

FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO

Gamified Systems Design for Grammar Learning and Teaching of Portuguese As Foreign Language

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DISSERTATION



Mestrado Integrado em Engenharia Informática e Computação

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Abstract

The demand for learning Portuguese as a foreign or second language has been increasing in recent years. The Portuguese language presents in its grammatical component a complexity that makes it hard to learn, so an online context or digital platforms will offer a help to overcome this problem. In the grammatical area, clitic pronouns assume the *Cape of Storms* for the teaching of the Portuguese language, in particular, for the individual who starts learning a foreign language in adulthood, to reach the level of competence of the native speaker. The *interlanguage* concept presupposes a course to the student, restructured and developed by phases and stages, at different rates. Due to the difficulty of learning some Portuguese grammar components, stagnation in a given stage is a recurring event among students and the clitic pronouns configure the critical area in the learning of the Portuguese language as a foreign language. The gamification phenomenon has expanded since the middle of 2010, due to the recognition of the enormous potential for the whole process of teaching and learning, in this particular case, for language teaching. The scarce quantity of gamified products related to this problem, not for isolated contents, but rather applied to teaching and learning the language as a whole, gives light to this work that aims to develop a web platform that uses gamification elements, such as rankings, points and levels and a new personalized teaching method, that offers a custom learning path to the user, to present a new solution for the learning of the Portuguese language.

Resumo

A procura pela aprendizagem da língua Portuguesa como língua estrangeira ou segunda língua tem vindo a aumentar nos últimos anos. A língua Portuguesa apresenta na sua componente gramatical, uma complexidade que torna mais difícil a sua aprendizagem num contexto online ou de plataformas digitais, não presencial. Na área gramatical, os pronomes clíticos assumem-se como o *Cabo das Tormentas* para o ensino da língua Portuguesa, em particular, para o indivíduo que inicia a aprendizagem de uma língua estrangeira em idade adulta conseguir atingir o nível de competência do falante nativo. O conceito de *interlíngua* pressupõe um percurso do aprendente, reestruturado e desenvolvido por fases e estádios, a diferentes ritmos. Devido à dificuldade de aprendizagem de algumas componentes da gramática portuguesa, a estagnação num determinado estádio é um acontecimento recorrente entre os estudantes e que impede o progresso para estádios mais avançados. Neste sentido, os pronomes clíticos configuram a área crítica na aprendizagem da língua portuguesa como língua estrangeira. O fenómeno da gamificação, por sua vez, teve a expansão a partir da metade do ano de 2010, devido ao reconhecimento das enormes potencialidades para todo o processo de ensino e aprendizagem, neste caso particular, para o ensino de línguas. A escassa quantidade de produtos gamificados relacionados com esta problemática, não para conteúdos isolados, mas sim, aplicada ao ensino e aprendizagem da língua no seu todo, dá luz a este trabalho que visa o desenvolvimento de uma plataforma web que utilize a gamificação, como ferramenta, e um novo método personalizado de ensino para apresentar uma nova solução para a aprendizagem da língua Portuguesa.

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“It is hard to fail, but it is worse never to have tried to succeed.”

Theodore Roosevelt

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Abbreviations

FL	Foreign Language
SL	Second Language
SLA	Second Language Aquisition
GT	Grammar-translation
AL	Audio-linguistic
CA	Communicative Approach
TBL	Task-based Learning
RPG	Role Playing Games
App	Application
NPM	Node Package Manager
HTML	Hypertext Markup Language
CSS	Cascading Style Sheets
EJS	Embedded JavaScript templating
MVC	Model-View-Controller
UI	User Interface
RDBMS	Relational Database Management System
BSON	Binary JSON
DB	Database

Chapter 1

Introduction

The world is in permanent technological progress but the teaching and learning strategies are not always keeping up and therefore are getting outdated. There is a need for the design of technological and digital support promoting a successful learning process, in line with the research in language learning.

The work presented in this dissertation was proposed by the Institute Polytechnic Gaya (ISP-Gaya) and joins two distinct areas, the linguistics and computer science. The technological side is used to improve the efficiency of the teaching of the languages, and in this work, it is done by creating a web application to learn the Portuguese language as a foreign language. As learning a language is a wide study object, this thesis focuses on a sub-area of the language, the clitic pronouns, that are known for being one of the hardest matters to master.

1.1 Context

The process to learn a new foreign language has never been an easy one. The Portuguese language emerges as one of the hardest to learn, and the clitic pronouns one of the most difficult areas of the grammar, as a result many times the learning process becomes tedious [DA15].

On the other way, gamification applied to the learning and teaching process has proven to be a great solution, as it motivates the learners to be more predisposed to face challenges and learn [HYH13]. A new complex and non-linear teaching model, created by Sousa M. [Sou17] will be used in this work as the target to improve the learning process.

1.2 Motivation and Goals

Economic and geopolitical issues have increased the need to learn foreign languages. Hence, the development of scientifically oriented works, in order to produce materials for the Portuguese language teaching and learning to foreigners, became a priority.

The concept *fossilization* also gives strength to the need for the creation of new materials, as it represents one of the biggest problems in the learning process of a foreign language. Such concept was introduced by Selinker [Sel72] in 1972, from its observation that a significant percentage of learners from a foreign language stagnate at a certain interlanguage stage, despite the necessary conditions for success in learning remaining. It is well-established that the interactivity of digital technologies makes learning much more dynamic and effective [IW13]. This way, gamification methodology emerges as a compelling solution. Gamification is a strategy for acquiring knowledge and develop skills, using elements and techniques from games to generate and enhance the involvement of the apprentices, as well as to simplify the learning process. According to a survey of Ihlström and Westerlund [IW13], the adoption of interactive learning materials is very scarce compared to traditional materials. They have raised the question of how efficient the technological materials would be, concluding that technological and interactive learning environment promote the student's achievements more efficiently than the traditional learning materials.

Gathering the gamification elements, that are meant to improve motivation and create some competitiveness between the users, with the non-linear model that gives customization to the user's learning process, is obtained a new way to learn the clitic pronouns more efficiently.

1.3 Dissertation Structure

This dissertation contains six more chapters in addition to this one.

Chapter 2 presents the state of art and is centred in the foreign language teaching and learning, starting to make a summary about its evolution throughout the years, but also the evolution of the methods. Some important topics are approached as well, such as the use of technologies in the teaching and learning process, distance education and the most important, the use of gamification. This chapter is meant to provide the reader with important concepts definition and insight on the topics that are more related to this work.

The clitic pronouns problem and the gamification are discussed in chapter 3, first separately, and then the application of a gamified system in the clitic pronouns. Both these topics are the main focus of this thesis, so the problem and the theoretical solution are analysed in this chapter.

Chapter 4, gives insight to the reader about the model created by Sousa M. [Sou17]. Furthermore, a description of how this model was applied in this work is also done and the main differences from this model to the others are pointed out.

Chapter 5 contains all the information relative to the implementation of the practical work, such as requirements, technologies and architectural patterns chosen in order to facilitate the development process, the application structure and the most important, the data storage. In this chapter, a detailed description about the documents structure, their relation and how they are used is made.

The project validation is done in the chapter 6, that starts by describing the experiment design and then making an overview of the tasks that the users that are participating in it are going

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through. This chapter ends by making an analysis of the data obtained in the experiment and taking conclusions out of the whole procedure.

In the last chapter [7](#), there is a review of the work and some insight about what can be done in the future, as well as the mention of some lessons learned and obstacles that were surpassed.

Introduction

Chapter 2

Foreign Language Teaching and Learning Context

2.1 Evolution in the Last Years

The foreign language (FL) teaching evolved throughout the 20th century, being influenced by diverse achievements in other science fields. The 50s were moments of turning, as important developments in the Linguistics and Psychology areas led to the birth of a new research field in Linguistics, the Second Language Acquisition (SLA), which opened new perspectives on the learning process and made an impact in the teaching and learning.

In this evolutionary course, Grammar was always in the center of attention, with sometimes noisy divergences regarding the teaching of this basic language component. The controversy revolves around foreground issues such as *what to teach*, which, on the other hand, lead to new questions about *how to teach*. The main question has been, *Should there be grammar teaching in the FL teaching process?*, if so, *Which of these two components, grammar or lexis, should have primacy?* For any of the answers, the question that follows is, *How to structure the teaching and learning process as a whole?*

In another aspect, which has to do with international geopolitical and economic developments, a line of evolution came to be associated with the teaching and learning process of the FL, this time of a social nature, which more recently, has included human factors [Ort18], with reflexes also in the languages learning. And in a wider view of FL teaching, technological development has changed the way we learn in general, which logically includes the foreign language and second language. This happened since the end of World War II, when the teaching and learning methods have been adapting themselves to new visions of the world that the science keep unlocking.

The grammar learning and teaching has been subject of research in the Second Language Acquisition field, contributing to this process understanding and, therefore, with possible influences in the development of teaching methodologies in this area.

2.2 The Method Concept, in the Foreign Language Teaching and Learning Field

The word *method* refers to a concept with somewhat diffuse boundaries, in a lexical field in which several words, such as, approach, principle and procedure, sometimes are confused and used as the same concept. "A method is a way of teaching a language which is based on systematic principles and procedures" [LF11]. It can also be defined as a coherent set of principles linked to techniques and procedures. All methods have both a conceptual and an operational component. It is also associated with techniques, as they carry out a method which is consistent with an approach.

2.3 Methods Evolution

"In the late 1960s, Kelly (1969) produced an overview of language teaching history which began in the period around 500 BC. (...) It is indeed a sobering thought to find that issues which we consider today to be the cutting edge of debate, and the methods we like to think of as *state of the art* are likely to have been around in Aristotle's time" [Joh13].

This quote makes an advice to be cautious about the concept of *innovation*, facing it not as the arising of something that did not exist until now, but as a change in the interaction between parts of a whole that gives rise to different configurations at different points in time.

The next sections present four methods, those that had, and still have, a broader application in the general panorama of foreign language (FL) education [LF18], and which more directly relate to the model that is going to be applied in this thesis. The four methods to be approached are: Grammar-translation, Audio-linguistic, Communicative Approach and Task-based Learning.

The dates that refer to each method indicate significant moments related to the emergence and evolution of it, but do not mean the life span of this method, in fact, all of them are still being used, somewhere on the planet, on a greater or lesser scale.

2.3.1 Grammar-translation (GT)

This method, also known as the *Classic Method*, because it was first used in the classical Latin and Greek languages teaching and learning, dominated the FL teaching until the 1950s, of the twentieth century.

Specific characteristics

In this method, the communication language in the classroom was the mother tongue. The main learning objective was to read literature in a foreign language. As it was not supposed to communicate in the target language, there was not much space to work with orality.

