Figure 3), The highlight was on creation of a modular, strongly coupled very cohesive system where the business logic resides within the domain of the application.



Figure 3 – DDD architecture representation [31]

All the above-mentioned architecture was implemented using .Net 6 and entity framework 6 was used as an internal bridge between any domain entities and the relational database, while identity framework 6 was used for security purposes.

Using the JWT makes the requirements for the authentication system effective and efficient since various services can authenticate users without polling the authentication server continuously.



Figure 4 – Backend architecture representation

Considering also DDD, among other best programming practices, the backend of the platform is ready to grow and change into microservices architecture if needed in the future (see Figure 4).

Presentation Layer (UI Layer):

• This layer is responsible for user interaction. It includes the graphical user interface (GUI) and other forms of interaction, such as mobile devices, smartwatches, and embedded systems in cars. Its role is to capture user requests and present data appropriately.

Application Layer:

 The application layer coordinates system operations, managing the flow of information between layers. It does not contain business logic but orchestrates the logic provided by the domain and service layers. It serves as a communication point between the presentation layer and the business logic and service layers.

Service Layer:

• The service layer is responsible for implementing services that can be used by the application layer. It provides a high-level interface for more complex functionalities that involve multiple components.

Business Logic Layer:

• This layer contains the business rules and logic that are central to the application's domain. It is where most of the application's behavior is implemented. It bridges the

operations requested by the application layer and the domain details, ensuring that business rules and policies are applied correctly.

Domain Layer:

 The domain layer represents the core of the system, modeling the entities, aggregates, and domain services that make up the business model. It contains domain-specific objects and logic, representing real-world concepts related to the problem the application is solving.

Data Access Layer (Persistence Layer):

• The data access layer manages communication with the database and other forms of data storage. It handles CRUD (Create, Read, Update, Delete) operations and other persistence operations that save or retrieve data to be used by the upper layers.

Each of these layers has a specific role and acts to modularize the application, facilitating maintenance, scalability, and separation of concerns.

Database Design:

SQL Server 15, a well-known and solid Relational Database Management System (RDBMS), was used for the database implementation. The database model was developed to comply with the DDD patterns employed at the backend, where tables and relationships represented the domain aggregates (see Appendix F).

To do this, the mapping of these entities was implemented using Entity Framework 6 and their efficient and safe 'Create, Read, Update and Delete' (CRUD) operations were applied.

Furthermore, the use of automatic migrations helps to alter the structure of the database to meet the changing needs of the project as it develops.

3.3.2. Integration with Virtual Agent and Text-To-Speech

This section presents the integrations that have been introduced in Schoolpedia, which in turn contributes for the improvement learning process and the inclusiveness provided by the platform. These integrations include the use of ChatGPT for virtual agent to interactive support and the integration of Google 'Text-to-Speech' into the platform to enhance accessibility.

ChatGPT Integration:

Based on the studies [32], we followed the path of integration with the GPT chat API for its ability to create contextual and dynamic interactions with students, facilitating the learning process.

For this integration, the platform's backend will be communicating with the ChatGPT API² whenever a user interacts with the intelligent agent present on the platform, hence making use of a REST API. Calling ChatGPT is as simple as sending a POST³ request the endpoint "https://api.openai.com/v1/chat/completions" with a token as described in the OpenAI configuration section (see Appendix G) and providing the payload given in the API documentation [32] (see Figure 5).



Figure 5 – ChatGPT payload simple request example

The type GPT model is indicated in the 'model' property on the other hand in the 'messages' property, there is an array of messages sent. It is an array since ChatGPT does not save history of our previous requests hence, we must append the messages that were exchanged earlier to provide context to ChatGPT the rest of the conversation (see Figure 6).



Figure 6 – ChatGPT payload request with context example

² API – Application Programming Interface

³ POST method sends data to the server. The type of the body of the request is indicated by the Content-Type header. Successive identical POST requests may have additional effects, such as creating the same order several times.

In the 'messages' property, the object sent has two properties: the 'role' and the 'content'. The role is defined as an 'user' in case of a message from the user, as a 'system' and as an 'assistant' where a message is from ChatGPT.

In the 'messages' property, we send an object which contains two properties: 'role' and 'content'. Here the role is defined as 'user' in case of a message from the platform user, as a 'system' to establish the behavior and general guidelines of the model during the conversation and as an 'assistant' where a message is response from ChatGPT.

Because it was important to tailor the responses to the instructional context, the communication with ChatGPT followed prepared contextualized prompts depending on the context, age of the student and the history of the interaction that the student had with the agent.

We have created three prompts: the first one helps begin the communication with ChatGPT (see Figure 7), while the second and third helps in the follow-up that (see Figure 8 and Figure 9).

If it's complete for a child of [STUDENT'S AGE] years old, just congratulate them. It is very important that you respond succinctly in American English, without images, and address [STUDENT'S NAME] informally, using 'you'.

Start the response with 'Hello [STUDENT'S NAME]! It's great to know that you're learning about the topic "[TOPIC]".'

If [STUDENT'S NAME] uses any disrespectful word or term, please start the sentence with "\$\$\$\$\$" and always explain to them that they shouldn't use such terms and why."

Figure 7 – First message to ChatGPT from article submitted

"Continuing to use you as a chatbot on a learning platform where your goal is to help [STUDENT'S NAME], who is [STUDENT'S AGE] years old and has written about the following topic. Can you challenge [STUDENT'S NAME] to research more if the description doesn't align with the topic or if it's incomplete?

If it's complete for a child of [STUDENT'S AGE] years old, just congratulate them. It is very important that you respond succinctly in American English, without images, and address [STUDENT'S NAME] informally, using 'You'.

Now, continue the conversation in a normal and fluid manner, according to the previous questions, along with the new one, and this time don't start the sentence with 'Hello', go directly to the point.

If [STUDENT'S NAME] uses any disrespectful word or term, please start the sentence with '\$\$\$\$\$' and always explain to them that they shouldn't use such terms and why."

Figure 8 – Other messages to ChatGPT from article submitted

"Continuing to use you as a chatbot on a learning platform where your goal is to help [STUDENT'S NAME], who is [STUDENT'S AGE] years old and is going to ask you another question.

It is very important that you respond succinctly in American English, without images, and address [STUDENT'S NAME] informally, using 'You'.

Now, continue the conversation in a normal and fluid manner, according to the previous questions, along with the new one, and this time don't start the sentence with 'Hello', go directly to the point.

If [STUDENT'S NAME] uses any disrespectful word or term, please start the sentence with '\$\$\$\$\$' and always explain to them that they shouldn't use such terms and why."

Figure 9 – Other messages to ChatGPT from article questions

[&]quot;Hello, I'm using you as a chatbot on a learning platform where your goal is to help [STUDENT'S NAME], who is [STUDENT'S AGE] years old and has written about the following topic. Can you challenge [STUDENT'S NAME] to research more if the description doesn't align with the topic or if it's incomplete?

As an example of a response from ChatGPT, we have the following result (see Figure 10).



Figure 10 – ChatGPT payload response example

So, in the response, the result from ChatGPT to our question is found within the 'content' property within the 'message' object which is part of the 'choices' array. Also, in the 'role' property, we can also observe the value 'assistant' which as we saw earlier is reserved for ChatGPT messages.

There is also the 'finish_reason' property that describes the reason for the end of the execution and there is also a property 'usage' which defines how many tokens were consumed in the prompt and in the response.

Now moving forward to a more real scenario of using ChatGPT, meets an imaginary student named Rodolfo Farinha who's seven years old and somehow has composed an article on the bird Falcon (see Figure 11 to Figure 16).



Figure 11 – ChatGPT payload first request real example



Figure 12 – ChatGPT payload first response real example







Figure 14 – ChatGPT payload second response real example

<pre>"model": "gpt-40", "messages": [</pre>
<pre>{ "role": "system", "content": "Hello, I'm using you as a chatbot on a learning platform where your goal is to help Rodolfo Farinha, who is 7 years old and has written about the following topic. Can you challenge Rodolfo Farinha to research more if the description doesn't align with the topic or if it's incomplete? If it's complete for a child of 7 years old, just congratulate them. It is very important that you respond succinctly in American English, without images, and address Rodolfo Farinha informally, using \"you\". Start the response with \"Hello Rodolfo Farinha! It's great to know that you're learning about the topic Falcon\".\nIf Rodolfo Farinha uses any disrespectful word or term, please start the sentence with \"\$\$\$\$\$\"stats\$\" and always explain to them that they shouldn't use such terms and why." },</pre>
<pre>{ "role": "user", "content": "\"Topic\": Falcon \"Description\": The falcon is a predatory bird that flies very fast." },</pre>
<pre>"role": "assistant", "content": "Hello Rodolfo Farinha! It's great to know that you're learning about the topic Falcon. Your description is good, but maybe you can add a little more information. How fast can they fly? What do they eat? Where do they live? Try to find out a few more details and write about them. Keep up the good work!" }.</pre>
<pre>{ "role": "system", "content": "Continuing to use you as a chatbot on a learning platform where your goal is to help Rodolfo Farinha, who is 7 years old and has written about the following topic. Can you challenge Rodolfo Fariha to research more if the description doesn't align with the topic or if it's incomplete? If it's complete for a child of 7 years old, just congratulate them. It is very important that you respond succinctly in American English, without images, and address Rodolfo Farinha informally, using \"you\". Now, continue the conversation in a normal and fluid manner, according to the previous questions, along with the new one, and this time don't start the sentence with \"Hello\"; go directly to the point.\nIf Rodolfo Farinha uses any disrespectful word or term, please start the sentence with \"\$\$\$\$\$\$" and always explain to them that they shouldn't use such terms and why." }</pre>
<pre>{ "role": "user", "content": "\"Topic\": Falcon \"Description\": The falcon is a predatory bird that flies very fast, lives in forests, and is a carnivorous animal."</pre>
<pre>}, { "role": "assistant", "content": "Great job, Rodolfo! Your description is really good. Maybe you can also add how fast they can fly and mention some examples of their prey. Keep up the awesome work!" },</pre>
<pre>{ "role": "system", "content": "Continuing to use you as a chatbot on a learning platform where your goal is to help Rodolfo Farinha, who is 7 years old and is going to ask you another question. It is very important that you respond succinctly in American English, without images, and address Rodolfo Farinha informally, using \"You\". Now, continue the conversation in a normal and fluid manner, according to the previous questions, along with the new one, and this time don't start the sentence with \"Hello\", go directly to the point. \nIf Rodolfo Farinha uses any disrespectful word or term, please start the sentence with \"\$\$\$\$\$\"and always explain to them that they shouldn't use such terms and why."</pre>
<pre>}, { "role": "user", "content": "\"Question\": Can you help me with examples of prey?" }]</pre>

Figure 15 – ChatGPT payload third request real example



Figure 16 – ChatGPT payload third response real example

In addition to the 'model' and 'messages' properties, we can also set a value between 0 and 1 in the 'temperature' property, thus defining the level of creativity in our model's responses, where 0 represents a low or no creativity level, and 1 represents a high creativity level. Since we did not set a value, the default is 0.7, as it was the value that presented the best results.

To evaluate the messages directed at the agent, we included a request in the prompt directing the agent to write '\$\$\$\$ whenever it comes across any response containing disrespectful words. This will help us intercept messages that have disrespectful and offensive content. These messages will be kept and posted later to the platform managers section to help them ascertain the quality/content of the respective message (see Figure 17).



Figure 17 – Message Handling Flow between the Student and the AI Agent

Google Text-To-Speech Integration:

This integration offers the ability for all text generated by the platform to be converted into sound. Now, we only implement it for reading approved articles, thus providing a more personalized and inclusive environment as represented in the study [33].

To use Google Text-to-Speech in the environment based on .NET, the steps of creating credentials and downloading a JSON file allowing you to call for an API will have to be performed (see Appendix H). For API invocation, apart from the 'SynthesisInput' object which will be defined earlier, there are also two other parameter objects which need to be specified: 'VoiceSelectionParams' and 'AudioConfig'. 'VoiceSelectionParams' object is used to indicate the name of one of the Google repos that we want to use in the 'Name' property. In our case it is a male and female voice: "pt-PT-Wavenet-B" a male voice and 'pt-PT-Wavenet-D' a female voice. The value of that property 'LanguageCode' is set to 'pt-Pt' to clarify that the language is European Portuguese (see Figure 18).



Figure 18 – 'VoiceSelectionParams' instance in .NET

'AudioConfig' is an object in which user configuration details of the sound file are defined. The 'AudioEncoding' property specifies a particular encoding of the output audio, in our case, the encoding will be MP3. The 'Pitch' property modifies the frequency of the audio voice, and in our case, we adjusted the value to '-4' to have a deeper voice. Lastly, the 'SpeakingRate' property moderates the speed at which the speech is produced, we applied a value of '0.9' so that the reading was quite slow, which makes it easier for young audience members to comprehend the material presented (see Figure 19).



Figure 19 – 'AudioConfig' instance in .NET

In the end, the 'SynthesisInput' object is charged with receiving the content text, via the 'Text' property, that will later be converted into voice. It was mentioned previously that a variable known as 'text' was employed to capture arbitrary values, which were articles composed by the children, after the managers approve (see Figure 20).



Figure 20 – 'SynthesisInput' instance in .NET

As the result, we receive the MP3 file, which is stored on the platform to be played later during the reading of articles.

3.3.3. User Experience

The platform was developed with the aim of being used by elementary school children. All the relevant User Experience (UX) characteristics were designed for them:

Clarity and Ease of Use:

Clarity and ease of use are essential when designing interfaces for children. We used simple and intuitive icons, preferably in a cartoon style, ensuring that each feature is clearly identified and accessible without visually overwhelming the user [34]. In addition, the interface has been adapted to the cognitive level of children, avoiding complex abstractions and using clear and direct instructions for each action [33].

Pleasant Design and Usability:

Pleasant design and usability are key to keeping children interested in the platform. We used vibrant colors and friendly characters to create a playful and welcoming environment. In addition, interactive elements, such as large, easily clickable buttons, help to avoid frustration during navigation, for example the buttons and icons for actions ('Jogar'⁴, 'Estudar'⁵ and 'Gerir'⁶). We adapted the design to the specific age group, ensuring that the visual experience is attractive and accessible [33].

Engagement & Game-like Features:

Gamification is a powerful strategy for increasing children's engagement and motivation. Using game-like elements, such as 'STOP', allows children to interact with the platform in a fun way, facilitating learning without turning the experience into something overly formal. Incorporating mechanisms such as scoring and virtual rewards can improve engagement and motivation, increasing the effectiveness of learning environments and promoting children's active participation [35].

⁴ 'Play' in English.

⁵ 'Study' in English.

⁶ 'Manage' in English.

Multimedia Integration:

The integration of multimedia, such as videos, images and audio, is crucial to cater for children's different learning styles. Interfaces that use a multimodal approach provide a richer and more inclusive learning experience, allowing children to explore content in a way that is tailored to their learning preferences [36]. The inclusion of different media helps to maintain children's interest and reinforce their understanding of the topics covered.

Organization and Accessibility:

Clear organization of content and accessibility are essential for children to be able to navigate and easily find what they are looking for, such as the different colors applied to each category. Structuring the interface into colored sections and using large action buttons with readable text, such as 'Guardar'⁷ and 'Enviar'⁸, facilitates independent use and reduces comprehension difficulties. Studies suggest adapting design tools to better reflect children's cognitive abilities, making navigation more intuitive and accessible [37].

Focus on Child Autonomy:

Promoting child autonomy is one of the main objectives when designing platforms for children. Interfaces that allow for the creation and editing of content, such as articles or videos, empower children to explore and develop their skills independently. Giving children the ability to interact and create on their own terms fosters a sense of ownership and encourages the exploration of content autonomously [36].

3.3.4. Application Flows

This section details the most impactful flows on the platform. On the manager's side, the approval and viewing of articles and on the students' side, the creation of articles, the STOP game, interaction with the virtual agent and the viewing of articles.

Before we go any further, let's take a look at the main menu screen for the manager (see Figure 21) and the student (see Figure 22). Note that all the data that appears for students and managers is fictitious and was created just to demonstrate the application and all flows are detailed in Appendix I.

⁷ 'Save' in English

⁸ 'Send' in English



Figure 21 – Manager menu screen (manager role)



Figure 22 – Student menu screen (student role)

Article Creation Flow (student role):

The article creation flow begins with the student clicking on the 'Jogar'⁹ button in the student menu (see Figure 22). They are then redirected to the game screen, where a STOP will appear with the letters rotating (see Figure 23).

⁹ 'Play' in English.

					oana Silves 💩	命 Q {	ل ھ	
	Jogo do STOP							
	B	0%		0%	R	0% 0%		
		0%		0%		0%		
		0%		0%	V	0%		
STOP		0%	•	0%	2	0%		
	-	\mathcal{T}						

Figure 23 – Stop game screen (student role)

The student clicks on the STOP button and selects the letter that will start their investigation (see Figure 24).



Figure 24 – Screen with the letter drawn for the stop game (student role)

Once the letter has come up, the student will have to choose the category they want to develop, always according to the letter that came up (see Figure 25).



Figure 25 – Category selection screen (student role)

Once the category has been chosen, the student is redirected to the article development screen (see Figure 26) where they can develop it textually and insert images, sounds or videos, offering different ways of multimodality for the reader.



Figure 26 – Article development screen (student role)

Once the article has been developed, the student can save it or send it for submission. If they send it for submission, the virtual agent's help is invoked to screen the article and give the student initial feedback (see Figure 27). At this point the student can talk to the agent to ask questions or ask for directions/suggestions, they can go back and adjust the work they have submitted or they can end this flow by sending the article for approval.



Figure 27 – Chat interaction screen before submitting the article (student role)

The flow described above is represented in the following sequence diagram (see Figure 28)



Figure 28 – Article creation flow sequence diagram (student role)

Article Approval Flow (manager role):

Once the article has been submitted by any student assigned to the manager's class, the manager receives a notification to approve it. The manager can access the article via the 'View Article' button in the notification they received or click on the 'Aprovar'¹⁰ option in the main menu (see Figure 21) and select the article that appears in the list of articles for approval.

The manager is then redirected to the article detail screen (see Figure 29) where they can see all the information related to the article, such as the written and multimedia content, the messages exchanged between the agent and the student, and finally the list of revision requests for the article.



Figure 29 – Article approval detail screen (manager role)

¹⁰ 'Approve' in English.

Once the article has been approved, the student will receive 100 coins as a reward for their work (see Figure 30).



Figure 30 – Coins received screen after approved article (student role)

The flow described above is represented in the following sequence diagram (see Figure 31)



Figure 31 – Article Approval Flow (manager role)

Article View Flow (student and manager role):

The flow for viewing articles is the same for managers as it is for students, although it starts from different points. The manager clicks on the 'Manage' button in the main menu (see Figure 21) and the student clicks on the 'Study' button also in their main menu (see Figure 22).

In this flow the articles are listed, the student or the manager also has the ability to filter the articles, and after selecting the desired article, they will be redirected to the article detail page (see Figure 32).



Figure 32 – Student's own article detail screen (student role)

The flow described above is represented in the following sequence diagram (see Figure 33)



Figure 33 – Article Management Flow (student role)

3.3.5. Deployment and Infrastructure

Deployment Strategy

Schoolpedia uses shared web server space rented out from PTisp, which is a Windows shared web hosting plan. Such kind of hosting is cost-effective and provides adequate resources to run the application. Even though there are some challenges associated with shared hosting in terms of flexibility and growth, it still offers a reliable space for small or average sized projects such as Schoolpedia.

The main resources offered by PTisps' infrastructure include:

- Web Host Support: The frontend uses Angular 16, which is supported by the web hosting environment.
- ASP.NET Support: The backend runs on .NET 6. This technology is supported by the shared hosting offered by PTISP.
- SQL Server: A database is used, namely SQL Server and it is fully supported on the shared Windows environment and provides a range of automated backup and security services to the users.
- Security: the hosting service provides basic DDoS mitigation and SSL certificates to its customers which helps in protecting the data traffic that is transmitted over the internet.

Deployment Process

The process of Deployment of Schoolpedia at PTisp are in Shared Hosting Environment The hosting site is done manually and Azure DevOps is used to version control the code.

Hosting Environment Configuration: The backend .NET 6 is installed onto the Windows server directly and the Angular frontend is hosted using IIS. The files are moved to the correct directories by hand.

Manual Deployment with Azure DevOps for Versioning: Versioning is implemented using Azure DevOps as a code repository. After the build, all of the built frontend and backend files are collected and placed into the production cells.

Scalability Considerations

The use of a shared web hosting environment restrains the scalability of the application, specifically with regard to processing as well as to the responding to multiple users at the same time. As an option, we think of resource usage improvement through code and architecture optimization and plan relocating to VPS or cloud hosting in the future with demand increase.

At present, multimedia files are uploaded to a server with a 30 GB storage capacity, which is good enough for testing purposes. Even so, this solution will not be sustainable as the amount of data increases. The intended future solution is to adopt a cloud-based blob storage service, which has almost infinite scalability and supports performance retention without being confined by the available storage space.

CHAPTER 4

Evaluation

This chapter looks at the findings of the research carried out using the Schoolpedia platform, focusing particularly on students and teachers. To do this, both groups were tested, and feedback was analyzed with the help of questionnaires. All the tests were done under classroom conditions at school.

This assessment attempts to investigate the effectiveness of the platform in three main aspects:

- Usability and ease of interaction with the system.
- Learning efficacy as well as motivation.
- Communication with the virtual agent and its role in the process of content development.

4.1. Evaluation with Teachers

The evaluation was carried out with the teachers in two stages. During the first stage, there were four teachers, between the ages of 20 and 70, and they tested only the manager flow on the platform.

In this phase, we explained to the teachers what was intended, which was to create student profiles and test the article approval flow. This phase occurred on July 17, 2024 and lasted for two hours.

After receiving feedback from teachers, we decided to change the student registration flow at the request of the teachers. Initially it was planned that students would register with a personal email. However, as these are children between the ages of 5 and 10, who don't yet have an email address, we changed the registration flow and passed the responsibility on to the teachers, who manage their passwords.

We have also improved some of the visual elements, such as changing the icons and colors so that they are more appropriate for our target audience, for example, illustrations of children with different skin colors or different characteristics to be more inclusive. Overall, teachers provided positive feedback, responding to the questionnaire with an open-ended question (see Appendix J):

Question: Please describe your experience with the platform.

- «Interesting, and I can see it has great potential for use with students. » Teacher A
- «The platform is a good tool for both students and teachers. » Teacher B

- «The platform is user-friendly and intuitive. I would improve some icons to make them a bit more expressive. I see its usefulness, as it can foster autonomy in children for their research and exploration of topics related to what they are taught, as well as subjects not explicitly covered in the curriculum. » Teacher C
- «Easy to access and interesting. » Teacher D

During the second stage of testing, five teachers took part in the test, between the ages of 20 and 70. In this stage, two teachers acted as manager whereas three teachers worked as students.

In this phase, we also explained to the teachers what was intended, which was to create student profiles and test the flow of article approval, and with the student profile, to play the STOP game and develop articles. This phase took place on September 10, 2024 and lasted for two hours.

4.1.1. Teacher Satisfaction and Experience with the Platform

Preliminary usability testing of the platform was carried out during the two phases, in the first by four teachers and in the second by five, where three of the teachers took part in both phases, testing the users' experience. Most of the teachers rated the platform's usability as easy (see Figure 34), adding that the interface was easy and straightforward to use.



Figure 34 – Evaluation of platform usage

On the other hand, some teachers reported technical problems with data entry, for example the entry of individual students was bugged. They also said that the system could be improved in terms of the text input interface, especially for the younger students who are still at the writing stage.

Apart from that, the educators assessed the platform in terms of its effectiveness (see Figure 35), noting that they viewed their use of the platform in general favorably (see Appendix K):

- «Very enriching due to its high level of interactivity. » Teacher A
- «Positive. I think it would be interesting for younger students to create a class encyclopedia to learn how to use the platform. *» Teacher B*
- «Very positive. » *Teacher C*



Figure 35 – Evaluation of the platform's effectiveness in encouraging content creation

4.1.2. Impact on Content Creation

The teachers pointed out that the platform might play a role in motivating students to generate content, particularly at the stage of developing articles, when they can supervise and help the students with the material they are working on. The findings of this study reveal that the platform is compatible with pedagogical strategies incorporating active and collaborative learning: there is strong supporting evidence in their answers to the following question (see Appendix K):

What features or resources do you consider most important on the platform?

- «The ability to continuously correct the articles as they are being created. Providing constant feedback. *» Teacher A*
- «The ease of obtaining information in an appealing way. » Teacher B
- «The research conducted by the students. » Teacher C
- «Viewing a variety of topics. » Teacher D

They also see the virtual agent being useful in assisting students with their research processes and article writing, thus revolutionizing their current approach to research (see Figure 36).



Figure 36 – Usefulness of the agent in supporting the research process

On the other hand, it was noted that younger students, especially those in the 1st and 2nd grades, are likely to experience greater problems in writing. It was recommended that the platform does offer a different option, and this will include the possibility of making the activities easier for students.

If you could suggest improvements, what would you change or add to the platform?

- «For certain situations or age groups, allow research to be copied instead of written by the students. *» Teacher A*
- «The possibility to limit a database where students could conduct their research. » Teacher B
- «For 1st-grade students who are still learning to read and write, I suggest adding a word game. For example, in the 'STOP game,' students would only need to write a word or sentence starting with the selected letter. » *Teacher C*

4.2. Evaluation with Students

Later, in a third stage, we tested six primary students aged between 6 and 9 years across grade levels and classes. We took care to design the children's questionnaire in an intuitive and simple way that they could easily understand [38].
4.2.1. Student Satisfaction and Motivation

The first metric analyzed was the students' motivation towards the Schoolpedia platform. In accordance with the answers, most students enjoyed using the platform and were mostly positive (see Figure 37).



Figure 37 – Student satisfaction and motivation

These responses suggest a large portion of students' acceptance of the platform which implies that the incorporation of gamification elements in 'STOP game' as well as the engagement with the virtual agent was most likely effective to attract interest and pleasure (see Figure 38).



Figure 38 – Components that most motivated the students

4.2.2. Ease of Use of the Platform

Also, the usability aspect was examined, and most of the students claimed that the platform was user friendly (see Figure 39), but some students expressed reluctance especially on writing (see Appendix L).