Grammar framing in the whole of language learning

This method, as the name implies, was directed towards form, and therefore, the grammar is the target and the structuring base of language learning, based on a structural syllabus.

Preferred procedures and techniques

The most used pedagogical technique was the explicit deductive, teaching of rules and later application [LF11]. The work is based on written productions, with exercises, breaking down speech into segments or units (words, phonemes, morphemes, etc.), classifying items into categories (names, adjectives, adverbs) [Joh13] and translate texts from the target language into the mother tongue and vice versa. Many current FL teachers learned themselves foreign languages using this method.

2.3.2 Audio-linguistic (AL)

Audio-lingualism, a behaviorist inspiration, also known as PPP (Present, Practice, Produce) comes in the late 50's.

Specific characteristics

Conceiving the learning as a process of habits acquisition, this method has, as general principle, the formation of *linguistic habits*, by understanding and automating the grammatically correct linguistic structures (patterns). Error is seen as an evil to avoid.

Orality plays a fundamental role in learning, because it promotes the interiorization and automation of correct sentences structures.

Grammar framing in the whole of language learning

Such as the previous one, this method also gives primacy to the form and, therefore, the grammar constitutes the structuring base of the language learning, being also the main content, based on structural syllabuses.

Preferred procedures and techniques

Oral speech approach, with intensive oral training of standard sentence structures (drills), aiming at the automation of the correct form (in a strategy of error prevention) that would later be activated by the learner through the stimulus and reinforcement, conditioned behavior.

It was concluded over time that, by this method, FL learners became grammatically competent but communicatively unfit.

"This type of learner will know their grammar well, and will be able to produce structurally correct sentences without problems. But deposit them at an airport in the target language country, and they may not know how to ask for a taxi. . . " [Joh13].

Thus, the discontent in terms of results in relation to the two previous methods created the conditions for the emergence of new methods in the seventies that constituted a new turning point in the teaching-learning process of FL. In brief, it can be described as the *focus on form* (or primacy of form) transition to the *focus on meaning* (or primacy of the message), followed by the adoption of new forms of work more appropriate to this renewed conception of FL teaching.

2.3.3 Communicative Approach (CA)

Scientific advances in several areas, along with the evident inefficiency of previous methods, and the increasing pressure for the need of communication between people of different countries, represent the basis of this new method.

"In the 1970s, though, educators began to question if they were going about meeting the goal in the right way. (...) Others noted that being able to communicate required more than mastering linguistic structure, due to the fact that language was fundamentally social" [Hal73].

Specific characteristics

A broader view of FL teaching has shifted the lessons from content to focus, and introduced new concepts, such as notions and functions." Within the social context, language users needed to perform certain functions, such as promising, inviting, and declining invitations." [Wil76]. Communicative competence is another concept that defends "language is for communication. Linguistic competence, the knowledge of forms, their meanings, is only one part of communicative competence. Another aspect of communicative competence is the knowledge of the functions that language is used for." [LF11] The teaching processing according to this perspective opened space for a new type of syllabuses: the notional and functional syllabuses, which focus in the sense and not in the form.

Grammar framing in the whole of language learning

Shifting the focus to meaning, form was seconded, the variety of forms is introduced into each function, according to communicative intentionality and situation, and using a notional and functional syllabus.

Preferred procedures and techniques

Student-centered activities in groups of different sizes make learners to communicate in the target language. Whith authentic materials, products arising from real-life situations and student's work with the language at the speech level, the error is decriminalized, coming to be seen as an opportunity to learn.

2.3.4 Task-Based Learning (TBL)

In this method, as the name suggests, the students use language as an instrument to overcome a main task.

Specific characteristics

The work focuses on *procedural knowledge* and *competence* (as a capacity to apply knowledge), the ability to *do* things (communicate) with or through the foreign language.

Grammar framing in the whole of language learning

The grammar comes from the communicative needs of the tasks, which are designed specifically for the exploration of grammatical contents, in concrete *focused tasks* or *pedagogic tasks* [Eli09]. Willis proposes a sequence of steps to accomplish the task, pre-task, task cycle, and post-task. In the first and last stage there will be room for *focus on form* with inductive processing [Wil96].

Preferred procedures and techniques

This method defends the work in pairs or groups, which promotes collaborative learning. The concept *Information gap* is the main idea of this method, to explain, the material provided to the student does not have all the information that he needs for the completion of the task, so he will have to obtain it by his own means. The missing information may be related to the grammatical knowledge to be applied at any time during the task. This technique may induce *collaborative learning*, if the missing information exists in the material provided to a colleague, or another group, which may yield it, generating moments of training and language learning.

2.4 Pedagogical Materials for Teaching the Foreign Language

The teaching materials are an important component in the FL teaching and learning process. The scientific evolution in the psychology and technology linguistics areas, in recent decades, has been reflected not only in methods (approaches to promote learning), but also in the teaching materials. Considering that these two components of the process go hand to hand, it is important to see if both have evolved at the same pace and in the same direction.

In the teaching materials field, two broad categories can be distinguished, the manuals and the other materials. Each manual constitutes a *structured whole* for a given course or school year, covering all the components of language learning. The *other materials* are separate products, of different nature, each focusing on a specific content. Any of these categories, which in the past only existed on paper, exists today in both paper and digital.

Beginning with manuals and the pace of innovation, developments in this field have been slow and superficial. In the book, *Doing Task-based Teaching* [Wil07], Dave Willis and Jane Willis, in the final chapter, entitled *How to integrate TBT into coursebooks, and other frequently*

asked questions, the authors present ways to work around the *mismatch* between manuals and this new methodology. Regarding support, recently have been seen the offer by publishers of online versions of their manuals on paper, with occasional additions to some interactive activities. The positive aspects in these initiatives create the question on whether they are, in fact, innovations, besides neglecting the immense potential that technology offers, for the foreign languages teaching and learning.

As for *other materials*, along with the traditional ones that have moved from paper to digital, others have emerged, unique to digital media, and taking advantage of the potential of this medium. This is the case for many games and activities which can be currently found online. However, being single materials, their place in the teaching and learning process will always be secondary and dependent on the degree of articulation that they can establish with the main process operators. It is necessary to produce pedagogical materials that, following scientific evolution and taking full advantage of the potential of technology, can play a role as main operators and learning promoters or facilitators. The model proposed in this dissertation has this aspiration, to reach a place among the main operators of the process, with the role of promoter and learning facilitator.

2.5 Teaching and Learning using Digital Technologies

Technologies mean to help human beings, can and should assist in some activities and thereby ensure new ways of learning. Thus, language teaching and learning changed completely as a result of the introduction of digital technologies. The books remain as a resource, however, new educational software is used. As Bates points out, digital technologies, such as the Internet, are neither better nor worse than the other materials used. They are a more effective complement to learning [BAT05].

As is well known, the use of new technologies as a pedagogical and didactic tool has produced great changes in the relationship between students and teachers. According to Faustini [FAU06], the teacher will continue to teach his class, but he can enrich the teaching and learning process by sending and receiving messages from the students, creating mailing lists and encouraging debates with texts and Internet pages.

Digital technologies add value to educational growth and enrichment. Lévy affirms that "the cyberculture brings a mutation between the relation with the knowledge." For this author "Cyberspace supports intellectual technologies that amplify, externalize, and modify numerous human cognitive functions" [Lé00].

Using software in education allows an infinite range of possibilities, such as, adapting the learning to each student, managing the time better and focusing on activities with more interest. The teacher will be more active in clarifying doubts, mediated debates, guidance on the use of different resources and a facilitator when evaluating, using, producing or participating in the production of such software.

It is worth noting the words of Peck and Dorricott [Pec94], when they affirm "that digital technologies can't replace the teacher since many of the teacher's routines can be performed by technology, improving but not replacing the teacher's role."

Many students have technologically advanced knowledge, given the access to information available on the Internet, and teachers should not fear this. They should rather take advantage of such experiences, seeking to reorganize and deepen them, as they are essential in learning and teaching.

As Lévy says, "the teacher becomes the point of reference to guide his students in the individualized process of knowledge acquisition and, at the same time, offers opportunities for the collective construction process development of knowledge through cooperative learning. Its competence must move, in order to encourage learning and thinking, its activity will be focused on the monitoring and learning management" [Lé00].

2.5.1 Distance Language Education

The last decade was marked by the accelerated development of technologies. This way, education can not be left out of this phenomenon.

In the languages field, there is a vast amount of didactic materials offered by digital technologies, to be explored. Disciplines with reduced classroom load can be taught as distance language education via the Internet. Although there is a physical distance between teacher and student, the computer will allow the connection or communication, through webcams, microphones, electronic mail, among others, thus minimizing the loss of isolation.

It is good to remember the fears of some less optimistic teachers to be replaced by the machine, and some students because they find this teaching of lower quality. However, it is important to emphasize the incentive that must be given in the ongoing teachers training, the change of attitude towards the use of new technologies and the creation of an environment, with favorable technological conditions, so that projects can be developed and collaborative work between teacher and student.

2.5.2 Website as Support and Supplement to Face-to-Face English Language Teaching and Learning

An investigation carried out by Martins [Mar12], in the creation of a website, as a support and complement to the face-to-face discipline advanced level teaching and learning of reading and writing in English as FL in a Fortaleza's english languages course. With this website students could publish their texts, receive comments, as well as read and write comments about the texts of other students. Also, it had links to online dictionaries, reading sites, grammar explanations and many others.

At the end of this experience, both students and teachers gave very positive feedback through a questionnaire, in which students mentioned that it was more fun and dynamic to study by this

means and teachers considered it to be a stimulating and diversifying way of learning a foreign language.

2.6 Gamification

Gamification consists of "using game elements (mechanics, strategies, thoughts) outside the context of games, with the purpose of motivating individuals to action, assisting in problem solving and promoting learning" [Kap12]. This phenomenon was extended to education, applied as a teaching and learning strategy directed at a target audience, referred to as a gamer generation, and with very positive results [She12].

2.6.1 Gamification description

Gamification is an emerging phenomenon, the potential that games present has been discovered for more than three decades [PAP08]. However, the gaming industry was still developing. Today its influence is felt in global terms and it reaches almost all the layers of the population.

Gamification presupposes the use of elements already found in traditional games such as narrative, feedback system, reward system, conflict, cooperation, competition, clear objectives and rules, levels, trial and error, fun, intention, interactivity, among others, whose purpose is to gain engagement and motivation.

The goal is to be able to visualize a particular problem or context and think about solutions from the point of view of a game designer, since this professional usually has a unique ability to produce experiences that concentrate energy and the focus of many individuals to solve problems in virtual worlds.

The choice of the elements and how to apply them in a specific context depends on the purpose of the project. We can build gamified systems based only on points, medals and leaderboards, which are the most basic mechanics of a game, to achieve changes in the behavior of individuals through additional rewards [Lad11] or to create more meaningful experiences that go beyond what basic gaming mechanisms provide and motivate individuals to develop their roles within the context in which they are found [Wer12].

Nowadays, gamification finds in formal education a very fertile area for its application. It is an alternative to passive teaching and learning methods used in most schools.

2.6.2 Gamification applied in Learning Environments

There are few reports of empirical experiences in gamified educational processes, since teachers have to master this approach well before using it in their projects. North American teacher Lee Sheldon's made an experience called *Multiplayer Classroom: Designing Coursework as a Game* that was really successful. In it, this teacher, who left the Games industry to teach Game design (a discipline that studies the creation of electronic games) in an institution of higher education,

decided to gamify his courses. This new approach triggered some changes, which are reported in his work [She12].

The feedback, uses a different grade system, where the grade became incremental. The students at the beginning of the semester had a grade of zero and from there they would build it through the proposed activities. And yet, just like in the games, several punctuated tasks were created instead of two or three rating exams. This gave a greater number of opportunities for success to students, through greater contact with the knowledge to be built.

The language used was transformed, for the rescue of online RPG (Role Playing Games). Students can group guilds together, create tasks to interact in activities, how tasks were, see actions, do exercises such as knocking down enemies. Seeming to be immersed in a virtual world.

The final marks were the result of the points obtained by the students. The purpose was not confined to the final grade, but also to the evolution of the characters, by accumulating points through the accomplishment of the proposed missions (class activities, tasks, presentations, research, among others).

The physical space of the room was modified, to accommodate the guilds (group of students) these spaces had designations coming from some elements of the games, which determined the type of activity performed in that space.

The gamification strategy error has received different treatment. In games, there is always a new opportunity for success, a new attempt to address the problem.

After applying these changes, the teacher introduced the games language to promote the learning about the games development. The teaching method was the main purpose of learning. According to the teacher, this experience increased the interest level, participation and motivation of its students, promoted a greater interaction between them and a different teaching method in relation to the expositive classes.

2.6.3 The Proposed Model to Gamification Systems: Characterization

Specific characteristics

This strategy introduces considerable changes in the teaching and learning process, looking at it as an interaction between three distinct but interconnected and constantly co-adaptive systems: the *teaching system*, the *learning system* and the *pedagogical materials system*. This third system, not considered in traditional teaching as a part of the teaching and learning process, is now included in the whole *ecosystem* and will be the entrance gate to the gamification into the learning process.

The characteristics applied to the methodological gamification principles are the increasing difficulty graduation, for organization of the teaching process and, the feedback and reward, in order to attract the students, engage them in tasks aimed at acquiring knowledge and developing high-level skills, learning pathways monitoring, including the provision of individual and group performance information and autonomy promotion in learning and management of the training course.

Grammar framing in the whole of language learning

This model is embedded in the global perspective of the *Communicative Approach* and *Task-Based Learning*, following the principle of *focus on meaning*, with moments of *focus on form* when this proves necessary. The variety of forms will be introduced into each function, as required by the communicative intentionality and the demands of the context of use. Thus, grammar is seen not as an end in itself, but as a necessity, together with the lexicon, for the construction of meaning, for the formal correction in the statement construction and for the adequacy of the message to the communication situation [LF18].

Preferred procedures and techniques

- Promotion of *know how*, process knowledge, along with involving declarative and conceptual knowledge;
- Learning from experience, using resources available in the context of the tasks, and may include any of the following modalities: information sources consultation, adjusted to the needs of the moment, collaborative learning for participation in online practice communities, multimodality, interactivity, simulations, virtual reality and other techniques that technology can provide, repetition of the task without penalty (opportunity to fail, to take risks), or using the rewards mechanism;
- Personal choices to follow along the course, depending on individual needs and goals;
- Appeal to diverse techniques promoting learning such as, noticing, consciousness raising and negotiation meaning;

2.6.4 General Guidelines for the use of Gamification

In order to apply gamification as transformation in teaching and learning processes, an online learning platform should be created for schools and students. Some suggestions should be followed, such as:

- Provide different experiments;
- Include fast feedback cycles (players should always visualize the effect of their actions in real time) which does not happen in schools today;
- Increase the difficulty of the tasks according to the ability of the students;
- Divide complex tasks into smaller ones;
- Include the error as part of the learning process (the error is part of the games in a natural way);

- Incorporate the narrative as context of the objectives (reason for the actions of the characters, a story that justifies why they are doing that);
- Promote competition and collaboration in projects;
- Taking fun into account, learning can be enjoyable;

2.7 Overview of Existing Foreign Language Learning Systems

"The growth of technology for educational use has transformed the way in which people learn and access education. This is particularly true for languages, an area in which the explosion of mobile apps and interactive software has provided choice to a range of people who were previously unable to access foreign language education." [CR]

There are a lot of good systems in the Internet that people can use to learn efficiently a new foreign language, and in this section an overview of the most important ones is going to be made, showing what each one has to offer to the student.

Duolingo

Duolingo is one of the most used free foreign languages learning platform, with at least 11 different complete courses. It is divided in modules and has a big variety of exercises, including listening and speaking based exercises. Once the learner finishes a module, a new screen pops up with his weakest words so he can strengthen them. The best things about this platform is that is very simple to use, helps with the motivation, using a goal system, and it uses a lot of visual content which makes everything easier and more attractive. On the other hand, there is no room for mistake, as Duolingo penalises the student for every small mistake he makes, some exercises use sentences that are unnatural, meaning they are not normally used, and the user does not have much control over the topics he wants to learn. [Agn]



Figure 2.1: Duolingo icon [Duo]

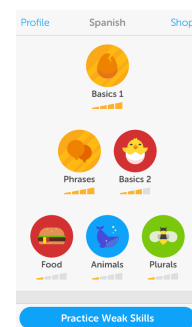


Figure 2.2: Duolingo menu [Agn]

Busuu

Busuu is another popular language learning platform, however, unlike Duolingo this one is paid. The biggest difference from the other platforms is that it has a social community that can help students learn from each other, and the exercises are corrected by native speakers, which is another good feature. In contrast, it is not very well organized, as students learn things that are not that much important, before the essential ones. The grammar and the pronunciation are topics that are barely explained [Nic].



Figure 2.3: Busuu icon [Ltd]

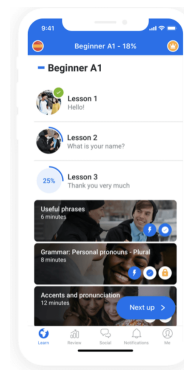


Figure 2.4: Busuu menu [Ltd]

Babbel

Babbel offers language courses that are online based, focusing mainly on quizzes. Users learn new vocabulary, grammar and then are asked some questions to reinforce the new acquired knowledge. The platform is excellent to go from beginner to intermediate level, however lacks tough exercises. The platform is not that expensive, it is really easy to use and has a lot of audiovisual contents. In other hand, less popular languages don't have so much content and it is not the best option to improve conversation skills. This way, this platform should be used as a complement to learning a new foreign language [J].



Figure 2.5: Babbel icon [Gmb]

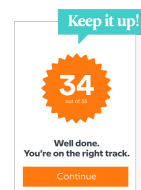


Figure 2.6: Babbel menu [J]

Livemocha

Livemocha is known for having a large list of languages that can be learned in this platform. It offers a really complete course with exercises in writing, reading, speaking and listening. In the end of each exercise native speakers give some feedback, and there is also a points system that gives students points so they can buy more lessons. There are some downsides as well, the feedback mentioned earlier is mandatory and some people might not be interested. Some of the questions are created by other members and this might not be the best idea, since not everyone can teach a language [Now].



Figure 2.7: Livemocha icon [Sar]



Figure 2.8: Livemocha menu [PCM]

2.8 Summary

Gamification is an emerging phenomenon, whether it will last or not, it is not known, however, at the moment it can be seen as an uprising force. The games popularity has increased, and so gamification is being integrated into different services. It can empower learning and its use in education is a challenge to teachers. With games you can create valuable experiences, give them meaning, both in schools and in other learning environments.

Teaching grammar is important, although it needs to be reconceived [LF18]. The introduction of technology into the teaching and learning process is a necessity at present and future times. This way, gamification, in a whole system, can be one harmonious solution to join these two lines of thought.

Chapter 3

Gamification applied in the Clitic Pronouns

This chapter introduces the problem of this thesis as well as explaining what a gamification system is and how it can be applied in the clitic pronouns studying. In addition, an overview of the solution and how it will be evaluated are also sections of this chapter.

3.1 The Clitic Pronouns Problem

Clitic pronouns are identified as a critical area in the learning of Portuguese in the European standard as a Second Language (SL) or Foreign Language (FL). They are already present in medieval literature, with the characteristics they currently maintain.

A clitic pronoun is a word that can not be prosodic itself, therefore, it must be aggregated or adjacent to another, being as two pronunciations as if it were one. To the word that adds a clitic is called host, in the case of pronouns, the host is always a verb.

The clitic pronoun can occur in three positions:

- Following the verb, linked by a hyphen. It is the most common one. Example: *As notícias chegam-**lhes** ao minuto;*
- Before the verb, without hyphen. Example: *Só **lhes** contarão o sucedido mais tarde;*
- In the middle of the verb, connected by two hyphens. Example: *Amanhã explicar-**lhes**-ão o que aconteceu;*

They form a closed group within the subclass of personal pronouns. Although it has a reduced number of words, it is considered a critical area on grammar learning. The difficulty manifests itself in its use and comes from the diversity of knowledge associated with them, including the concepts of clitic unity, its framing in the sentences structure, the changes in form, as well as their

identification in context, are sometimes confused with other words that are the same or similar in form, but different in function.

3.2 Gamified System

"In real life, individuals do not feel that they are as good as they are in games. When confronted with obstacles, people may feel depressed, overwhelmed, frustrated or cynical; feelings that are not present in the gaming environment. They also prefer instant gratification to keep themselves engaged and motivated. And this, is where gamification steps in." [HYH13].

There are different ways to describe the gamification concept, for example, Yu-kai Chou defines it as "the craft of deriving all the fun and addicting elements found in games and applying them to real-world or productive activities" [Cho15] and for Ray Wang it can be explained as a "series of design principles, processes and systems used to influence, engage and motivate individuals, groups and communities to drive behaviours and effect desired outcomes." [Wan11].