For their primary school students, the challenge to write posed a greater barrier as seen below:

- «I didn't have many ideas for the letters that came up. » Student A
- «I found it somewhat easy to use the platform. I had more difficulty with writing. » Student B

The incorporation of multimedia content was another major difficulty encountered. For instance, none of the students were able to add any multimedia content at all.

Nonetheless, even with these difficulties, all the learners managed to write articles and send them to be approved for publication (see Figure 39).



Figure 39 – Ease of use of the platform

4.2.3. Learning and Content Enrichment

In terms of learning, two students expressed the opinion that they acquired a deeper knowledge from the usage of the virtual platform. Content creation and content article writing were explicitly listed as the most rewarding elements of the experience based on final notes of the students in open-ended responses (see Appendix L).

- «I felt that I learned more things. » Student A
- «It was really fun, and I hope to do this again. » Student B

These findings show that Schoolpedia achieves its purpose of encouraging students' active participation in both research and content generation.

4.3. Evaluation of Interactions with the Virtual Agent

During the tests, when the students were working with the platform, we noted that apart from the 'STOP game', another component was also a big motivational factor, the virtual agent. Equally impressive where those students, after writing the articles, spent some time interacting with the agent and clearing any doubt that might have arisen.

4.3.1. Analysis of Interactions with the Virtual Agent

The virtual agent held a position of prominence in helping the students during the article composition process and during the phase of gathering information. As evidenced by the analyzed chat scenarios of virtual agent and students, it was determined that the Agent was proficient in providing feedback and instructing transitions to improve the writer's descriptions and the exploration of new topics.

For example, in the dialogue between Student A and the virtual agent concerning "Caramel" (see Figure 40 and Appendix N), the agent encouraged the student to further elaborate on the candy and seek for other aspects to write about. This type of interaction demonstrates that the agent was able to promote a more in-depth and detailed projects explaining the students reasoning and scope of work.



4.3.2. Challenges in Interactions with the Virtual Agent

Although most interactions between the students and the agent were positive, some difficulties were also observed. In one instance, Student B (see Figure 41 and Appendix M) displayed less polite communication during the interaction, responding with disorganized and sometimes disrespectful comments. This behavior may indicate the need for an additional module for the agent in order to handle these more complex interactions or to respond to moments of student frustration. Nevertheless, the teachers have the complete access to the dialogues and can personally take care of such situations.



Figure 41 – Conversation between Student B and the Virtual Agent

In another example, the agent constantly tried to convince Student C (see Figure 42 and Appendix Q) that the article he had submitted could be improved, which, in our opinion, is demotivating when this type of statement goes on in an endless cycle.

The analysis of these interactions suggests that the virtual agent can be improved regarding the personalization of responses and the ability to detect when a student is feeling 'frustrated', providing more empathetic feedback adapted to the user's emotional state.



Figure 42 – Conversation between Student C and the Virtual Agent

a tua descrição já está bastante boa e clara para a tua idade! Mencionaste várias palavras começadas com a letra N. Gostaria de te desafiar a pensar em mais algumas palavras que comecem com essa letra. Consegues pensar em mais exemplos? Se precisares de inspiração, podes pesquisar palavras com N e ver quantas consegues encontrar! Boa sorte e parabéns pelo excelente trabalho até agora! 🞉

Tema: N Descrição: A letra N é usada para escrever algumas palavras como: não, nunca, nadar, Nadia, nabo, nada nó navio noitenovo



A tua lista de palavras que começam com a letra N está bem feita, No entanto, poderias explorar mais palavras e talvez organizar a lista melhor. Por exemplo, podias separar as palavras em duas linhas ou inserir mais palavras. Que achas de procurarmos mais palavras juntas? Aqui vão alguns desafios para ti: 1. Consegues encontrar mais palavras que comecem com a letra N? 2. O que achas de colocar as palavras por ordem alfabética? Se preferires, posso ajudar-te a começar! O que achas?



Claro, Em que é que precisas de ajuda agora? Se for sobre a letra N ou outra coisa, podes perguntar à vontade!

Tema: N Descrição: A letra N é usada para escrever algumas palavras como: não, nunca, nadar, Nadia, nabo, nada nó navio noitenovo

Parece que listaste uma boa quantidade de palavras que começam com a letra N. No entanto, noto que a lista de palavras está um pouco desorganizada. Que tal fazeres uma lista mais estruturada? Além disso, podes pensar em mais algumas palavras que começam com a letra N. Que te parece? Aqui fica um exemplo de uma lista mais organizada: - não nunca - nadar - Nadia - nabo - nada - nó - navio - noite - novo Desafio-te a pesquisar mais algumas palavras com a letra N e a adicioná-las à tua lista. Boa sorte e diverte-te a aprender! Se precisares de mais ajuda, estou aqui.

Figure 43 – Conversation between Student C and the Virtual Agent (Continuation)

CHAPTER 5

Conclusions and Future Work

5.1. Conclusions

This report presented the conceptualization and implementation of the gamified digital platform Schoolpedia, whose main objective was to promote autonomous research and the collaborative construction of knowledge between elementary school students and teachers. Through an action research methodology and using Design Thinking techniques, the study sought to answer how the use of collaborative digital platforms can impact the construction of scientific knowledge by elementary school students, stimulating their active participation and motivation.

We investigated the impact of using the Schoolpedia on the construction of scientific knowledge by elementary school students, as well as the role of gamification and teacher mediation in this context. The research questions were answered as follows:

What kind of influence (positive or negative) does the use of a collaborative digital platform have on the way elementary school students construct their scientific knowledge?

The Schoolpedia platform proved to have a positive influence on the construction of students' scientific knowledge. Analysis of questionnaires and classroom observation indicate that students engaged significantly in active research and content creation, which resulted in a significant increase in engagement and mastery of digital and scientific skills. Students were able to carry out autonomous research and actively participate in the collaborative construction of knowledge, thus validating the platform's effectiveness in promoting a more dynamic and interactive learning environment.

How can gamification support students' active participation in collaborative learning environments and motivate them?

Gamification, through elements such as the STOP game and interaction with the virtual agent, was crucial to increasing students' motivation and active participation. The use of rewards and the integration of an AI agent that provided real-time feedback encouraged students to become more engaged in the proposed activities. The data collected showed a high level of student satisfaction, especially in the activities that involved these gamified components, proving that gamification was a relevant motivational factor in the educational context explored.

How can teachers benefit from the aid of artificial agent to help validating and mediating the material produced by their students?

Based on teacher feedback, the use of the virtual agent was considered an effective support in the content validation process. Teachers reported that the agent's ability to provide immediate feedback and correct common errors during the creation of articles helped to make the process more agile. In addition, the agent encouraged students to deepen their work, suggesting improvements and promoting autonomy.

Initially we also thought about developing a reward system using virtual coins and displaying a league table by class, but the studies we saw in the literature review revealed that the introduction of ranking systems did not have good results, so we decided to keep the reward with coins, but hidden for each student and without ranking.

In short, the Schoolpedia project achieved its objectives of promoting collaborative and engaging learning through the use of a gamified digital platform, demonstrating the potential of these tools in basic education.

However, there are some limitations regarding the number of participants in the tests carried out. There would have been the potential and need to test with a larger number of students and teachers, but due to the vacation season and deadlines for submitting the dissertation report, it was not possible to carry out more tests.

5.2. Future Work

Given the results achieved and the observations made by users, there are several promising directions for the future development of the Schoolpedia platform. To maximize its impact and meet the diverse demands of students, teachers and families, it is suggested that three main lines of investigation and improvement be adopted: expanded and inclusive gamification, research in three distinct dimensions, and educational rewards and external partnerships.

5.2.1. Expanded and Inclusive Gamification

Gamification and the inclusion of AI have been the core elements in the platform's success, but there is room for expansion, especially for younger students. To increase engagement and cater for different learning profiles, we suggest:

- **Diversification of Games:** Include a wider variety of educational games, ranging from simple cognitive challenges to more complex games that encourage problem-solving and critical thinking. These games should be adaptable to different age groups and skill levels.
- Inclusive Technologies: Incorporate technologies such as speech-to-text to help students with writing difficulties. In addition, the possibility of integration with mechanical remote controls would allow students with special educational needs to participate more actively and autonomously in the platform's activities.
- Ease of Multimedia Use: Simplify the insertion of multimedia files, such as images, sounds and videos, through specialized APIs or existing libraries where the user only selects the file. This will allow students and teachers to add multimedia content more intuitively and quickly, enriching the learning experience and promoting creativity.
- Family Integration into the Platform: The creation of a restricted profile for family members will allow parents or guardians to closely monitor students' progress on the platform. Initially, access would only be restricted to students' activities and academic progress, but the inclusion of feedback on the development of specific skills, participation in collaborative projects and interaction with other students could be evaluated. This monitoring will bring greater engagement from families, reinforcing support for learning and promoting more effective communication between school and family.

5.2.2. Classroom-directed, family-based and AI-Supported Research

Exploring new forms of investigative learning can transform the way Schoolpedia is used. Three distinct avenues of inquiry can be explored:

• Classroom-Directed Research: In this mode, the teacher provides teaching materials on a given topic, guiding the students' investigation. The integration of RAG (Retrieval-Augmented Generation) technology could enhance the role of the AI agent, helping students to carry out deeper, more focused research into the materials provided. This would help contextualize learning and promote more structured and effective teaching.

- Family-Based Research: Extending learning beyond the classroom, allowing children, with the support of their families, to explore topics of interest during everyday activities, such as outings, trips or family time. The platform could offer specific resources for documenting these experiences, allowing students and their families to record discoveries and develop investigative projects together, strengthening family ties and collaborative learning.
- AI-Supported Research: In this format, the student starts an investigation based on a visual or auditory stimulus captured in everyday life (for example, a photo or sound). The AI agent identifies the content and suggests an initial research topic, encouraging the student to continue exploring and investigating. This type of investigation is particularly interesting for stimulating students' natural curiosity and promoting autonomous and exploratory learning.

5.2.3. Educational Rewards and External Partnerships

One innovation that could further increase student engagement is the introduction of a rewards system that extends beyond the platform:

- Exchanging Coins for Real-World Benefits: Schoolpedia could establish partnerships with theme parks, museums, monuments and other cultural and educational institutions. With this, the coins accumulated by students during their investigative activities could be exchanged for discounts on tickets or cultural activities. This system of tangible rewards would not only encourage student participation, but also promote access to enriching educational experiences outside the school environment.
- **Coin Exchange System Among Students:** In addition, allowing students to exchange coins with each other could foster a sense of community and collaboration, encouraging them to help each other gain benefits and to develop negotiation and teamwork skills.

These lines of development suggest a promising future for Schoolpedia, expanding its functionalities and educational impact. By exploring new gamification and inclusion approaches, diversifying investigation paths and creating a reward system connected to the real world, the platform can become an even more effective and attractive tool for students, teachers and families. These enhancements will not only increase engagement, but also contribute to the formation of citizens who are better prepared for the challenges of the future.

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Appendices

Appendix A – Script

What is your name, which academic institution do you attend, and what is your position in the school (Student, Teacher, Coordinator)?

2 – Student Script:

2.1. Are you able to describe yourself as one of the most scholars who achieves results in his/her subjects?

2.2. If not, what are the dominant reasons for the lack of commitment or success?

2.3. Can you say that you are inspired and encouraged by the subjects and courses that are being taught?

2.4. Of which subjects do you feel the most enjoyment in and expound?

2.5. In your study routine, how many hours a week do you dedicate to self-study?

2.6. After learning a topic in class do you do outside reading or research on your own on that particular subject to expand on it?

2.7. What do you think of the use of technology in your lessons?

2.8. Do you own personal technology, a computer or a mobile phone or similar?

2.9. If the answer is affirmative, how many times per day would you use it?

2.10. In your opinion would the integration of technology enhance your motivation and academic performance as a student?

2.11. Do you know the game 'STOP'?

2.12. If so, what other games do you usually play that are of the same nature?

2.13. Do you have classes for special education?

2.14. If yes, what methods did you apply during the classes, and are you able to blend well with the students in the regular education system?

3 – Teacher Script:

3.1. What is your area of specialization, and how long have you been teaching?

3.2. In your opinion, what are the internal dynamics of your classes' activities?

3.3. How would you assess the efficacy of the pedagogical methods employed?

3.4. What do you think is the level of students' motivation in your classes? Are they engaged in the processes of learning the content provided to them?

3.5. How do you see the contribution of teachers towards the improvement of the learners' motivation?

3.6. How do you deal with diverse learner types within the classroom?

3.7. What measures do you take in order to engage the students actively in the class sessions?

3.8. What is the role of educational media in the course family, and what technologies do you use in your courses?

3.9. How do you manage to teach such types of students who are very different in their own and the their culturally oriented student centered approaches to learning?

4 – Coordinator Script:

4.1. How would think of the possibilities of technology in the sense of individualization in education, and changing the pace of learning?

4.2. What measures has the school taken to ensure that teaching methods are responsive to the individual requirements of the learners?

4.3. How can the teachers use technology to communicate among themselves in the course of this communication, how is a wider picture of the student presented?

4.4. What measure has the school put in place to make sure that teachers are following the general pedagogical principles and the aim of the education?

4.5. In your opinion, how can consolidation of teaching help achieve better conformity towards the achievement of specified educational objectives?

4.6. What is the school doing towards teachers-built-up professional growth so that teachers are timely and ready to integrate new tools?