Both affirm that one of the ultimate goals of the gamification in the education is the intent to motivate the students to improve their learning when they are facing obstacles.

This way, gamification, as stated above is recognized as having great motivating power, as it can create a strong association with technology, and from this association both are reinforced, as gamification finds in the technology potentialities the ideal mean for its full realization, and shares with it its motivating potential. In this maximizing effect, the set of the two potentiates the learning pathways customization, resulting in positive learning effects in quantitative and qualitative terms.

In addition to the gamification elements, a non-linear model created by Sousa [Sou17] will be used to complete this system and improve the student experience in the clitic pronouns learning process. The implementation of this proposal, therefore, requires a structuring model of the teaching and learning process that is flexible enough to allow a variety of courses. The model designed is a hypothesis, which is intended to be tested.

3.3 How to apply the Gamified System

The Gamification system application needs to follow a set of principles, that working with each other and involving several other aspects make possible the achievement of the desired final result.

1. Short steps with clear objectives. This principle involves:
 - The content segmentation and its sequencing in the difficulty increment;
 - The definition of intermediate objectives, by stage, concrete and measurable;
2. Learning by practice, which requires:
 - Tasks design and appropriate activities, in form and substance, to the immediate objective, but without losing sight of the ultimate goal;

3. Help currently available through the provision of information, which implies:
 - Careful preparation of the information to be provided, in order to make it attractive, easy to understand and still conveniently dosed, depending on the need of the moment;
 - Accurate location in the system as a whole, allowing an integrated view of each part in the whole;
 - Efficient management of their availability, along the way, aiming at effectiveness in terms of learning outcomes;
4. Immediate feedback, in three areas:
 - Informative, about the result obtained;
 - Corrective, providing the right answer;
 - Guidance for the next step, depending individual factors and goals of the student;
5. Reward, contemplating:
 - The merit;
 - The effort;
6. Guidance for follow-up (to be provided in the final feedback) which requires:
 - Management, by the system, of the strengths and weaknesses of each learner, in order to enable:
 - Indications to the best next step in terms of motivation and learning;
 - Choices based on the student's current state of knowledge and short, medium and long term personal goals;

3.4 Solution

The solution proposed, in order to full fill the requirements in the section above, is the creation of a web application, that involves the use of gamification elements, such as points, levels, rewards and rankings, that mean to turn a tedious task in an addictive one.

In addition to these elements, as stated above, a non-linear model will be the base to structure the levels, that to say there will be three types of progression on the levels, that is due to this model. This way, the students will have a more customized path, that will focus on strengthen their weaknesses and achieve their goals faster and more efficiently.

The gamified system obtained by gathering all these features, forms the solution to build the application around. The app will require registration and will challenge the users to complete exercises with different levels, rewarding them in the end if they had a good performance. They will, not only be placed in a ranking system based on their achievements, but also be able to climb

in the levels map. The Clitic pronouns will be the area of study, as it is one of the hardest and tedious themes to learn.

The solution validation will be done by carrying out an experiment with some people, evaluating their performances with and without gamification elements, for example, examine how their attitude change when adding some competitiveness, letting them know there are rankings based on their exercise results. In the end of the experiment tasks, they will be asked some questions about their motivation levels in the different conditions, and also about what that could be done to improve the application.

3.5 Summary

The difficulty in using the clitics lies in the volume of knowledge related to this category, and also by the amount of other knowledge that in practice is associated with them, given the diversity of situations in which they are used. The use of the clitics in the sentence intersects with other sentences mechanisms, namely the knowledge about the verb, the adverbs and the subordination. The clitics learning can not be learned in a single moment, taking into account the network of relations that establish with other categories in the sentence. The work developed in this thesis can help to respond to this problem.

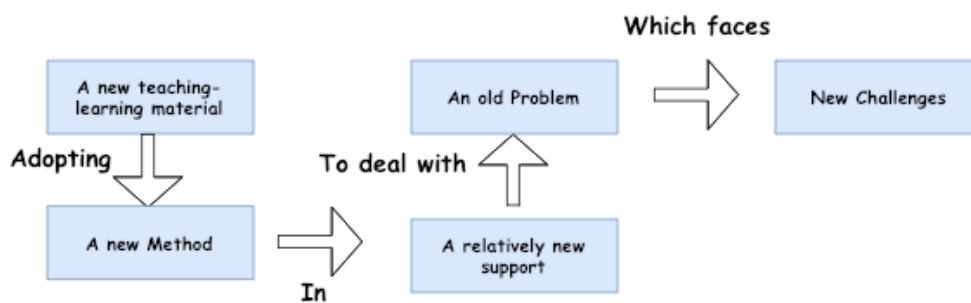


Figure 3.1: Problem summary scheme

Chapter 4

Teaching and Learning Model

In this chapter, the non-linear teaching and learning model is explained, so the reader can understand how it works and how it was implemented in the application, showing the levels distribution based on it. In addition there is a description of the gamification elements, such as the reward system, and what their role is on the app and their impact in the users performance.

4.1 Model Architecture: Lines of Progression

The gamification methodology application on language learning has impact on the organization and distribution of the content. Its basic principle is the difficulty segmentation in short steps, each one with concrete objectives, immediate feedback and also help available in the context of the task, adjusted to the difficulty of the moment. The content to learn is divided into smaller segments, in a progression that is logic oriented from the simplest to the most complex. The representative image of the flow channel 4.1, shown below, illustrates the need for such upward and balanced progression in terms of difficulty in order to avoid either the anxiety caused by the excess difficulty or the annoyance caused by excessive ease.

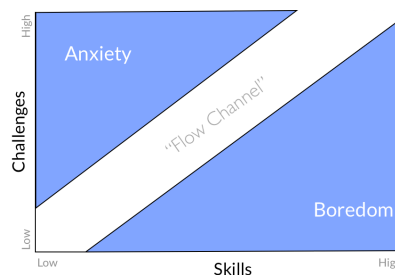


Figure 4.1: Flow Chart [Bai13]

The fragmentation process should be based on predefined criteria together with pedagogical-didactic principles, taking into account current knowledge on the Second Language Acquisition

Teaching and Learning Model

process. The model created is a response to this need. In its conception, four co-operative factors were identified:

- **Content**, related to the language knowledge (to be acquired) required in each use situation;
- **Competence**, which includes the set of skills (linguistic and non-linguistic) involved in the use of the language;
- **The communicative object**, that puts together the context of use with the set of knowledge inherent to enunciation;
- **The tasks and activities**, specifying the practical side of the language in use;

Each of these factors, present in each communication act, has its own complexity, and its interaction results in volumes of complexity of greater or smaller size, and higher and lower degrees of difficulty. The first three work as one, they are related to the knowledge with the circumstances of its application, the competence and context. The fourth, tasks and activities, of various types and forms, joins with the other three blocks, according to their purpose.

The structuring table

The structuring table is based on the syntactic structure of the sentence. The first three factors give it form, in three dimensions, with three lines of progression, one in each factor. The content is the main factor, which progresses in level, horizontally, supported on two sides, the competence, which progresses in degree, vertically, and the object, in depth, that progresses in category as it can be seen in the tables below.

The content progression, horizontally, reflects the difficulty inherent to the different knowledge of the language operation, reflected in the types of knowledge, that are included in the Bloom Taxonomy, revised version in 2001.

	Factual Knowledge	Conceptual Knowledge	Procedural Knowledge	Metacognitive Knowledge
Level A	+	-	+	-
Level B	+	+/-	+	+/-
Level C	+	+	+	+

Table 4.1: Knowledge type table. The + means big amount, +/- a medium amount and - small amount of that type questions of that knowledge.

Along with the types of knowledge, another criteria is used to differentiate the content, necessary in the management of courses for different profiles of students, related to the more concrete or abstract nature of the knowledge.

The vertical progression (competence) organizes the difficulty degree at the clause level, the number of clauses within the sentences, I degree has one clause, II degree has two or three clauses and in the III degree, more than three clauses. On the other hand, the object organizes the difficulty

Teaching and Learning Model

	Concrete	Abstract
Level A	+	-
Level B	+/-	+/-
Level C	-	+

Table 4.2: Knowledge nature table. The + means big amount, +/- a medium amount and - small amount of that knowledge nature in the questions.

degree at the syntagmatic level, it is related to the number and composition of the phrases within the sentence, as well as the quantity and type of the parts that align around the core of each syntagma. Each of these factors, in addition to its own organic, keeps up with the evolution of the content, resulting in a category 1, 2 or 3 level B object, that has a degree of complexity greater than its relative level A, and the same for level C in relation to B. Also, progression in competence is processed in the same way, the level B sentence structures sub-levels will be more complex than level A and less than level C. This way, a relatively global economic structure 27 levels is achieved. It can be described as stable and functional, capable of accommodating in its interior, in an organized way, a great diversity of sentence patterns to which the students will need in multiple communicative interactions of their daily lives.

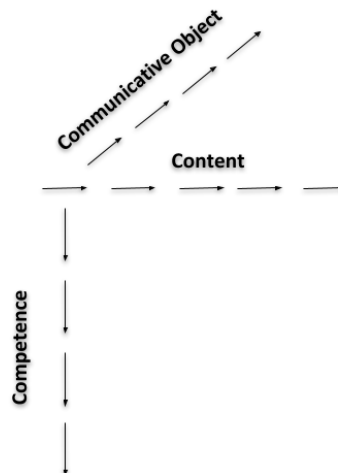


Figure 4.2: Three progression lines

4.2 Model Implementation

In order to transmit the model idea to the user, an adequate interface had to be built. In the end, a cards structure based was determined to be the best suited one to this non-linear model. In the image below, is represented the final result of the visual implementation of the model [4.3](#).

Teaching and Learning Model

This representation consists of a structure of cards displayed in a logic way. There are 27 cards, each one represents a different level of difficulty, but not necessarily a different exercise, as it is possible to create a large variety of different exercises of the same level.



Figure 4.3: Non-linear Model Visual Implementation

Teaching and Learning Model

The 27 cards are displayed following the Three progression lines model, this means that the 3 model variables are the base of this structure.

The content variable is represented as the three columns A, B and C. This means that the difficulty of the variable content in the exercises changes according to the column the card is in. For instance, the difficulty increases from A to C, so an exercise from a card in the A column, in terms of content, will be easier than an exercise from a card belonging to column C.

The variable competence changes vertically, as there are 3 rows and each one represent a different difficulty for this variable. The 3 rows are I, II and III, being the I the row with the easiest difficulty for the competence and III the hardest one.

The third and last one is the communicative object, and this one changes as the depth of the cards change. There are 3 levels of depth, represented by the numbers 1, 2 and 3, being the number 1 the easiest level and the cards displayed in the front and the depth 3 the hardest one and is displayed in the back of the structure.