4.7. How critical is the undertaking and evaluation of body of educational work data with respect to modifying strategies towards the teaching and backing systems for quality enhancement?

4.8. How would you explain to the school how it is possible to factor in modern technologies into practice and without neglecting the social and emotional aspects of the students?

4.9. How does the school cope with teachers, or parents who are against the bringing of the technology in education?

5. Would you find it interesting to have a knowledge platform that is populated and validated by the students using educational games and endorsed by teachers/expert?

6. What are some ways that we can encourage students to make use of this platform? How about annual public assessments interspersed with the classes during the session and whereby winning prizes at the end is encouraged?

Appendix B – Personas

Persona 1 (Student):

Luís is quite the active and inquisitive boy. While he is very responsible at school, he enjoys the initiation into discovery actively, mostly outside, in the countryside. At the age of seven years only, he is such an enthusiastic individual who is fond of the sounds of nature and little subtleties of life such as observing different species of birds, and flowers, and butterflies.

Being in 3rd grade, Luís is an insatiable explorer looking to know more about the environment. He is also very much involved in science lessons and shares some of his experiences which are quite helpful in class.

Persona 2 (Student):

Maria, a 9th-grade girl living in the city is very much involved in the virtual world. A lot of her time is dedicated to online activities making ideas come to life in the form of blogs, videos and even social media. Although she is not particularly active in class, preferring social science subjects wiki and read the material on her own.

She also indicates that education should be different, and schools should use modern technologies and approaches as the current generation of students requires that. In her room, which is a scanning creative workshop, she is a designer and implements her ideas and represents herself on the web.

Persona 3 (Student):

João is a one special educational needs student who is eleven years old suffering from a hearing and attention difficulties. His teachers make use of more of visual based approaches with the use of graphics and presentations among others. The surroundings of the school are such that they offer help to João working with different specialists for his wellbeing and development academically and socially. Nevertheless, the topics and subjects taught to João at times are different from those other students are taught because of the conventional and strict curriculum leaving João out of most conversations and discussions with his peers.

Persona 4 (Teacher):

Carla, who teaches Physics and Chemistry in 8th and 9th grade, encounters the problem of combining the traditionalist approaches with the technologies. Concerned how students will pay attention to the lesson she uses PowerPoint presentations, video, and e-learning. For Carla, the introduction of new technologies is just a chance to improve her competencies and skills and redirect the processes of teaching according to the needs of the young people.

Realizing that what she is doing is helpful for the students, she fights for attention without being overbearing ensuring students do not feel overwhelmed and incorporating increased activities in her lessons.

Persona 5 (Teacher):

Emanuel is a special education teacher who believes that he can help enhance the quality of life of his students with special educational needs. He understands that this field of special education is constantly evolving, nevertheless, scarcities in some aspects become glaring as the world changes. In his preparation of his students, "technological developments" and the knowledge attitude is focused on basic and secondary knowledge only as well as interaction skills to scraping the students along with the trend.

Persona 6 (Coordinator):

Lurdes, the head of the coordinating team, has a worry regarding the alignment of each student with the methods of teaching that are at hand. Technology in her view will enhance the visibility of individual accomplishments whereby where necessary modifications are needed may be done. Lurdes is of the opinion that the education will be made centralized through technology and that enhances also the communication amongst teachers which in turn will aid in understanding the students' needs better and hence, more efficiently tailoring the teaching at them.

Appendix C – Prototype

Student Profile:



To access the platform, all students must have a login.



After logging in, they will be taken to a menu with three options.

"Play" Option:



The students will play the "Stop" game.



They will be redirected to choose the category you want to develop.

"Play" Option:



The students will develop it, and then send it for approval.



When finished, a first screening is done by our AI agent.

"Study" Option:



The students will select the category they wish to study.



They are then redirected to search for articles in that category.

"Study" Option:



The students open the article they want to read.

"Manage" Option:



The students can view all the articles they have written.



The students can open an article in detail and make updates.

Manager Profile:



To access the platform, all managers must have a login.



After Login, they will be taken to a menu with two options.

Manager Profile:

"Approve" Option:



The managers can view all the articles that are yet to be approved.



The managers can open an article in detail to approve or to send for review.

Manager Profile:

"Manage" Option:



The managers can view all the articles.



The managers can open an article in detail and archive it.

Appendix D – FISTA Presentation


























































Appendix E – Publication by the AEJD about FISTA participation



Escola Superior de Educação João de Deus 5 de março · 🚱

O projeto Schoolpedia/Escolapédia cuja ideia foi proposta pela Associação de Jardins-Escolas João de Deus. Este projeto foi apresentado, pelo estudante de Mestrado em Engenharia Informática do ISCTE, o Rodolfo Farinha, com a orientação da Professora Doutora Isabel Alexandre, no FISTA 24 - Forum of ISCTE-IUL School of Technology and Architecture - é um evento anual que traz o mundo das empresas à universidade. A apresentação ocorreu no âmbito de uma sessão de empreendedorismo, no qual este projeto foi selecionado.



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Appendix F – Entity Relationship Diagram



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Appendix G – Configuring an OpenAI API Key

Step 1: Create an OpenAl Account

- If you don't have an OpenAI account yet, follow these steps:
 - 1. Go to the OpenAI website <u>https://beta.openai.com/signup/</u>.
 - 2. Create your account using your email or by logging in with Google or Microsoft account.

Step 2: Generate an API Key

- After creating and/or logging into your account:
 - 1. Access the OpenAl Dashboard https://platform.openai.com/account/api-keys.
 - 2. In the dashboard, click the "Create new secret key" button.
 - 3. After that, A modal will appear and we click on the "Create secret key button".

Create new secret ke	wreade new secret key wind by You Service account his API key is tied to your user and can make requests against the selected project. If ou are removed from the organization or project, this key will be disabled. ame Optional My Test Key roject Default project ermissions All Restricted Read Only Cancel Create secret key			
Owned by	reate new secret key wned by) You Service account is API key is tied to your user and can make requests against the selected project. If u are removed from the organization or project, this key will be disabled. ame Optional My Test Key oject Default project Cancel Create secret key			
You Service account				
Create new secret Key Owned by You Service account This API key is tied to your user and can make requests against the selected project. If rou are removed from the organization or project, this key will be disabled. Name Optional My Test Key Project Default project				
Name Optional				
My Test Key)
Project Default project			¢	
Permissions				
All Restricted Read O	nly			
	Ca	incel	eate secret key	
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- 4.
- 5. Next, another modal will appear with the generated key. Copy the API key and store it in a safe place, as you will not be able to view it again after closing the modal.
- 6. Now we are ready to integrate with the ChatGPT API.

Step 3: Integration with .NET

- This integration is done via .NET's "HttpClient", where in the "DefaultRequestHeaders.Authorization" property we create an instance of the "AuthenticationHeaderValue" with the values "Bearer" and the OpenAI API Key as parameters.
- Finally, we can invoke POST method calling "https://api.openai.com/v1/chat/completions".

Note: Avoid sharing this key publicly, as it grants access to your account and API usage.

Appendix H – Configuring a Google Text-to-Speech Credentials

Step 1: Set Up Google Cloud

- Create a Project in Google Cloud
 - Access Google Cloud Console:
 - 1. Visit the Google Cloud Console <u>https://console.cloud.google.com/</u>.
 - 2. If you don't have a Google Cloud account yet, you'll need to create one.
 - Create a New Project:
 - 1. In the Google Cloud Console dashboard, at the top of the page, click the project dropdown to the right of the Google Cloud logo.
 - 2. Click the New Project button.
 - 3. Give your project a name (for example, MyTextToSpeechProject).
 - 4. Choose an organization (if applicable) and a location, if configured. Otherwise, leave the default organization as "No Organization."
 - 5. Click Create. The project will be created, and you'll see a notification when it's ready.
- Enable the Google Cloud Text-to-Speech API: Now that you've created your project, you need to enable the Text-to-Speech API within Google Cloud.
 - Access the API Library:
 - 1. In the left-hand navigation menu, click on APIs & Services, then click on Library.
 - 2. In the API library search bar, type "Text-to-Speech."
 - Enable the Text-to-Speech API:
 - 1. In the search results, click on Google Cloud Text-to-Speech API.
 - 2. On the API page, click the Enable button.
 - 3. This will allow your project to use the Text-to-Speech API services.
- Create Authentication Credentials (Service Account Key): To authenticate when making requests to the Text-to-Speech API, you'll need to create service account credentials. This gives your application the necessary permissions to interact with Google Cloud.
 - Access the Credentials Page:
 - 1. In the left-hand navigation menu, go to APIs & Services > Credentials.
 - 2. On the Credentials screen, click the Create Credentials button and select Service Account.

- Create a New Service Account:
 - 1. In the window that appears, define the name of the service account (e.g., my-text-to-speech-service-account).
 - 2. Optionally, enter a description (e.g., "Account for Text-to-Speech API").
 - 3. Click Create and Continue.
- Grant Permissions to the Service Account:
 - In the next step, you can choose a role for the service account. A role with appropriate permissions to use the API is Project > Editor or Project > Owner, but you can set more restrictive roles if you want more granular control.
 - 2. Select the role and click Continue.
- Generate and download the JSON Key:
 - 1. After setting up permissions, the next screen will allow you to generate an authentication key.
 - 2. Choose the JSON format (this will be selected by default) and click Done.
 - 3. The JSON file will be downloaded to your computer. This file contains the credentials your .NET application will use to authenticate with the API.
 - 4. Finally, this file should be placed in the .NET project and instantiated as an environment variable so that when we invoke the voice production method, the process can include the authorization settings in the request.

Appendix I – Application Flows

Default User:

- When the application is started, a default user "admin@admin.com" is created with the roles of 'Manager' and 'Admin'.
- This user is used to set up the first school and create the first real administrator manager.
- Once this profile has been created, this default user will no longer be needed.

At this point, we'll show you the happy path where we create just one school and one non-admin manager. It should be noted here that all administrators have the role of managers, but there can be managers without administrative functions.

Note: All data associated with the following flows that appear in the screenshots are fictitious

Login Flow (admin, manager, and student roles):

1. The login process is uniform for all users, regardless of their role, including managers and students. However, for students, there is a fundamental difference when it comes to using credentials. Managers and administrators log in with their e-mail addresses and retrieve their passwords through these. In the case of students, login is done with a username, and password management is the responsibility of managers. In addition, the login page includes a "remember me" option, which allows you to store your e-mail address or username in the browser, making it easier to fill in the fields automatically when you log in again (see Figure I-1 and I-2).

		, Q
$\overline{\mathbf{a}}$	SCHOOLPEDIA Login	
	Email ou Username Palavra-passe	
	Entrar	

Figure I-1 – Login screen



Figure I-2 – Login Flow (admin, manager, and student roles)

Manager Creation Flow (admin role):

1. When the manager with 'Admin' role logs in, they are presented with two options: 'Aprovar' or 'Gerir' buttons. This page is also displayed to users with the 'Manager' role (see Figure I-3).



Figure I-3 – Manager menu screen

2. Only when a user has the 'Admin' role can they create manager accounts. To register a manager, it is first necessary to create the school with which the manager will be associated. To do this, the administrator must click on the 'Gerir' button, go to the 'Escolas' tab, enter the name of the school and click on the add button (see Figure I-4). On this page, you can also use the search filter to find schools.



Figure I-4 – Schools screen (admin role)

 After creating the school, we can ask the manager to register on the platform. On the 'Convites' tab, enter the manager's email address in the 'Email' text field and, in the 'Escola' field, select the school where the manager will be working from a drop-down list (see Figure I-5).

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		\mathcal{T}		Informação de Convite enviac 'rodolfo.alves.f	e convite X lo com sucesso para arinha@gmail.com'.

Figure I-5 – Valid invitations screen (admin role)

4. This page also has an add button to invite the user and another to search for users by email or school. On the 'Utilizados' button, you can see the invitations that have already been accepted by the managers. If, for some reason, the manager doesn't receive the email with the invitation to join the platform, they can resend the invitation by clicking on the yellow refresh button that appears in the manager's line. If the invitation needs to be removed, simply click on the red button on the same line. Once the invitation has been sent, the manager will receive an email with a link to register on the platform (see Figure I-6).

Convite de registo 🔉 Caixa de entrada ×	
Schoolpedia <noreply@schoolpedia.pt> para mim 👻</noreply@schoolpedia.pt>	18:29 (há 7 minutos)
Olá rodolfo alves farinha@gmail.com,	
A Schoolpedia, convida a increver-se na mais inovadora plataforma de conhecimento, desenvolvida pela Associação de Jardins Escolas João de Deus, com a função de gestor.	
Por favor, clique na seguinte hiperligação para registar. http://localhost.4200/#/register/rodolfo.alves.farinha@gmail.com/c29a1faf-b745-44dd-88d8-954e8b62ffb8	
••••	
Com os melhores cumprimentos, Equipa Schoolpedia	

Figure I-6 – Registration invitation e-mail

5. When the manager clicks on the link in the email, they will be directed to the registration page, where they will have to choose the avatar they like best, enter their full name and create a password (see Figures I-7 to I-9).



Figure I-7 – Manager registration screen



Figure I-8 – Manager registration screen avatar list

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	rodolfo.alves.farinha@gmail.com Rodolfo Aires Alves Farinha	Um caractere especia Um tetra malúscula Um tetra minúscula Um número As palavras-passe col	ncidem	
		Registar		

Figure I-9 – Manager registration screen avatar selected

6. After this step, you will be redirected to a page informing you that a registration completion email has been sent (see Figures I-10 and I-11).



Figure I-10 – Registration confirmation screen

Confirmação de registo 🄉 Caixa de entrada 🗙		
Schoolpedia «noreply®schoolpedia.pt> para mim ♥	18:35 (há O minutos)	☆
Olá rodolfo alves farinha@gmail.com,		
Bem-vindo à Schoolpedia, a mais inovadora plataforma de conhecimento, desenvolvida pela Associação de Jardins Escolas João de Deus.		
Por favor, clique na seguinte hiperligação para confirmar o seu registo: http://localhost.4200/#/register/validation/871fbd82-74c5-40f4-0a89-08dcd4e38dfe/Rodolfo\$\$\$Farinha/Q2ZES/hEMUs4V1ZiVGxGRnUzaDhkR1ZjSFVWNXh1eFZ0eUxSaFp2UHdiSG rNDFZaEU4cFA4VS9sMzhNWXNFNIIUa3MwbzNVbjFuRGoyMFhKRTkwbJGV0dqRFnZV3dGGnVoRzczMG10MGcxNUZJOGNwTU5yWHVZNZIBY0ZOTmFPR2U3dm5CYjdsciJcm1 mUZS2hGU02FSXdjQ2puM3Q1bmJENViGUVpmcjxSGlibmVBYmV5ZKZhL2czMkp3MkNydktCTndwUHk2V0tSK2R3cnVyZ29ftkE9MVjpyCHkySGp2YSikdFpQZz09	<u>pwbkR1SIBGZIA3T3ILa</u> IVNGt5bTZhSFA0eVdk	<u>amU</u> :Q
Com os melhores cumprimentos,		
Equipa Schoolbedia		

Figure I-11 – Registration confirmation email

7. In the administrator's session, you can check in the invitation management section, via the 'Utilizados' button mentioned above, that the manager has already used the registration invitation. However, if the manager's confirmation e-mail is lost, the administrator can validate the registration by clicking on the green button with a checkmark (see Figure I-12).

873	SCHOOLPE	EDIA						Olá, Admii	nistrator 🇑	<u>ଜ</u>	\$ () €
											/
				Gestores Σ	Convites						
Email				E	Iscola					• Q	Válidos
Email			Escola				Código				
rodolfo.alves.	farinha@gmail.co	m					c29a1faf-b745-	44dd-88d8-95	4e8b62ffb8		~
				« «	1 >	» 25 v					

Figure I-12 – Used invitations screen (admin role)

8. When the manager clicks on the registration confirmation link, the process will be completed, and they will be redirected to the registration completion page (see Figure I-13).



Figure I-13 – Registration confirmation screen

9. At this stage, the manager's registration will have been successfully completed, and from that moment on they will be able to log in to the platform. In the 'Gestores' tab, the administrator can locate a specific manager, update their details or even block the manager if necessary (see Figures I-14 and I-15).

	\$73	SCHOOLPI	EDIA				Olá, Admir	iistrator 🇑 🏠	₽ ֎ ⑴
1						<u> </u>	1 Contraction		
				Alunos & G	estores 🖾 Convites				
	Pesquisa							Adminis	trador Bloqueados
	Nome			Email		Escola			
	Rodolfo Aires	Alves Farinha		rodolfo.alves	.farinha@gmail.com	-			8
					≪ < 1 >	» 25 ¥			
					2				

Figure I-14 – Managers list screen (admin role)

	Ą	Olá, Administrator 🍙 🍙 🗘 🍪 🕛
🗏 Artigos 👖 Escolas 🍂	: Turma 😤 Altunos 🔗 Gestores 🖾 Convites 🔍 Chats 🐵 Definições	
Pesquisa	Gestor	Administrador Bloqueados
Rodolfo Aires Alves Farinha	Email rodolfo.alves.farinha@gmail.com	
	Rodolfo Aires Alves Farinha Escola	
	Administrador	
	Editar 🖉 Cancelar X	

Figure I-15 – Managers list screen (admin role)

ł		Login	Page Main	Menu	School Re	gistration	Invitation M	lanagement	Registration Page
Admin	Log in with Email and Passw	ord							
	Login Successful	•							
	View 'Aprovar'	or 'Gerir' options							
	Click	'Gerir'							
				Navigate to 'Escola	as' tab				
		Create new schoo	1						
		School created							
		Navig	ate to 'Convites' tab						
		Enter man	ager's email and school						
			Invitation sent				-		
•			Ac	cept invitation					
			Regi	stration link sent					
		•		Register with name	and passw	ord			
				Confirmation	email sent				
		• Validate	registration if needed						
				Click registration co	onfirmation	link			
				Registration	complete				
	Update or lock manager in 'Gestores' tab	4							
\bigcirc			De se		6-1				
Admin	Man	Login	Page Main	Menu	School Re	gistration	invitation N	lanagement	Registration Page

Figure I-16 – Manager Creation Flow (admin role)

Application Settings Flow (admin role):

 Finally, while still in the administrator's session, users with this role can change application settings like turning on/off the 'Agente Virtual' or 'Leitura Automática de Artigos' (see Figure I-17 and Figure I-18).



Figure I-17 – Application settings screen (admin role)



Figure I-18 – Application Settings Flow (admin role)

Student Registration Flow (manager role):

 The process of registering students is the responsibility of the managers. In the main menu, the manager has two options: 'Aprovar' or 'Gerir' (see Figure I-3). In the 'Gerir' option, on the 'Estudantes' tab, the manager can start by clicking on 'Template' to download the template (in csv format) for filling in student data (see Figure I-19).



Figure I-19 – Students screen (manager role)

2. On the downloaded template, the manager fills in the fields associated with each student, where each line represents a student (see Figure I-20).

4	Guardar Automaticamente) 🔚 🦻 × 🤍 ∓ templa	ite.csv 🗸		€ Procura	ır							RA -	• • •
Fiche	ro <mark>Base</mark> Inserir Esquer	ma da Página Fórmulas Dad	los Rever Ve	er Automatiza	ar Ajuda								Comentário:	🖻 Partilhar
	Colar V I	$\begin{array}{c c} & & & \\ \hline \\ \hline$	= = ≫ • = = ⊡ ⊒	라 Moldar Te	tto Ger trar ~ 🗺	al ~ % 000 58	- Formata	eção Formatar con nal ~ Tabela ~	no Estilos de Célula ~	Inserir Eliminar	Formatar	ČZ Ordenar e⊥ Filtrar čSe	ocalizar e Sup	lementos
Área	de Transferência 🕞	Tipo de Letra 🏻 🖓	Alinhan	nento	Fa	Número	F5	Estilos		Células		Edição	Sug	lementos
A12	\checkmark : $\times \checkmark f_{x}$													
	А	В	С	D	E	F	G	н	1	J	K	L	М	N
1	Nome Completo	Data de Nascimento	Ano	Turma										
2	João Manuel	14/09/2016	4	А										
3	Ângelo Fernandes	15/09/2017	3	Α										
4	Cristiana Moreira	16/04/2017	3	В										
5	Carla Santos	17/03/2018	2	Α										
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
<	> template	+						1.40						

Figure I-20 – Template for batch student registration

3. The template is then uploaded to the platform using the upload button (see Figure I-19), where a modal will open to insert the file created (see Figure I-21).

				Olá, Rodolfo	Farinha 🁩 🙆	U @ Q 1
🗏 Artigos 🦟 Turma 🙁 Alunos	Q Chats		<u> </u>	<u>f</u>		
Pesquisa					Bloqueados	Template 🗘 🕀
Nome	Utilizador	Palavra-passe Ano	Turma Do	ata Nascimento	Escola	
	Inserção Por favor, Escolhei	e de Alunos insira o ficheiro para adição d ficheiro template.csv (Formato *ex* - máximo de 5 mb) Registar + Cancelar (× le novos alunos			50

Figure I-21 – File insertion screen for student registration (manager role)

4. After clicking on the registration button, another confirmation modal will appear, where the manager will have to paste the same code that appears on the screen into the text box (see Figure I-22). This action confirmation appears in most of the flows carried out by managers and administrators to check that they actually intend to carry out that action.

		Olá, Rodolfo I	Farinha 🁩 f	D 🕸 🛈
Pesquisa			Bloqueados	
Nome	Util Confirmação de Ação Tem a certeza que pretende registar os estudantes do ficheiro carregado	ascimento	Escola	,
	Por favor insira o seguinte código de confirmação: 92249587			
	Registar 🗸 Cancelar X			

Figure I-22 – Action confirmation screen (manager role)

5. Once confirmed, the students will have been registered on the platform and affiliated to the school of the manager who registered them (see Figure I-23).

					Olá, Rodolfo Fa	arinha 🇑 🔓	U @ Q 1
	5			S			
🗏 Artigos 🦀 Turma 🐥 Alunos 📿							
Pesquisa						Bloqueados	Template 🗘 🛈
Nome	Utilizador	Palavra-passe	Ano	Turma	Data Nascimento	Escola	
Ângelo Fernandes	AngeloFernandes1592017	dP4@0lyV	3°	A	15/09/2017		
Carla Santos	CarlaSantos1732018	kW1@QGq4	2°	A	17/03/2018		
Cristiana Moreira	CristianaMoreira1642017	gQ0@vtm9	3°	В	16/04/2017		
João Manuel	JoaoManuel1492016	wQ6#vsJd	4°	A	14/09/2016	-	
4	×	< 1 → 3	» 25 V	•			, F
		2	, (- 2		Ē	- Fr

Figure I-23 – Student screen after registration (manager role)

 Another way of adding students is individually via the add button (see Figure I-19) which, when clicked, opens a modal to manually fill in the details of the student we want to insert (see Figure I-24).

		, Rodolfo Farinha 🍙 🏠 🗘 🖞
🗏 Artigos 🙉 Turma 🔎	R, Alunos Q, Chats	
Pesquisa	Estudante	oqueados Template 🗘 🏵
Nome	Nome Completo	Escola
Ângelo Fernandes	Joana Melo Silves	6
Carla Santos	Data de Nascimento 27/01/2017	
Cristiana Moreira	Ano 3º	
loão Mapuel	Turma	
	Pasitor b Constre Y	· · · · · · · · · · · · · · · · · · ·

Figure I-24 – Student detail screen (manager role)

7. At the end of this process, the manager can also search for students by name on the search button, filter active or blocked students on the 'Ativos'/'Bloqueados' button for better management of school accounts. The student can be blocked by clicking on the red button on each line for each student (see Figure I-23).



Figure I-24 – Student Registration Flow (manager role)

Class Creation Flow (manager role):

 Each manager who wants to view and approve the articles submitted by students must create a class and associate their students with their class. In the 'Gerir' option, on the 'Turma' tab, the manager can associate the students by dragging them from the 'Alunos da Escola' column to the 'Turma do Professor' column. They then have to click on the 'Guardar Turam' button to assign the students to their class (see Figure I-25).

					Olá, Rodolfo Farinha 🇑 f	д б	\$ \$
	🗉 Artiaos 🤌 Turma 🔗 Alunos 🔎 Chats						
	Guardar turma 🛱 Passwords 소						
	Alunos da escola			Turma do professor			
	Pesquisa	Q		Pesquisa			۹
	2º A - Carla Santos			3º B - Cristiana Moreira			
	3º A - Ângelo Fernandes 4º A - Inão Manuel		>	3° B - Joana Melo Silves			
			<				
4							
P		Co	7				

Figure I-25 – Class management screen (manager role)

2. Another option is the 'Passwords' option, which saves the file with all the students in the class with their usernames and passwords (see Figures I-26).

8	Guardar Automaticamente	5 % . 6 .	⇒ passwords	,csv ∽ P Procurar					RA	- o ×
Fiche	iro <mark>Base</mark> Inserir Esquema o	da Página Fór	mulas Dados	Rever Ver Automatizar Ajuda					Com	entários 🖻 Partilhar 🗸
	Colar	->[11 -> A ⊞ -> <u>⊅</u> ->		Image: System of the syste	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	ormatação Forma ndicional ~ Tab	tar como bela * Célula *	Inserir Eliminar Formatar	∑ ~ A Z V Ordenar e Selecionar	e Suplementos
	POSSÍVEL PERDA DE DADOS Pode	erá perder alguma	s funcionalidades	se guardar este livro no formato delimitado por víro	ulas (.csv). Para preservar	estas funcionalidad	des, quarde o livro nu	im formato de ficheiro do Excel.	Não mostrar novamente	Guardar Como ×
A7										
~		P	6	D	5	F	C			
1	A Nome Complete	Ano	Turmo	Utilizador	Bassword	F	G		J K	L
2	Ioana Malo Silves	Ano	3 0	loanaSilves2712017	tug@28Vd					
2	Cristiana Moroira		30	CristianaMoroira1642017	(09@2810					
1	Clistialla Plotella		56	Clistiana forena 1042017	860@Auna					
5										
6										
7										
8		-								
9										
10										
11										
12										
13										
14										
15										
16										
17										
<	> passwords	+				:				

Figure I-26 – Student file with passwords download result (manager role)



Figure I-27 – Class Creation Flow (manager role)

First Login Flow (student role):

1. At the first log in, the student has to select an avatar (see Figures I-28 and I-29).

		Olá, Joana Silves 🌔 🏠	D 🕸 🕧
	Parfil		
$\left \right\rangle$	Selecionar Avatar		
	Nome Completo Joana Melo Silves		
	Escola		
	Jardim Escola João de Deus - Estrela		
	Nome		
0	Joana Silves		
	Guardar		

Figure I-28 – Student profile screen to choose avatar after login (student role)

		Olá, Joana Silves 🅙 🍙 🗘 🥸 🕛
Ţ.	Perfil	
	Nome Completo	
	Joana Melo Silves	
	Escola	
	Nome	
	Joana Silves	
	Guardar	

Figure I-29 – Student profile screen after choosing avatar (student role)

 After entering the platform, three options are displayed, 'Jogar', 'Estudar' and 'Gerir'. (see Figure I-30).