In sum, horizontally there are changes in the content difficulty, vertically the changes are in the competence difficulty and in depth the communicative object difficulty changes.

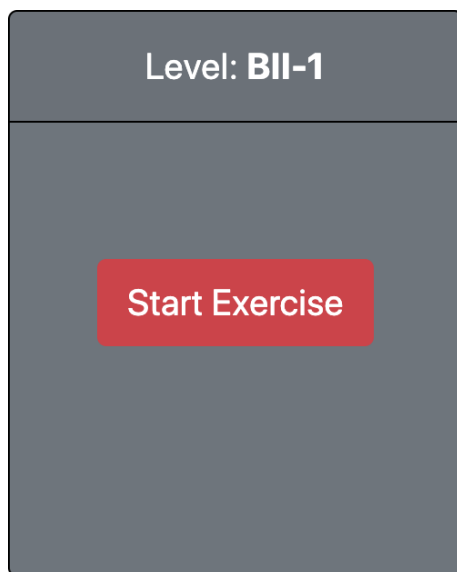


Figure 4.4: Not user current level card

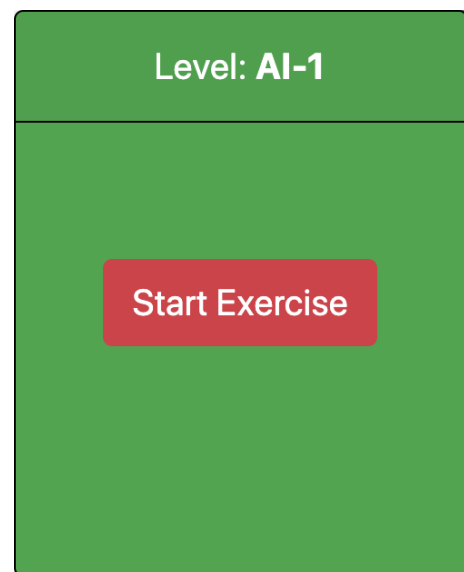


Figure 4.5: User current level card

The user current level will match one card from the cards map. This card will be displayed with a green background so it can be distinguished from all the other 26 cards that will be painted with a gray color. As stated above, each card corresponds to one different difficulty level. This level is represented in the top of the card and is made out by combining the row, column and depth. The first part of the level identification is the column, this means every level starts with the letter A, B or C depending on the column the card belongs. After the letter that identifies the column, appears the symbol I, II or III that represents the row that the card is positioned, meaning I the

first row and III the last one, from the top the page. After this two, there is a dash to separate the column and row from the depth so it doesn't get too hard to read the level. This way, the depth appears after the dash and is represented by the numbers 1, 2 or 3. The number 1 corresponds to cards that are in the front and the number 3 to the cards in the back. In sum, the level AI-1 is the first one and the most basic one, and the level CIII-3 is the last and hardest one.

4.3 Rewards System

As it was mentioned before, rewarding a student is a key feature of a gamified system. After completing an exercise, the user is rewarded for the merit of having correct answers but also for the effort. Instead of only rewarding the users when they have excellent performances, in this model they are also rewarded for all the dedication and effort that they putted in the task. This approach will keep them motivated and works as a self-esteem boost, even when they only have decent performances.

In the table below, it is possible to see how the rewards are given based on the hit percentage of the students answers.

Hit %	Points %	Trust Credits
Up to 49%	0 points	0 trust credits
50% to 69%	25% of the total points	0 trust credits
70% to 84%	50% of the total points	2 trust credits
85% to 99%	75% of the total points	3 trust credits
100%	100% of points	5 trust credits

Table 4.3: Rewards table of an exercise

There are two types of rewards that the user can receive in this model. The main one are the points, as they can be used in different situations. When a user concludes an exercise, he will receive the amount of points corresponding to the number of correct answers. These number of points vary from exercise to exercise, so in order to have something consistent, points are given based on the hit percentage. In addition, even if a student has a mediocre performance, he will still receive some points in order to keep him motivated and to make him feel that his effort was not in vain.

There is another factor, that might give additional points to the student, that is the time. Depending on how much time he takes to complete the exercise, the student might gain bonus points. Although that to obtain this bonus, the hit percentage must be at least 70%.

The second type of rewards are the trust credits and, unlike the points, to obtain them the student needs good performances. These credits can not be accumulated or stored, they are immediately applied when the student finishes an exercise, as they make the user advance more than he should. When concluding an exercise with a great performance, for instance, if he receives 2 trust

Teaching and Learning Model

credits, this means, that his new current level will be assigned 2 levels above the one he should have gone. This will raise the student's confidence levels, as they will advance to a higher level than what they were supposed to.

Teaching and Learning Model

Chapter 5

CliticIt application explained

This chapter presents the web application developed and the strategy used to build and structure it. As mentioned before, the platform allows foreign adult people to take their Portuguese to the next level, improving their knowledge about the clitic pronouns, one of the most difficult subjects of the language. As a theoretical base, the study carried out by Manuela Sousa, about the clitic pronouns teaching and learning, was used to get the most out of this work.

An overview about the web application model and structure will be presented, so that it is clear the solution implemented in this work.

5.1 Requirements

As stated above, the target audience of this work are grown people, that already have a good Portuguese understanding and intend to improve it even more, learning the clitic pronouns. This way, worrying too much about an animated interface was not the main focus of this work, instead, keeping it simple, clear and objective was determined to be much more important, as keeping the user focused and motivated is one of the main goals of the application.

The application is a website, so it can be accessed in the browser using a computer or a smart-phone, which means users can easily use it.

5.2 Technologies

In order to full fill the requirements of the application, the technologies choice was an important part of the process. This is a typical client-server application, so the first part of the technology research was to find what programming language would suit more this work.

In the end, JavaScript was decided to be the best option to this project as the main programming language, because it is a really common language and very efficient in web development. Equally important, the Node.js technology, was another addition to the app as it facilitates the project

development mostly because of the package manager. NPM allows the installation of modules and libraries in the project that are available for free and that also have very good documentation. This modules make the development of some features much easier as they provide some functionalities that would take some time to create without them.

The client side of the application, was built using HTML, a markup language used to create and structure the web pages, CSS, to add some design and styles to the pages, and JavaScript to create some functionalities inside the pages. In order to render the pages and display data from the server side, a view engine was necessary and EJS was the one chosen, as it is a simple templating language that allows HTML generation plain JavaScript.

In the server side, JavaScript is enough to do all the desired operations. Express framework from Node is used to let the client communicate with the server through requests. The server is in charge of dealing with these requests from the client and send information to the client as answer to those demands.

In terms of data storage, MongoDB was the number one choice to save information about the user and about the platform material, such as exercises and their solutions. MongoDB is schema-less, as the database does not have a fixed data structure, which means it is really flexible and can handle large unstructured data. Another benefit that MongoDB offers is the scalability, as it can perform even under larger operational demands.

5.3 Architectural pattern

In order to connect all of these pieces, an architectural pattern was needed, so the application is properly structured and divided into components. The MVC pattern was the one chosen as it is one of the most used in industry-standard web development.

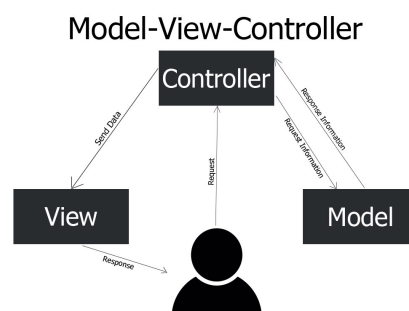


Figure 5.1: MVC components [MVC]

In the figure above it is possible to see the three components of this pattern and their relation.

The Model component is responsible for all the data-related logic. It is independent of the user interface and is also in charge of retrieving and sending new information to the database or even updating the existing one. This data will be used by the View and Controller components.

CliticIt application explained

The View component is related to the user interface logic of the application. This view includes all the UI components or any representation of information, such as charts, diagrams or tables.

The Controller works as intermediary between the View and Model components. It processes all the data that comes from both this components, manipulates data that comes from the Model and sends it to be rendered in the View. It can also send data that comes from a User input, to the Model so it can be updated, added or deleted in the database.

This architecture allows to have multiple views for the same model, this way it is possible to avoid code duplication. It also makes easier the addition or elimination of views, as the model part does not depend on the views.

5.4 App Structure

The application is divided into 6 pages, each one with a specific function. All of them are connected, and it is possible to navigate from one to another. Their relation and main functionalities can be seen in the figure below. The arrows represent what page it is possible to navigate from and to. Inside each box, in bold and at the top is the name to identify the page and below is a list of the main functionalities that are available in that page. A more specific description will be done further ahead.

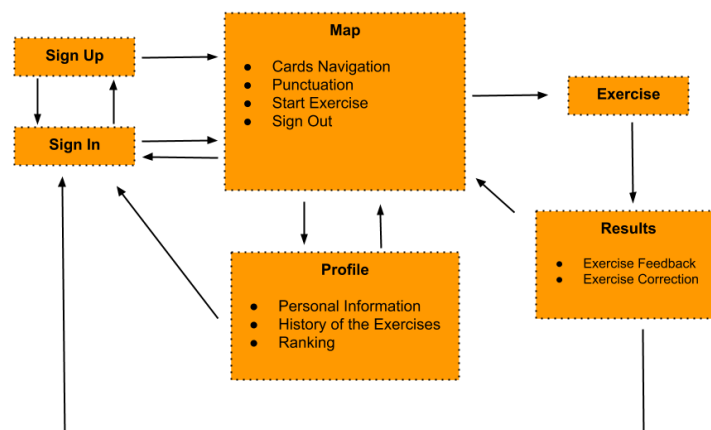
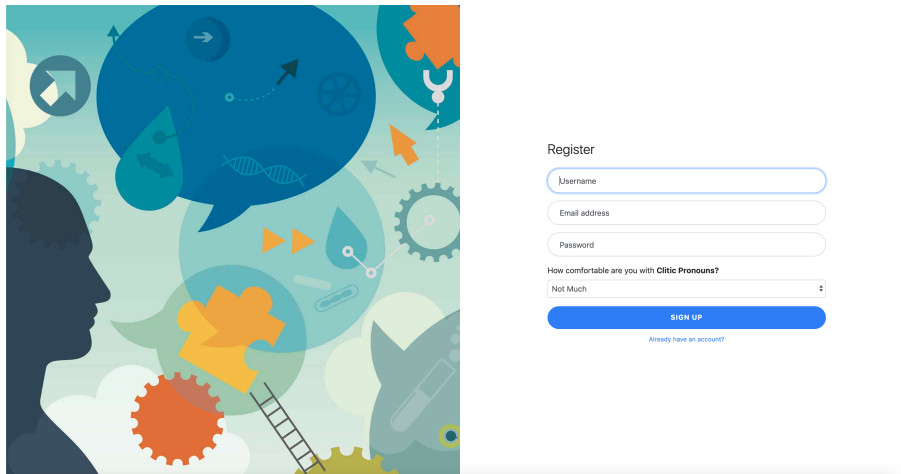


Figure 5.2: App pages relationship model

To use the app, as the first step, the user needs to create an account. The reason behind this necessity, is the fact that the app has many features that need the user's performance information. In addition, one of the main ideas of this project is the custom learning, which means that storing relevant user's information is a must.

CliticIt application explained

The image shows a registration form on the right side of a page. The background on the left is a colorful illustration featuring a silhouette of a person's head, gears, a DNA helix, a speech bubble, and various arrows and shapes. The form is titled "Register" and includes the following fields: "Username", "Email address", "Password", and a dropdown menu for "How comfortable are you with Clitic Pronouns?" with "Not Much" selected. Below the fields is a blue "SIGN UP" button and a link that says "Already have an account?".

Register

Username

Email address

Password

How comfortable are you with Clitic Pronouns?

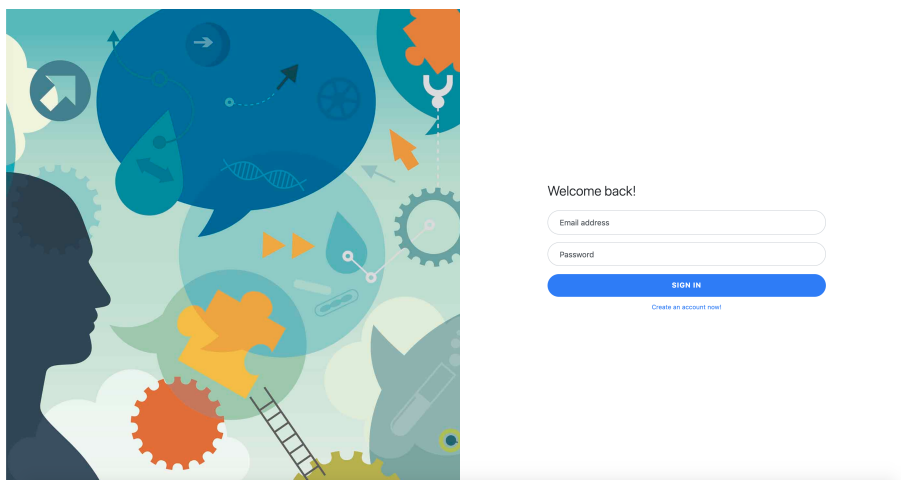
Not Much

SIGN UP

[Already have an account?](#)

Figure 5.3: Sign up page

In the account creation, the user has to fill some gaps with the email, username, password and how comfortable they are with the clitic pronouns, so they can have a suitable level to start. After creating an account or if they already have one, they need to authenticate, and to do so, they just need to type the email, the password and then press the login button.

The image shows a login form on the right side of a page. The background on the left is the same colorful illustration as in Figure 5.3. The form is titled "Welcome back!" and includes the following fields: "Email address" and "Password". Below the fields is a blue "SIGN IN" button and a link that says "Create an account now?".

Welcome back!

Email address

Password

SIGN IN

[Create an account now!](#)

Figure 5.4: Sign in page

After the login process, the user is redirected to the main page of the application, where he can see all the existing levels represented as grey cards, and his current level as the unique green card.

The way the cards are displayed, follow the idea of the non-linear model, explained previously, as the user can progress in three different directions. Each card represents a different level that can be seen in the top of the card and that changes depending on the row, column and depth. There are three columns (A,B and C), three rows (I,II,III) and three depth levels (1,2,3) that combined

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Figure 5.5: Levels map page

create all the 27 levels. For example, the level AII-3 is placed on the first column, second line and third depth level. The main objective proposed to the users is to reach the last and highest level, which means they have mastered the clitic pronouns. To reach this level, the user needs to keep doing exercises and perform as well as possible in each one.

CliticIt application explained

Tomar Café

Teresa
A Ana e o João já chegaram de férias, convidei- para virem tomar um café. [Play Audio](#)

Paulo
Que bom! Podemos a conversa em dia e dão- ideias para o nosso plano de férias. [Play Audio](#)

Teresa
Vamos fazê- hoje? [Play Audio](#)

Paulo
Sim; querem que entregue esta semana. [Play Audio](#)

Teresa
Tenho de ir comprar café; tu recebe- ? [Play Audio](#)

Paulo
Está bem. Traz pão; eles adoram- quente, com manteiga! [Play Audio](#)

Teresa
Se eles demorarem, liga para apressares. [Play Audio](#)

Ana
Olá; desculpem, só despachamos agora! [Play Audio](#)

[Submit Answers](#)

Figure 5.6: Exercise page

After pressing the button Start, on the green card, the user is redirected to the exercise page. The difficulty of the exercise is based on the level of the card the user clicked. Each exercise is a dialog between two or more people in different real life situations. The student will see some blank spaces in the middle of the sentences, and the goal of the exercise is to fill them with the right clitic pronoun in each situation so that he fails as few pronouns as possible. While doing the exercise, the user can use a feature that might help with some pronouns that he doesn't know the answer, which is an audio button. Pressing this audio button the user will be able to listen the whole complete dialog with the pronouns included. This will allow the student to identify some pronouns that, just by reading, he couldn't. When he finishes the exercise, clicking the Submit button, in the end of the page, will send him to the results page.

In this new page, some information about the student's performance and the exercise that the student just finished, is shown. This results page contains a modal that has on the top, the number of right answers out of all the number of spaces to fill. Right below, the time the student took to complete the exercise is shown, in minutes and seconds, because it matters in the performance evaluation. The modal also contains a list with all the student's answers and each one has a symbol associated. If that answer is correct it has a green check on the left, otherwise the symbol associated is a red cross which means the user's answer is wrong or he didn't fill that space. To complete this page, there is a button called, Show answers, that allows the student to see the exercise solutions. All the dialogues are shown as they were in the exercise, but instead of the

CliticIt application explained

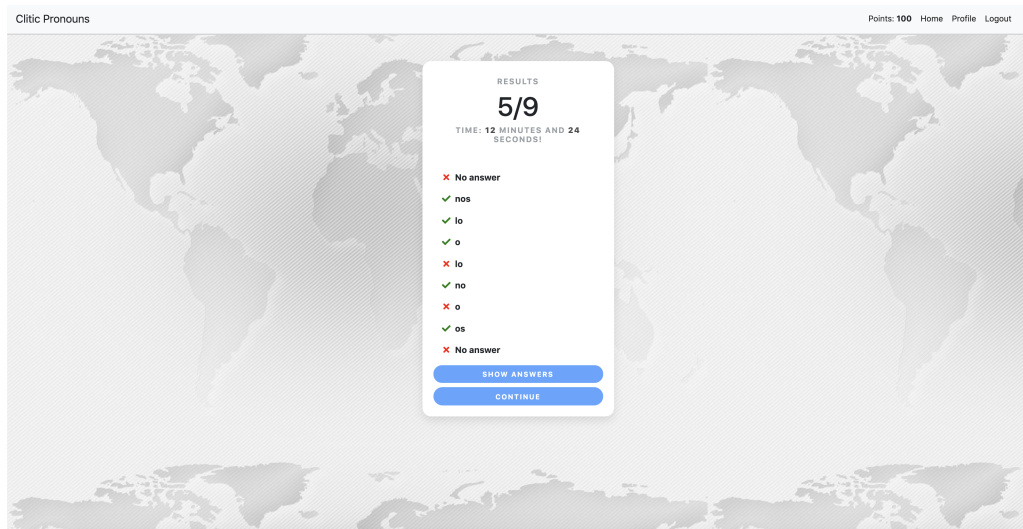


Figure 5.7: Results page

blank spaces there are the answers in bold, and if the student had that specific dialogue correct the background will be green, otherwise it is red. After reviewing the answers the student just needs to click on the button, Continue, down below, Show answers, and he will be redirected to the Map page again, where he will find his new level based on his last performance as the green card.

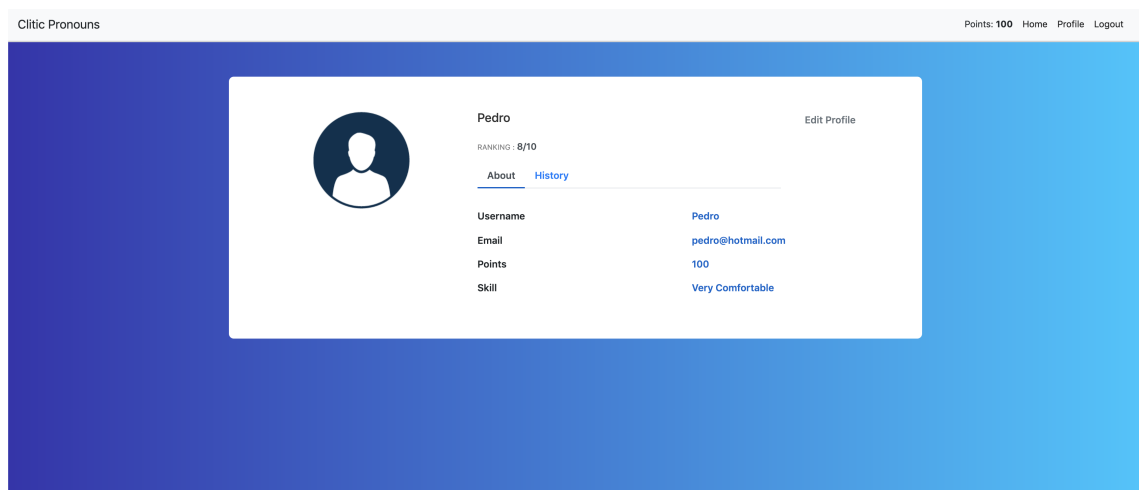


Figure 5.8: Profile page

The last page is the Profile, which can only be accessed by the navigation bar on the top of the pages. This page contains a modal with a tab called, About, that has information about the user, such as the username, email, the current amount of points that he possesses... The modal also has a tab called, History, where the user can see his last 10 exercise results.

5.5 Data Storage

In this work, data storage was fundamental and the way to do it was key in the development process. Throughout the work many changes were made, and that is a big reason for choosing Mongo as the database, as it is a Schema-free database. Inside the DB, there are collections, which are equivalent to the RDBMS tables. These collections are constituted of documents, which are records in a MongoDB collection and represent the basic unit of data. Documents are analogous to JSON objects but are stored in the database in the BSON format.