Figure I-30 – Student menu screen (student role)



Figure I-31 – First Login Flow (student role)

Article Creation Flow (student role):

1. The next step is to create articles, which is started by clicking on the 'Jogar' option in the main menu (see Figure I-30), where the STOP game will be displayed (see Figure I-32).

				Olá, Joa	ana Silves 💩	🗅 🗘 🕸	Ċ
			Jo	go do STOP			
		0%		0%	•	0%	
	в	0%		0%	R	0%	
	C	0%	K	0%	s	0%	
		0%		0%		0%	
		0%	M .	0%		0%	
	E _	0%		0%		0%	
	G	0%	•	0%	×	0%	
STOP	H	0%	P	0%	Z	0%	
	_	2,	G		e		

Figure I-32 – Stop game screen (student role)

2. On this screen, the student sees the letters that are in play, and these letters also show the percentage of progress of the approved articles written in each category for the current school year. Also on the same screen, the student can play the STOP game, in which the letters are rotating, and the student presses the STOP button to freeze a letter (see Figure I-33).



Figure I-33 – Screen with the letter drawn for the stop game (student role)

3. The student can play a maximum of three letters without any item being approved. To play a fourth letter, it is mandatory that at least one of the three letters played already contains an approved article. The student then clicks on the 'Continuar' button, which takes them to another screen where they select a category to work on (see Figure I-34).



Figure I-34 – Category selection screen (student role)

4. Once the category has been chosen, the student advances to the article creation screen. The name of the article must begin with the letter indicated. There is no maximum or minimum length for the number of words in the content of the article, however, it must contain at least one letter as a minimum requirement. The copy, cut and paste functions are disabled so that students can be encouraged to write, even if they are recopying (see Figure I-35). As students write the article, they can also incorporate relevant images, sounds or videos (see Figures I-36, I-37 and I-38).

<u>~</u> 73	SCHOOLPEDIA				Olá, Joana Silves 🧕	6 D 6	Ċ
				Estudo do Meio			
	G	Título					
		H1 H2 BI⊻€	A m x₂ x² IE ::	EEE = % fx			
I	nserir Imagem						
Audio	4) Vídeo 🕞						
						Guardar	inviar
				- 0, -			

Figure I-35 – Article development screen (student role)

ź	SCHOOLPEDIA			Olá, Joana Silves 🔮 🏠 🗘 🤃	
			Estudo do	Meio	
	G	Gato		Rascunho	
		H1 H2 B	Inserção de Imagem $\qquad \qquad \times$		
		O gato e ur alimentar, é realizadas p	Por favor, insira uma imagem alusiva ao seu tema	r como animal de estimação. Ocupando o topo da cadeia ssaros, lagartixas e alguns insetos. Segundo pesquisas egundo animal de estimação mais popular do mundo,	
		estando nu			
			Escolher ficheiro images.jpg (Formato "jpg", "jpeg" cu "png" - máximo de 10 mb)		
			Inserir + Remover 🗐		
	Audio 데 Vídeo D				
				Guardar Enviar	

Figure I-36 – Image insertion screen in article (student role)
			Olá, Joana Silves 🐠 🏠 🗘 🤃 🕛
G		Estudo do Meio	
	Gato		Rascunho
	Ha Ha B O gato é ur alimentar, é realizadas ; estando nu	Inserção de Audio ×	no animal de estimação. Ocupando o topo da cadeia
		Por favor, insira um som alusivo ao seu tema agun o.00 / 0:10 o.10	s, lagaruxas e arguns mectos, segundo pesquisas do animal de estimação mais popular do mundo,
		Escolher ficheiro EFEITO SONNDO 😹.mp3	
		(Formato "mp3", "wav" ou "wma" - máximo de 25 mb)	
Audio 41 Vídeo D		insent T Kemover W	
			Guardar Enviar

Figure I-37 – Audio insertion screen in article (student role)

		Olá, Joana Silves 📀 🏠 🗘 🤃 🕛
	Inserção de Vídeo X	
G	Por favor, insira um vídeo alusivo ao seu tema	Rascunho
Gaim real esta		animal de estimação. Ocupando o topo da cadela lagartixas e alguns insetos. Segundo pesquisas animal de estimação mais popular do mundo,
Audio 4) Video D	Escolher ficheiro Gatos miando 🧺 - Filhotes e adultos.mp4 (Formato 'mp4' ou 'webm' - máximo de 50 mb)	
	Inserir + Remover 🗇	Guardar Enviar

Figure I-38 – Image insertion screen in article (student role)

 Once they have finished their article, students save it or submit it for approval. If it is submitted for approval, the article is evaluated by our AI Agent giving the student suggestions on the topic they are developing (see Figure I-39).



Figure I-39 – Chat interaction screen before submitting the article (student role)

6. On this screen, the student can also write questions to the Virtual Agent, submit the article or exit the screen by closing the chat, returning to editing it. If the student presses the submit button, the status changes to 'Em Aprovação' and a notification is sent to the respective class teacher (a process we'll cover later) (see Figure I-40).



Figure I-40 – Chat interaction screen before submitting the article (student role)



Figure I-41 – Article Creation Flow (student role)

Article Management Flow (student role):

 If the article has already been submitted or saved, the student can manage it by clicking on the 'Manage' option in the main menu (see Figure I-30). After the student clicks on that option, they view a page that displays all their articles together with the current status of each article (see Figure I-42).

<u>~</u> 73	SCHOOLPEDIA			Olá, Joan	a Silves 🙆 🏠 🗘 🥴 🖯	
🗏 Artigos	e Estatísticas					
Pesquisa					Pesquisa Avançada	
Título	Letra	Categoria	ΑναΙίαção	Estado	Data	٦
Gato	G	Estudo do Meio	Sem avaliações	Em Aprovação	14/09/2024	
			«< < 1 > »»	25 🗸		
Y						7
<u>9</u>						

Figure I-42 – List screen of items produced by the student (student role)

2. To help the students who may want to search on the list once it is large, they are offered an advanced search option (see Figure I-43).

<u>~</u> 73	SCHOOLPEDI	A					Olá, Joan	a Silves 🚇 🏠 🗘 🔅 🕛
			\bigcirc					
🗉 Artigos								
Pesquisa								Pesquisa Avançada Q
Título	Letra	Categoria	Pesquisa Avang	;ada		×		Data
Gato	G	Estudo do Meio	Título				ovação	14/09/2024
			Categoria		Estado			
			Estudo do Meio		Rascunho			
			Data de Início		Data de Fim			
			dd/mm/aaaa		dd/mm/aaaa			
_			P	esquisar Q	Limpar 🗇			

Figure I-43 – Advanced search screen in the list of articles produced by the student (student role)

3. At the end, after the search is done, the student can click on the article of choice and view it (see Figure I-44).



Figure I-44 – Article management screen (student role)



Figure I-45 – Article Management Flow (student role)

Article Approval Flow (manager role):

 The moment a particular student submits an article to be published on the platform, the manager or managers concerned are notified to approve the article. This notification is only visible on the platform, via an indicator of the number of unread notifications, which can be found on the bell icon in the menu bar (see Figure I-46). The notification will disappear when the manager clicks the 'Marcar como lida' button.

<u>8</u> 73	SCHOOLPEDIA		Olá, Rodolfo Farinha 🇑		
				Ø	
	Y	Notificações por Ler	×		
		Lidas 🔄			
		✓ 14/09/2024 20:47 - Artigo enviado para aprovação			
		14/09/2024 20:47			
		Olá Rodolfo Farinha,			
		O estudante Joana Silves enviou para aprovação o artigo 'Gato'.			
		Clique no botão 'Ver Artigo'.			
		Com os melhores cumprimentos, Equipa Schoolpedia			
		Ver Artigo Marcar como lida			

Figure I-46 – Article approval request notification screen (manager role)

2. Afterwards, the manager can view the article via the notification (see Figure I-46), which explains the article's details (see Figure I-47), or they can click on the 'Aprovar' option in the managers' main menu (see Appendix I, Figure I-3), which will take them to the articles awaiting approval (see Figure I-48).

873 s	CHOOLPEDIA				Olá, Rodolfo Farinha 🇑 🕙	<u>ن</u> چې ش
Título	Letra	Categoria		Autor	Data	
Gato	G	Estudo do Meio		Joana Silves	14/09/2024	4
			« < 1 >	» 25 v		
9)						
1						

Figure I-47 – Article approval list screen (manager role)

	Olá, Rodolfo Farinha 🇑 🍙 🕂 🕸 🕛
	Estudo do Meio
Gato	Joana Silves (3ºB) 14 de setembro de 2024
Audio C ⁴ Video C ³	O gato é um mamífero carnívoro da família dos felídeos, muito popular como animal de estimação. Ocupando o topo da cadeia alimentar, é predador natural de diversos animais, como roedores, pássaros, lagartixas e alguns insetos. Segundo pesquisas realizadas por instituições norte-americanas, os gatos consistem no segundo animal de estimação mais popular do mundo, estando numericamente atrás apenas dos peixes de aquário.
> Mensagens	
> Revisões	
	Agrovar

Figure I-48 – Article approval list screen (manager role)

 In the article details, the manager can evaluate the title, body, and multimedia elements, for example, the images (see Figure I-48), the sound (see Figure I-49) and the video (see Figure I-50).

			Olá, Rodolfo Farinha 🌍		
	Estudo de	o Meio			
Gato	O gato é um mamífero carnivoro da familia alimentar, é predador estural do diversos es	dos felídeos, muito popular	como animal de estimação. Ocupa aros, lagartixas e alguns	Joana Silves (3°B) 14 de setembro de 2024 ndo o topo da cadeia iegundo pesquisas	
	estando numericamei	× no seç	undo animal de estimação mais po	pular do mundo,	
Audio 44 Video D					
> Mensagens					
> Revisões					

Figure I-49 – Article approval audio detail screen (manager role)



Figure I-50 – Article approval video detail screen (manager role)

4. In addition, they can also see the messages exchanged between the students and the Virtual Agent (see Figure I-51) and the article review requests received (see Figure I-52).

<u>a</u> n	SCHOOLPEDIA Diá, Rodolfo Farinha 🎯 🏠 🕂 🥸 🕛
	Video Di
∨ Mens	agens
0	cadela alimentar, é predador natural de diversos animais, como roedores, pássaros, lagortixas e alguns insetos. Segundo pesquisos realizadas por instituições norte-americanas, os gatos consistem no segundo animal de estimação mais popular do mundo, estando numericamente atrás apenas dos peixes de aquário. Olá Joana Silvesi É ótimo saber que estás a aprender sobre o tema "Gato". A tua descrição está muito boa, mas podes acrescentar mais algumas informações interessantes. Por exemplo, poderias falar sobre as diferentes raças de gatos, onde eles nasceram (a sua origem), como cuidá-los ou até mesmo o comportamento dos gatos, pois são todos temas muito interessantes para explorar. Que achas de investigar um pouquinho mais sobre isso? Bom trabalho e continua a aprender!
	Olá, quais são as diferentes raças que existem? consegues ajudar-me?
8	Claro, Joanal Existem muitas raças diferentes de gatos. Aqui estão algumas das mais populares: 1. **Síamês**: Conhecidos pela sua pelagem clara com extremidades mais escuras e olhos azul-vivo. 2. **Persa**: Têm um pelo longo e denso e um rosto achatado. 3. **Maine Coon**: São grandes, com uma pelagem espessa e cauda felpuda. 4. **Bengal**: Têm um pelo longo e denso e um rosto achatado. 3. **Maine Coon**: São grandes, com uma pelagem espessa e cauda felpuda. 4. **Bengal**: Têm uma pelogem que parce com a dos leopardos, com manchas e padrões exóticos. 5. **Sphynx**: É uma raça sem pelo, famosa pela sua pele enrugada. 6. **Ragdoll**: Conhecidos por serem muita dóceis e relaxados, geraimente têm olhos azuis e pelo comprido. 7. **British Shorthair**: São robustos com pelagem curta e denso, e geralmente têm um ar meio sério. Se quiseres saber mais sobre alguma dessas raças, diz-me! Dou-te mais detalhes.
> Revis	iões

Figure I-51 – Article approval messages list screen (manager role)

	Olá, Rodolfo Farinha 🍖 🏠 🧔	Ċ
Audio 41 Video D1	O gato é um mamífero carnivoro da família dos felídeos, muito popular como animal de estimação. Ocupando o topo da cadei alimentar, é predador natural de diversos animais, como roedores, pássaros, lagartixas e alguns insetos. Segundo pesquisas realizadas por instituições norte-americanas, os gatos consistem no segundo animal de estimação mais popular do mundo, estando numericamente atrás apenas dos peixes de aquário.	a
> Mensagens		
✓ Revisões		
	Não existem revisões	
Enviar revisão		7
		Aprovar

Figure I-52 – Article approval reviews list screen (manager role)



Figure I-53 – Article Approval Flow (manager role)

Article Revision Flow (student role):

1. Coming back to the previous flow, when the manager assigns a revision to them, the student receives an alert about it (see Figure I-54). Notifications for students are managed and displayed in the same manner as according to how they are implemented to managers, as earlier explained.

		Olá, Joana Silves 🐠	命 🗘 🕸 🔱
Y L	Notificações por Ler	×	
	Lidas 🙆		
	✓ 14/09/2024 20:59 - Artigo enviado para revisão		
$\left(\right) $	14/09/2024 20:59		
	Foi solicitada uma revisão ao teu artigo 'Gato'.		
	Clica no botão 'Ver Artigo' para poderes rever.		
	Com os melhores cumprimentos, Equipa Schoolpedia		
	Ver Artigo Marcar como lida		

Figure I-54 – Article review request notification screen (student role)

2. The notification enables the student to view the article where they will see the request of the manager for a revision (see Figure I-55).



Figure I-55 – Article review screen (student role)

3. After doing the appropriate changes, the article submission process is same and passes by the Virtual Agent once again (see Figures I-56 and I-57).

Â	73	SCHOOLPEDIA Olá, Joana Silves		佡	ц р	ŝ	ப	
							٦	
	Profe	ssor				×		
	2	cuida-los ou até mesmo o comportamento dos gatos, pois são todos temas muito interessantes para explorar. Que achas de investigar um pouquinho mais sobre isso? Bom trabalho e continua a aprender!				•		
		Olá, quais são as diferentes raças que existem? con	nsegues aj	judar-ı	me?			
		Claro, Joanal Existem muitas raças diferentes de gatos. Aqui estão algumas das mais populares: 1. "Slamês": Conhecidos pela sua pelagem clara com extremidades mais escuras e olhos azul-vivo. 2. "Persa": Têm um pelo longo e denso e um rosto achatado. 3. "Maine Coon": São grandes, com uma pelagem espessa e cauda felpuda. 4. "Bengal": Têm uma pelagem que parece com a dos leopardos, com manchas e padrões exólicos. 5. "Sephynx": É uma raças em pelo, famosa pela sua pele enrugada. 6. "Ragdoll": Conhecidos por serem muito dóceis e relaxados, geralmente têm olhos azuis e pelo comprido. 7. "British Shorthair": São robustos com pelagem curta e densa, e geralmente têm um ar meio sério. Se quiseres saber mais sobre alguma dessas raças, diz-mel Dou-te mais detalhes.						
↓ F	2	A tua descrição sobre os gatos está muito boa, Joana! É claro que te esforçaste bastante. No entanto, desafia-le a ti mesma a descobrir mais algumas coisas. Que tal investigares sobre as diferentes raças de gatos, como o siamês ou o persa? Podes também explorar como cuidar de um gato, o que achas? Parabéns pelo bom trabalho até agora! Continua assim, vais longe!						
6						Ŧ		
Olá	Envia	r mensagem	Ø		Confirm Envio	har D		
				Gua	ırdar			

Figure I-56 – Chat interaction screen after revised the article (student role)

CHOOLPEDIA	Olá, Joana Silves 🚇 🏠 🗘
	Estudo do Meio
	Gato Em Aprovação
	H ₁ H ₂ B $I \sqcup \ominus \underline{\mathbb{A}}$ $ \underline{\mathbb{M}} $ x ₂ x ² $ \underline{\mathbb{H}} \equiv \underline{\mathbb{H}} = \underline{\mathbb{H}} = \Phi f_x$
Audio 41 Video D	O gato é um mamífero carnívoro da família dos felídeos, muito popular como animal de estimação. Ocupando o topo da cadeia alimentar, é predador natural de diversos animais, como roedores, pássaros, lagartixas e alguns insetos. Segundo pesquisas realizadas por instituições norte-americanas, os gatos consistem no segundo animal de estimação mais popular do mundo, estando numericamente atrás apenas dos peixes de aquário.
✓ Revisões	
Rodolfo Farinha 14/09/2024 20:59	
Olá Joana, o teu artigo está excelente, mas v	u lançar-te o desafio de pesquisares mais sobre a raça persa.

Figure I-57 – Revised article screen (student role)



Figure I-58 – Article Revision Flow (student role)

Article Approval Flow (manager role) – Continuation:

5. Once the article has been improved and re-submitted by the student, the managers will be notified yet again for the approval of the article (see Figure I-59). At this point, the process can iterate as many times as the manager wishes until a final version acceptable for approval is obtained.

SCHOOLPEDIA		Olá, Rodolfo Farinha 🇑	命 🗘 🕸 🔱
	Notificações por Ler	×	
	✓ 14/09/2024 21:31 - Artigo enviado para aprovação 14/09/2024 21:31		
9	Olá Rodolfo Farinha, O estudante Joana Silves enviou para aprovação o artigo 'Gato'.		
	Clique no botão 'Ver Artigo'. Com os melhores cumprimentos, Equipa Schoolpedia		
	Ver Artigo Marcar como lida > 14/09/2024 20:47 - Artigo enviado para aprovação		

Figure I-59 – New article approval request notification screen (manager role)

6. In our example, the manager approves the article by clicking on the 'Aprovar' button (see Figure I-60), which makes the article accessible to all students who want to read it. The manager can also view it in the 'Gerir' option of the main menu (see Figure I-3) in the 'Artigos' tab (see Figure I-61).

- A	👫 👔 SCHOOLPEDIA Dià, Rodolfo Farinha 🍘 🏠 🚅 🤅	<u>ل</u> ھ
∽ Mer	isagens	
	Olá, quais são as diferentes raças que existem? consegues ajudar-me?	@ *
	Claro, Joanal Existem muitas raças diferentes de gatos. Aqui estão algumas das mois populares: 1. **Siamês**: Conhecidos pela sua pelagem clara com extremidades mais escuras e olhos azul-vivo. 2. **Peresa**: Têm um pelo longo e denso e um rosto achatado. 3. **Maine Coon**: São grandes, com uma pelagem espessa e cauda felpuda. 4. **Bengal**: Têm uma pelagem que parece com a dos leopardos, com manchas e padrões extóricos. 5. **Sphynx**: É uma raça sem pelo, famosa pela sua pele enrugada. 6. **Ragdoll**: Conhecidos por serem muito dóceis e relaxados, geralmente têm olhos azuis e pelo comprido. 7. **British Shorthair**: São robustos com pelagem curta e densa, e geralmente têm um ar meio sério. Se quiseres saber mais sobre alguma dessas raças, diz-mel Dou-te mais detalhes.	
	Tema: Gato Descrição: O gato é um mamifero carnívoro da familia dos felídeos, muito popular como animal de estimação. Ocupando o topo da cadeia alimentar, é predador natural de diversos animais, como roedores, póssaros, lagartixas e alguns insetos. Segundo pesquisas realizadas por instituições norte-americanas, os gatos consistem no segundo animal de estimação mais popular do mundo, estando numericamente atrás apenas dos peixes de aquário.	0
2	A tua descrição sobre os gatos está muito boa, Joanal É claro que te esforçaste bastante. No entanto, desafia-te a ti mesma a descobrir mais algumas coisas. Que tal investigares sobre as diferentes raças de gatos, como o siamês ou o persa? Podes também explorar como cuidar de um gato, o que achas? Parabéns pelo bom trabalho até agora! Continua assim, vais longe!	v
> Rev	isões	
		Aprovar

Figure I-60 – Article approval new messages list screen (manager role)

	Olá, Rodolfo Farinha 🍖 🏠 🧔 🔱
🖹 Artigos 🦗 Turma 🙏 Alunos 🗘 Chats	
Pesquisa	Pesquisa Avançada Q
	≡ 88
Gato Sem avaliações Estudo do Meio	Joana Silves (3⁰B)
	\ll \langle 1 \rangle \gg 25 \vee

Figure I-61 – Article list view screen (manager role)

 On this screen, the manager can also perform an advanced search on the list of articles written by their students (see Figure I-62). The full details of the article can be viewed at any time (see Figure I-63).

			Olá, Rodolfo Farinha 🍙	命 🗘 🏶 🕛
🗉 Artigos 🦗 Turma 🐥 Alunos 🖓 Chats				
Pesquisa				Pesquisa Avançada Q
	Pesquisa Avançada	×		= 88
	Título			
Sem avaliações	Categoria			(
S Estudo do Meio	Selecionar			Joana Silves (3ºB)
	Data de Início Data d	de Fim		
	dd/mm/aaaa 🗖 dd/m	m/aaaa 🗖		
	Pesquisar Q Limpa	ar 🗇		

Figure I-62 – Advanced search of articles list (manager role)



Figure I-63 – Article detail screen (manager role)



Figure I-64 – Article Approval Flow (manager role) – Continuation

Article Approval Flow (student role):

 Once the article has passed through the approval process, the author of the article is credited with 100 coins in their for the fact that the article was approved (see Figure I-65), and this information is also sent by notification to them (see Figure I-66).



Figure I-65 – Coins received screen after approved article (student role)

SCHOOLPEDIA		Olá, Joana Silves 🐠	命 🗘 🕸 🕛
	Notificações por Ler	×	
9	 v 14/09/2024 21:34 - Artigo aprovado com sucesso 14/09/2024 21:34 Olá Joana Silves, Parabéns, o teu artigo 'Gato' foi aprovado com sucesso. Já podes visualiza-lo na área 'Estudar' ou clicares no botão 'Ver Artigo'. Com os melhores cumprimentos, Equipa Schoolpedia Ver Artigo Marcar como Tida 		
	> 14/09/2024 20:59 - Artigo enviado para revisão		

Figure I-66 – Article approved notification screen (student role)

 At this point, the student can view the article in the 'Estudar' option of the students' main menu (see Figures I-30 and I-67).



Figure I-67 – Article list view screen (student role)

 This screen also has access to advanced search options to assist in finding articles process (see Figure I-68). The students can click the details of the article to obtain the final output of their work (see Figure I-69).

		Olá, Joana Silves 🐠 🏦 📫 🤃
Pesquisa		Pesquisa Avançada Q
	Pesquisa Avançada X	= 88
Gato Sem availações	Título	Joana Silves (3ºB)
C Estudo do Meio	Categoria Estudo do Meio	
	Data de Início Data de Fim dd/mm/aaaa dd/mm/aaaa	
	Pesquisar Q Limpar 🗇	

Figure I-68 – Advanced search of articles list (student role)



Figure I-69 – Student's own article detail screen (student role)



Figure 70 – Article Approval Flow (student role)

Article Rating Flow (student role):

 In case the students' login is not that of the authored article and in case the student has not rated the article yet, student can rate the article by-clicking the 'Avaliar' button (see Figure I-71).



Figure I-71 – Article detail screen (student role)

 A modal with 5 stars will show up over the article that the reader wishes to rate after reading it (see Figure I-72). After submitting the rating, the student who rated the article receives 2 coins (see Figures I-73 and I-74), whereas the student who was rated is awarded 5 coins multiplied by the number of the stars awarded (see Figure I-75).



Figure I-72 – Article rating screen (student role)



Figure I-73 – Coins received screen after article rated (student role)



Figure I-74 – Coins received screen after article rated (student role)



Figure I-75 – Coins received screen after own article rated (student role)

—	Article V	/iewer		Rating	Modal		Coin S	iystem		Aut	nor
View article and click 'Av	valiar' ►	Show	5-star rating m	nodal							
	Submit ra	iting									
		Notify rate	er of 2 coins ea	arned	Awa	ard 2 coins to ra	ater 🕨				
4					Awar	d 5x coins to au	uthor	Notify	/ author of coins ea	arned	
Student	Article V	/iewer		Rating	Modal		Coin S	ystem		Aut	nor

Figure I-76 – Article Rating Flow (student role)

Student Statistics View Flow (student role):

 The student can monitor the development of self as a writer, reader, and rater in the progress over a period by a very simple dashboard which indicates the total articles written, coins earned, ratings given and received (see Figure I-77).

		Olá, Joa	ana Silves 🚭 🏠 🗘
	\sim		
Estatisticas			
	7	E	a
12 Moe	20 vdas	Arti	1 igos
*		*	
0 Avaliações Enviadas	0,0 Média Avaliações Enviadas	1 Avaliações Recebidas	4,0 Média Avaliações Recebidas

Figure I-77 – Statistics screen (student role)



Figure I-78 – Student Statistics View Flow (student role)

Chat Review Flow with the Virtual Agent (manager role):

 Through the option 'Gerir' which is under the 'Chats' tab, the manager is able to view all the chat history between their students and the Virtual Agent (see Figure I-3). When there is inappropriate language, the messages are highlighted in red and moved to the top (see Figure I-79). The manager will open the details of the chat, confirm them and mark them as reviewed, to change color to green (see Figure I-80).