The most important collection of the project is called exercises. In this collection, the documents structure is very similar as each one represents the data related to one application exercise, and at this point, all the exercises are of the same type, in particular dialogues between 2 or more people.

The focus of this section will be around this collection, how the documents inside are structured and how the data is used in the application.

Documents structure inside exercises collection

A document inside the exercises collection is represented by an object with 8 keys [5.9](#).

The first two keys work as identifiers, both are unique, but the first one called *key*, and is the one used in the application to find the desired document. The value of the key is a string made by an *l* that represents the word *level* and numbers, as each exercise corresponds to a different level number. The second identifier as the key called *title* and the value corresponds to the name of the exercise.

```

▼ object {8}
  key : l14
  title : Tomar Café
  ► exercise [16]
  ► answer [22]
  ► downgrade [6]
  ► downgradeNewLv1 [6]
  ► upgrade [2]
  ► upgradeNewLv1 [2]

```

Figure 5.9: DB exercise collection structure

The key called *exercise* has an array as value. This array contains the sentences that are going to be displayed to the user in the exercise in the string format. Important to realize that each position of the array corresponds exactly to one dialog of one person. In the middle of this

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dialogues it is possible to find the symbol *, in the amount of at least 2. Each sentence starts with the name of the person that is speaking, then there is a * that is used to separate the person's name to the dialogue. In the middle of the dialogue there can be zero, one or more *, and those represent the blank spaces that are going to appear to the user so he can complete them with the suitable clitic pronoun. In sum, the symbols are used to identify where the clitic pronoun appears and so that the application knows where to split the dialogue to introduce the blank spaces.

The *answer* key of the object is directly related to the *exercise* key, as it contains an array with the answers to the exercise. Each position of the array contains one clitic pronoun, and it corresponds directly to the order the blank spaces of the exercise appear. For example, the answer for the first blank space is the pronoun with the index zero of the *answer* value array, the second position of this array contains the pronoun that is the answer to the second blank space of the exercise and so on. This relation can be seen in the figure 5.10.

In the answers page 5.7 there is a button named *Show Answers* and that button triggers a function that uses the *answer* array to replace the * in the *exercise* array with the clitic pronouns and so that the user can see the correct answers to the exercise.

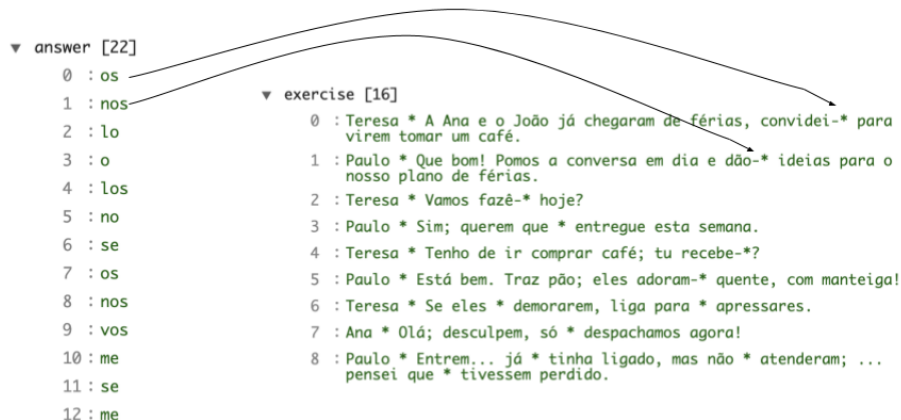


Figure 5.10: Relation in the exercise collection between keys answer and exercise

The remaining keys and values of the JSON object 5.9 are related to the evaluation of the student's performance. When a student finishes an exercise two things can happen, he is either redirected to an inferior level or to a superior level. In order to decide that, his answers are

CliticIt application explained

evaluated, and to check if he is going to a lower level the values of the keys *downgrade* and *downgradeNewLvl* are used.

The key *downgrade* contains an array of arrays, inside each one of these arrays there are numbers that correspond to the index of the blank spaces where the user introduces the clitic pronouns. For example, if inside the array *downgrade*, in the position zero, that means the first array inside it, is the number one in the index zero, means that this number one corresponds to the first blank space that appears in the exercise for the student to fill with the right clitic pronoun.

Each array inside the *downgrade* array represents a new level (the correspondence between the arrays and the levels can be seen in the figure 5.11), and the numbers inside are related to each other, they are indexes of blank spaces of the exercise, that need to be filled by clitic pronouns that, for example, are used in similar situations and that is why those specific numbers are grouped inside the same array.

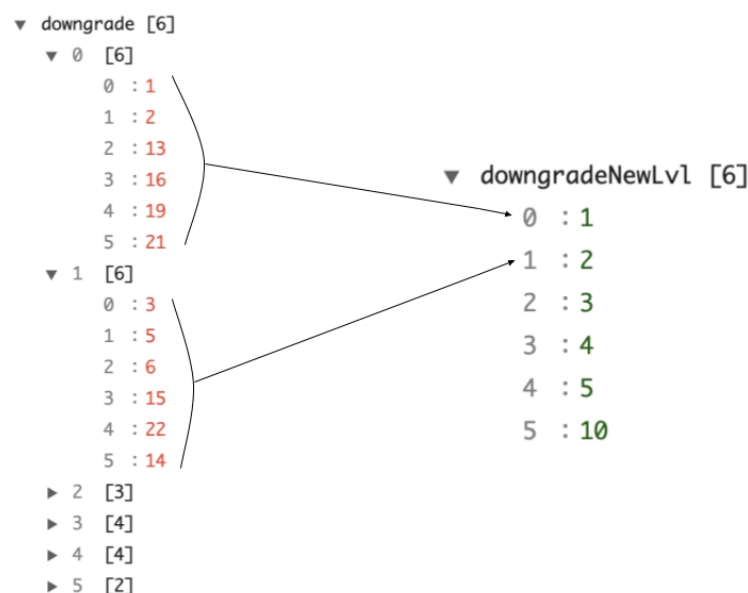


Figure 5.11: Relation in the exercise collection between keys *downgrade* and *downgradeNewLvl*

The key *downgradeNewLvl* contains an array with numbers, that represent the levels that the user can be redirected in the end of an exercise. These levels, that in this array are represented as numbers, each one corresponds to one different card that can be seen in the figure 5.5.

For instance, if the user fails some of the clitic pronouns which their indexes in the exercise are inside the first array of the *downgrade* array, in other words, the array with index zero of the *downgrade* array, he will be redirected to the level that is inside the *downgradeNewLvl* array in the position zero.

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In fact, the position of the arrays inside the *downgrade* array correspond directly to the positions of the numbers inside the *downgradeNewLvl*, and with this mechanism it is possible to redirect the student to a new level based on his wrong answers.

On the other hand, if the user had a great performance and he is supposed to climb in levels, the keys *upgrade* and *upgradeNewLvl* are analysed.

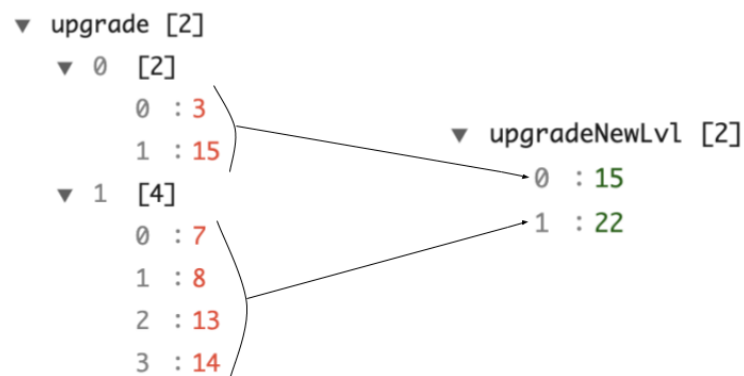


Figure 5.12: Relation in the exercise collection between keys *upgrade* and *upgradeNewLvl*

Similar to the *downgrade*, the *upgrade* key has an array of arrays as value, and inside those there are numbers that correspond to index of pronouns. They are also grouped by arrays based on the similarity between them. In this case, if the student has right answers in many of pronouns of the same array he will be redirected to a level related to the index of the array in the *upgradeNewLvl*, as it can be seen in the figure 5.12.

For instance, if he got right many of the pronouns of the first array of the *upgrade* array, he will be redirected to the level inside the index zero of the *upgradeNewLvl* array.

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Chapter 6

Validation

This chapter will present all the steps taken to carry out the project validation. Notably, this was done by conducting an experiment, with users testing the application in order to confirm that the initial project requirements were successfully full filled. First, some details of the experiment are going to be described, then the tasks that the users went through, and then the data obtained from the study, containing the user's feedback and some notes from their performances, are going to be analysed.

In the end, some conclusions and results are going to be mentioned in the last section of this chapter.

6.1 Experiment design

Considering this study, the experiment was mostly qualitative, as it was based on user's feedback and opinion. This was designed to ascertain if the application really helps the users to learn the clitic pronouns, efficiently improving their Portuguese, and also understand if their motivation keeps high in the learning process.

For this experiment, 14 persons, most of them were Erasmus students from the University of Porto, were recruited to participate in this test, using the platform in a computer and going task by task individually. Learning the clitic pronouns already require a vast knowledge of the Portuguese language, therefore finding persons that met this requirement was a hard job, and it will be more explained in the validation threats section.

The experiment consisted in giving a similar set of tasks to the users and taking notes about their performances. In the end, some questions were asked so that some negative and positive aspects of the application could be pointed out. The goal was to evaluate the effect of the gamification elements on the learning process and also if the non-linear model was an improvement to the linear ones.

Validation

First, an introduction about the experiment was given to the users, such as, how the application works, what they were going to do and the objective of each task. All the tasks are related, as the user is intended to solve exercises in each one, however in different conditions.

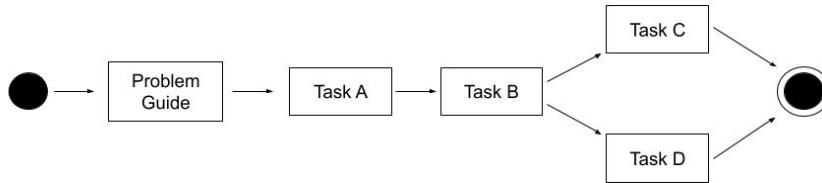


Figure 6.1: Experiment design

The data collected in this experiment is divided into two categories. One comes from the user's performances in the different tasks and then they are compared to see, for example, how the gamification elements affect their performance. The second type of data is collected at the end of the experiment by asking questions to the users in order to improve the application.