273	SCHOOLPEDIA		Olá, Rode	plfo Farinha 🇑 🏠 🗘	\$ ()
Artigos	R Turma R Alunos Q Chats				
Autor	Artigo	Letra	Categoria	Data	
Joana Silves					
Joana Silves			Estudo do Meio	14/09/2024	
		« < 1 >	» 25 V		
Y					$\overline{\mathcal{A}}$

Figure I-79 – Chat rooms list screen (manager role)

	Clá, Rodolfo Farinha 🍘 🏦 🚨 🥹	ا ل
🗏 Artigos 🖉 Turma 😤 Alunos Q Chats		
Fechar X Marcar como verificada Ø		
Gritar	Joana Silves 15 de setembro d	(3° B) de 2024
Olà Joana Silves! É ótimo saber que estás a aprender sobre o tema	ema: Gritar Descrição: Vou conjugar o verbo gritar:Eu grito, Tu gritas,Ele grita,Nós gritamos, Vós gritais, Eles gritam "Gritar". A conjugação do verbo "gritar" que fizeste está correta. Parabéns pelo teu	
trabalho! Continua a aprender e a explorar novos temas. Bom trab	alho!	
	Olá consegues dar-me indicação de mais tempos verbais?	
Claro, posso ajudar-te com mais tempos verbais do verbo "gritar". gritamos, Vós gritais, Eles gritam. **Pretérito Perfeito do Indicativo do Presente do Indicativo:** Eu gritarei, Tu gritarás, Ele gritará, Nó saber sobre mais tempos verbais, é só pedir!	Aqui tens alguns exemplos: **Presente do Indicativo:** Eu grito, Tu gritas, Ele grita, Nós ** Eu gritei, Tu gritaste, Ele gritou, Nós gritàmos, Vós gritastes, Eles gritaram. **Futuro s gritaremos, Vós gritareis, Eles gritarão. Estes são apenas alguns exemplos. Se quiseres	
	Possa tantos?	
Sim, há muitos tempos verbais, Joana! Aprender todos pode pareo	er um desafio, mas com o tempo vais conseguir. Queres que te explique mais algum	

Figure I-80 – Chat rooms detail screen (manager role)



Figure I-81 – Chat Review Flow with the Virtual Agent (manager role)

Profile Editing Flow (admin, manager and student roles):

 Application users can change or update their information by clicking on the gear symbol that appears at the top of the application. An administrator or a manager can change their avatar and name different from that of the one registered, however, students can only change their avatar (see Figure I-82).

		Olá, Rodolfo Farinha) 命 🗘 ۞ 🕛
E Artigos & Turma & Pesquisa	Perfil	×	Pesquisa Avançada Q
Gato			= 88
Sem avalia	Email rodolfo.alves.farinha@gmail.com		کی Joana Silves (3ºB)
	Escola		
	Jardim Escola João de Deus - Estrela		
	Nome Completo		
	Rodolfo Aires Alves Farinha		
	Guardar		

Figure I-82 – Manager profile screen



Figure I-83 – Profile Editing Flow (admin, manager and student roles)

User Settings Flow (admin, manager and student roles):

1. Also, users update their settings by choosing whether they want music, whether they want a voice, and if so, what type of voice (male or female) (see Figure I-84).



Figure I-84 – Manager settings screen



Figure I-85 – User Settings Flow (admin, manager and student roles)

Appendix J – Teacher Questionnaire – Stage 1

Formulário de concentimento - Fase 1

Termos de Consentimento:

- 1. Participação Voluntária: A sua participação neste estudo é totalmente voluntária. Poderá recusar participar ou desistir a qualquer momento, sem qualquer penalização ou prejuízo.
- Confidencialidade: Todas as informações recolhidas durante o estudo serão tratadas com confidencialidade. Os dados serão utilizados apenas para fins académicos e de investigação.
- 3. **Procedimento:** Será solicitado que utilize a aplicação "Schoolpedia" e responda a um questionário sobre a sua experiência. Este processo terá uma duração aproximada de 60 minutos.
- Benefícios e Riscos: Não existem riscos significativos associados à sua participação. Os benefícios incluem a possibilidade de contribuir para o desenvolvimento de uma ferramenta educativa inovadora.
- 5. Contactos: Para qualquer questão ou esclarecimento, pode contactar o aluno responsável, Rodolfo Farinha, através do email: raafa2@iscte-iul.pt.

* Indica uma pergunta obrigatória

1. Declaração de Consentimento: *

Marcar tudo o que for aplicável.

Eu, abaixo-assinado, declaro que fui informado(a) sobre os objetivos e procedimentos deste estudo e que aceito participar de forma voluntária.

2. Idade *

Marcar apenas uma oval.

20-29 30-39 40-49 50-59 60-70

- Outra:
- 3. Perfil de Utilizador Testado *

Marcar apenas uma oval.

Estudante

Gestor

4. Descreva a sua experiência com a plataforma *

Este conteúdo não foi criado nem aprovado pela Google.

Google Formulários

Appendix K – Teacher Questionnaire – Stage 2

Formulário de concentimento - Fase 2

Termos de Consentimento:

- 1. Participação Voluntária: A sua participação neste estudo é totalmente voluntária. Poderá recusar participar ou desistir a qualquer momento, sem qualquer penalização ou prejuízo.
- Confidencialidade: Todas as informações recolhidas durante o estudo serão tratadas com confidencialidade. Os dados serão utilizados apenas para fins académicos e de investigação.
- 3. **Procedimento:** Será solicitado que utilize a aplicação "Schoolpedia" e responda a um questionário sobre a sua experiência. Este processo terá uma duração aproximada de 60 minutos.
- Benefícios e Riscos: Não existem riscos significativos associados à sua participação. Os benefícios incluem a possibilidade de contribuir para o desenvolvimento de uma ferramenta educativa inovadora.
- 5. Contactos: Para qualquer questão ou esclarecimento, pode contactar o aluno responsável, Rodolfo Farinha, através do email: raafa2@iscte-iul.pt.

* Indica uma pergunta obrigatória

1. Declaração de Consentimento: *

Marcar tudo o que for aplicável.

Eu, abaixo-assinado, declaro que fui informado(a) sobre os objetivos e procedimentos deste estudo e que aceito participar de forma voluntária.

2. Idade *

Marcar apenas uma oval.

20-29 30-39 40-49 50-59 60-70

- Outra:
- 3. Perfil de Utilizador Testado *

Marcar apenas uma oval.

Estudante

Gestor

Usabilidade da plataforma

4. Como avalia a facilidade de uso da plataforma?*

Marcar apenas uma oval.



5. De acordo com a questão anterior, descreva as suas dificulades nos fluxos que classificou como "Difícil" ou "Muito difícil" e como poderíamos melhorar?

6. Houve alguma funcionalidade específica da plataforma que achou confusa ou pouco intuitiva?

7. Encontrou algum problema técnico ao utilizar a plataforma?

Impacto na Aprendizagem

8. Como avalia a eficácia da plataforma no incentivo à criação de conteúdos pelos alunos? *

Marcar apenas uma oval.

- Muito eficaz
 Eficaz
 Pouco eficaz
- 🔵 Ineficaz
- 9. O agente AI foi útil no apoio ao processo de investigação do aluno? *

Marcar apenas uma oval.

C	🔵 Muito útil
C	Útil
C	🔵 Pouco útil
	Nada útil

Preferências e Sugestões

10. Quais as funcionalidades ou recursos que considera mais importantes na plataforma? *

11. Se pudesse sugerir melhorias, o que mudaria ou acrescentaria na plataforma? *

	Acreata que a platalorma pode ser uma terramenta elicaz no ensino a longo prazo?		
Exp	periência Geral		
3.	Descreva a sua experiência com a plataforma de uma forma geral. *		
	Descreva a sua experiência com a plataforma de uma forma geral. *		
	Descreva a sua experiência com a plataforma de uma forma geral. *		
	Descreva a sua experiência com a plataforma de uma forma geral. *		

Este conteúdo não foi criado nem aprovado pela Google.

Google Formulários

Appendix L – Student Questionnaire

Questionário Alunos

* Indica uma pergunta obrigatória

1. Qual a idade do aluno?*

Marcar apenas uma oval.

C) 5 anos
C	6 anos
C	7 anos
C	8 anos
C	9 anos
C) 10 anos

2. Gostou de jogar na plataforma?*

Marcar apenas uma oval.



3. Achou fácil mexer na plataforma? *

Marcar apenas uma oval.



4. Se não, quais foram as dificuldades que sentiu? (se conseguir verbalizar)

5. Qual foi a parte mais divertida? *

Marcar tudo o que for aplicável.



Ver os artigos dos colegas

Interação com o professor virutal

🗌 Todas

6. Conseguiu criar um artigo? *

Marcar apenas uma oval.



7. Se sim, utilizou algum vídeo, som ou imagem para descrever melhor o artigo?

Marcar tudo o que for aplicável.


8. Gostou de pesquisar com a ajuda da plataforma? *

Marcar apenas uma oval.



9. Gostaria de usar a plataforma novamente?*

Marcar apenas uma oval.



10. Notas adicionais que o aluno queira deixar

11. Observações do investigador

Este conteúdo não foi criado nem aprovado pela Google.

Google Formulários



Appendix M – Student X1 – Virtual Agent Chat







Appendix N – Student X2 – Virtual Agent Chat







Appendix O – Student X3 – Virtual Agent Chat





1





de como ele é. No entanto, seria fantástico se pudesses adicionar mais alguns detalhes. Por exemplo, podes falar sobre: - O que vocês gostam de fazer juntos? - Alguma memória especial ou engraçada que tens com o Xavier? - O que faz dele um irmão tão especial para ti? Tens curiosidade sobre alguma coisa específica acerca do Xavier ou da letra "X"? Tenta pesquisar mais um pouco! Continua assim, estás no bom caminho!



Appendix P - Student X4 - Virtual Agent Chat



SCHOOLPEDIA Olá, Rodolfo Farinha





melhorar ainda mais a tua lista de palavras com a letra "i". Por exemplo, podes incluir palavras como: - Imagem - Indivíduo - Inseto - Ideia -Impossível - Invernosidade Experimenta fazer uma lista e ver quantas palavras consegues encontrar com a letra "i"! Se precisares de mais ajuda ou tiveres outras perguntas, estou aqui para ajudar. Continua o bom trabalho!

Tema: i Descrição: l é uma letra que se usa em varias palavras como: lnês , iguana , inverno , ilha , ímpar varias palavras tao a ver

Parece que já tens uma boa lista de palavras que começam com a letra "i", No entanto, a tua descrição pode ser um pouco mais completa. Que tal procurares mais algumas palavras e acrescentares à tua lista? Podes incluir palavras como: - Ideia - Início - Imagem - Inscrição - Inteligente Além disso, podes falar um pouco sobre como a letra "i" é usada em algumas destas palavras. Por exemplo, a palavra "inverno" refere-se à estação mais fria do ano, enquanto "ilha" é uma porção de terra cercada de água por todos os lados. Se precisares de mais ajuda ou de mais palavras, diz-me. Estás no bom caminho! Continua assim e vais ver que o teu texto vai ficar ainda melhor.

Tema: i Descrição: l é uma letra que se usa em varias palavras como: Inês , iguana , inverno , ilha , ímpar varias palavras tao a ver

A tua descrição está a ficar muito boa, Já encontraste várias palavras interessantes. Que tal acrescentares ainda mais algumas palavras com "i"? Aqui vão algumas sugestões: "independente", "internet", "idade" e "imagination". Se tiveres tempo, podes explorar como a letra "i" é usada noutras áreas, como em nomes de cidades (por exemplo, "Ílhavo") ou em conceitos (como "inspiração"). Continua assim, estás a fazer um ótimo trabalho! Se tiveres dúvidas ou precisares de mais ajuda, estou aqui!





Appendix Q – Student X5 – Virtual Agent Chat







a tua descrição já está bastante boa e clara para a tua idade! Mencionaste várias palavras começadas com a letra N. Gostaria de te desafiar a pensar em mais algumas palavras que comecem com essa letra. Consegues pensar em mais exemplos? Se precisares de inspiração, podes pesquisar palavras com N e ver quantas consegues encontrar! Boa sorte e parabéns pelo excelente trabalho até agora! **ﷺ**

Tema: N Descrição: A letra N é usada para escrever algumas palavras como: não, nunca, nadar, Nadia, nabo, nada nó navio noitenovo

A tua lista de palavras que começam com a letra N está bem feita, No entanto, poderias explorar mais palavras e talvez organizar a lista melhor. Por exemplo, podias separar as palavras em duas linhas ou inserir mais palavras. Que achas de procurarmos mais palavras juntas? Aqui vão alguns desafios para ti: 1. Consegues encontrar mais palavras que comecem com a letra N? 2. O que achas de colocar as palavras por ordem alfabética? Se preferires, posso ajudar-te a começar! O que achas?

valá ajuda-me

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Claro, Em que é que precisas de ajuda agora? Se for sobre a letra N ou outra coisa, podes perguntar à vontade!

Tema: N Descrição: A letra N é usada para escrever algumas palavras como: não, nunca, nadar, Nadia, nabo, nada nó navio noitenovo

Parece que listaste uma boa quantidade de palavras que começam com a letra N. No entanto, noto que a lista de palavras está um pouco desorganizada. Que tal fazeres uma lista mais estruturada? Além disso, podes pensar em mais algumas palavras que começam com a letra N. Que te parece? Aqui fica um exemplo de uma lista mais organizada: - não nunca - nadar - Nadia - nabo - nada - nó - navio - noite - novo Desafio-te a pesquisar mais algumas palavras com a letra N e a adicioná-las à tua lista. Boa sorte e diverte-te a aprender! Se precisares de mais ajuda, estou aqui.





Appendix R – Student X6 – Virtual Agent Chat