Research Questions and Hypotheses

The research questions that support this experiment are the following:

- Q1: Does the use of gamification elements help in the learning process?
- Q3: Does the non-linear model represent an improvement to the linear ones?

The table 6.1 contains the hypotheses regarding the questions mentioned above, and in the conclusions section, an analysis about both will be done.

Null Hypothesis	Alternative Hypothesis
The tool does not positively impact the learning process of the clitic pronouns	The tool positively impacts the learning process of the clitic pronouns

Table 6.1: The null and alternative hypotheses

6.2 Tasks

In this experiment there are four different tasks, but the users only went through three of them, because of the non-linear model, as after completing Task B they were either redirected to Task C

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if they had a good performance, and they climbed in levels, going to a higher level, or they were redirected to a lower level due to a bad performance and went to Task D.

After being guided through the application, the users start by doing the Task A. In this task, they were supposed to complete a medium difficulty exercise, without using any gamification elements or even knowing about their existence, such as the exercise rewards, audio buttons, etc... So they were supposed just to complete the exercise, filling the blank spaces with the right clitic pronoun.

In Task B, another medium difficulty exercise was given, but this time they were allowed to use audio buttons to help to find the pronoun, and they were told that at the end of the exercise they would receive points based on the performance and that those would count to the user ranking. In addition, they were told that they could receive additional points based on the time they took to solve the exercise.

Finishing the Task B, the users were redirected to the last exercise, but this one varied from person to person, as the difficulty level was based on Task B performance. If they had a great performance and they were redirected to a higher level, they went to Task C, otherwise, they went to Task D.

After completing this last task, the users were asked four questions, three of them, of *yes* or *no* type. The fourth question was about asking for suggestions to improve the application.

6.3 Data Analysis

This section presents an analysis of the obtained results. In relation to tasks A and B, the goal of these tasks was to figure out if the gamification elements are indeed having a positive effect on the learning process. With this in mind, after completing both tasks, A and B, with a similar difficulty level, the expected outcome was for the users to have a better result in task B than in task A, as in B they were aware of the existence of the gamification elements, such as rewards, rankings and even the use of audio in exchange of points, to help filling the blank spaces with the pronouns.

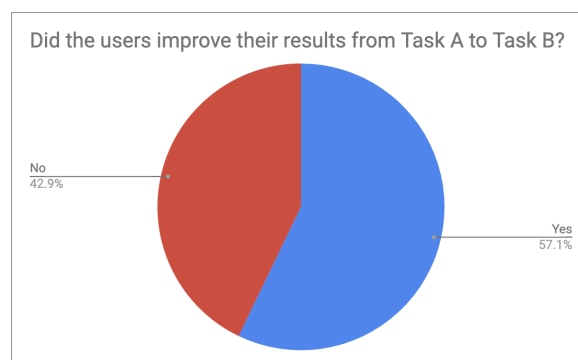


Figure 6.2: Results from the analyse of the performances from the Tasks A and B

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In the figure 6.2 it is possible to see that 57.1% of the users involved in the experiment, had more correct answers in Task B than in the Task A. The results were not that close to what was expected, however, it can be explained by the fact that some of the participants had every answer right in both tasks. This analyse is not the most accurate one, and it will be explained in the section Validation threats 6.4. The ones that improved, confirmed the fact that audio helps finding the pronouns.

After finishing the next task, C or D, the users were asked two questions. The first one, was if they felt that adding the gamification elements helped to increase the motivation and the competitiveness to perform as well as possible and to be placed higher in the ranking system. The answers can be seen in the chart 6.3.

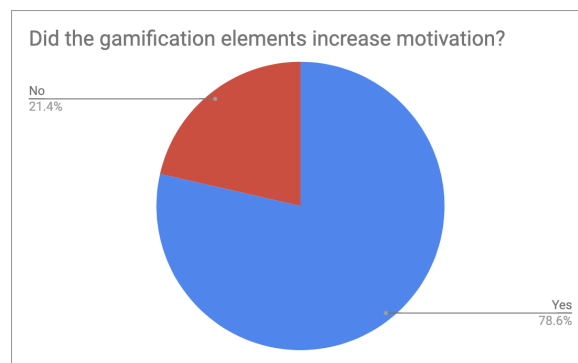


Figure 6.3: Results of the quiz whether the participants felt more motivated after the introduction of the gamification elements

The chart shows that the majority felt more motivated when the gamification elements were added to the experiment. In contrast, there was a little group that defended that if a person is determined to learn the language those elements won't make that big of a difference.

The second question was related to the non-linear model, that applies a custom path to each user in the levels map, which means, in the end of an exercise the users are redirected to a new level, and it varies depending on their last performance.

The users were asked if the new level in the tasks C or D, was appropriated to their knowledge, and as the figure 6.4 shows, the majority of the users felt the exercise difficulty was suitable and supported the idea of the non-linear model, meaning they prefer a custom path in levels to be more focused on the strengths and weaknesses of each one.

On the other hand, there were users affirming that they didn't see a big of a difference in the exercises and also that the model was a little confusing, because of the fact that a user can progress in three different directions. They stated that a linear model would be more clear, even though doesn't offer that much customization.

To end the experiment, they were asked about some suggestions to improve the platform, and the ideas that were most mentioned, were the creation of more types of exercises, the addition of

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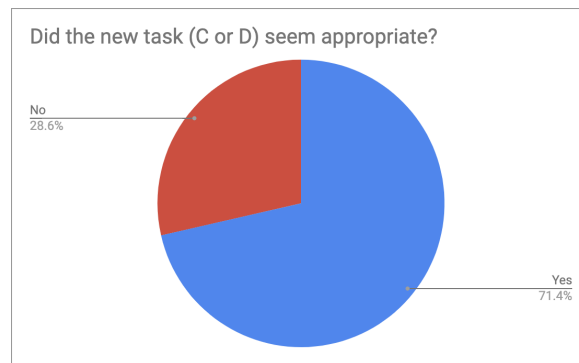


Figure 6.4: Results of the quiz whether the participants felt that after being redirect to a new level (Task C or D), the new exercise of that Task was suitable to their knowledge

informative content pages, where the users could learn a certain matter, the creation of a tutorial to guide the user through the application and explain all the features that involve the learning process, and the most important one, the non-linear model.

6.4 Validation Threats

This section presents the issues that may distort and compromise the experience results, and as consequence the analysis and conclusions drawn from them. Bellow is a list with the validation threats identified in this study and that should be avoided in future experiments in this area:

- **Low number of participants:** One of the most important factors is to have a big pool of subjects, to get an outcome as accurate as possible. Although, because of matters of time and specific profile of candidates needed, 14 was the most that was able to participate in the experiment.
- **Participants profile:** The target audience of this work are foreign adults, that want to learn the Portuguese as secondary language. Although, as this thesis focus on clitic pronouns, an area that already requires an advanced level of Portuguese knowledge, finding candidates that met these requirements was quite hard, so the choice fell on Brazilian students, that speak the Portuguese language but have some differences in the grammar, including the clitic pronouns, such as the position of the pronoun in the sentence and this made them a good choice, as they are already comfortable with the language but had to apply the clitic pronouns in the European Portuguese. Taking this into account, the most affected analyze is the first one, where the improvement from Task A to B is investigated. Those results, are not accurate and this must be taken into account in future experiences.
- **The work is a prototype:** The work developed in this thesis was meant to represent the beginning of a huge change, that is to apply the gamification elements and non-linear model in education. The obtained application already applies both these concepts, but it is still a

platform with a low number of features. This way, the tests and data extracted can be easily upgraded in the future.

6.5 Conclusions

This chapter conducted an experiment to find arguments to support the theory that the use of gamification elements together with the non-linear model could improve drastically the person's learning process of a difficulty and tedious matter, as the clitic pronouns.

The tasks A and B, were meant to see how the users reacted to the introduction of the gamification elements, by choosing two exercises of the same difficulty, one without knowing of the gamification elements and the other with them, and finding out what differences in the performance and motivation would do the introduction of those elements. In the end, half of the performances from tasks A to B improved, but as was mentioned before in section 6.4, this analyse is not that accurate. In addition, the feedback from the majority of the students was that they felt more enthusiastic knowing that they were competing with other users and also that wanted to get the best reward possible in the end.

The tasks C and D were also done with the gamification elements, but the purpose of those was to understand if the levels redirection was accurate and adjusted to the users last performance difficulties. The non-linear model provides different paths for each user, and to understand that, they were asked if it was an improvement in relation to the static and linear models, and the majority agreed that was better to have individual progression. The ones that disagreed with this model, affirmed that it was confusing, and that is a point to improve in the future, with, for example, a tutorial about the levels structure.

To conclude, even though the experiment is not the most accurate one, the results were relatively close to what was expected and support the alternative hypothesis, meaning that the application can have a positive impact in the clitic pronouns learning.

Chapter 7

Conclusion

The traditional learning environments constitute a barrier to a learning process, as the student may demotivate to keep going, due to different reasons, such as difficulty and lack of interest. Although, the use of gamification elements and techniques, together with a custom path to the learning process, created based on the non-linear model, emerge as a trustworthy solution.

This dissertation raised the problem whether the addition of gamification elements to a web application could improve the learning process of a tedious task, such as the clitic pronouns learning. The elements and techniques related to games that were used in this work, such as exchange of points for assists during the exercises, rankings to increase the competitiveness between the users, the progress based on levels and also the rewards distribution in the end of the exercises based on the performances, helped in both motivation and efficiency in the learning process of a hard matter for the foreigners. One of the conclusions of this study is that these elements are not completely accepted as an improvement by everyone, but may be a reliable solution if applied the right way and in the right context.

The non-linear model applied in this work, was intended to open new doors in the learning processes, as it unlocks numerous paths for the student to go through, avoiding every user to follow the same monotonous path. To implement this model, was one of the hardest tasks of this work, as it is fairly complex and it had to be implemented in a way that the users could understand it. The cards structure was decided to be the most suitable one, even though it can have some improvements to make it easier to understand, being that one of the experiment participants feedback.

The objective initial proposed of developing a prototype application that could improve the learning process of the clitic pronouns by using gamification elements and the non-linear model was successfully achieved. This work may be used as a base to future studies in this area, as the basic concepts are already implemented, and there are different features that can be added to the application to make it even more complete. This can be extended to different areas of the

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Portuguese language and not be restricted only to the clitic pronouns, and later it can be scaled to other learning areas beyond the languages.

This approach to the learning process can open new possibilities in the education area, and improve the quality of the apprenticeship of every student in the world.

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