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Doc management: Proposal for a doctoral management system

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Master Degree in Computer Engineering

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TECNOLOGIAS
E ARQUITETURA

Department of Information Science and Technology

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Resumo

O controlo é uma função essencial para uma boa gestão, para o que concorre uma organização burocrática, ou seja, um sistema de regras, procedimentos regularizados, divisão de responsabilidades e hierarquia. Para uma burocracia eficaz são necessárias ferramentas que ajudem e por isso o desenvolvimento de aplicações para a gestão de produtos ou serviços são importantes

O presente trabalho aborda as questões relacionadas com um problema encontrado na gestão de alunos dos doutoramentos. Tradicionalmente manual, este processo deixou de ser eficiente. Isto traz problemas como dificuldade em pesquisar o processo de um aluno e suas informações, dificuldade em perceber se um aluno está sem documentação ou em descobrir que tarefas devem ser concluídas e entregues e quais as datas para o fazer. O sistema atual é propenso a demoras, erros e exige um esforço desnecessário. O objetivo deste trabalho é desenvolver uma proposta para a resolução dos problemas descritos, por via de uma aplicação, como uma interface simples, que consiga gerir, criar e editar alunos, as suas informações, as suas notas e as suas entregas, gerir, criar e editar unidades curriculares e as informações relacionadas, gerir criar e editar docentes académicos e as suas funções. Ou seja, é pretendido que a aplicação consiga facilitar a gestão de todos os processos do curso e documentar o caminho académico de um aluno.

Isto irá fazer com que os trabalhadores tenham uma melhor qualidade de vida, reduzindo a probabilidade de erro gerando ganhos de qualidade e eficiência na gestão dos processos do aluno, assim melhorando a vida profissional de quem use a aplicação.

Palavras-Chave: Burocracia; Aplicação de gestão; Gestão de alunos; Gestão de cursos; Gestão Escolar; Desenvolvimento Web.

Abstract

Control is an essential function for good management, for which a bureaucratic organization, that is, a system of rules, regularized procedures, division of responsibilities, and hierarchy, contributes. For a bureaucracy to be effective, tools to help are needed, and so the development of applications for the management of products or services are important.

This paper addresses the issues related to a problem encountered in the management of doctorate students. Traditionally manual, this process is no longer efficient. This brings problems such as difficulty in searching a student's file and its information, difficulty in noticing if a student is undocumented, or in figuring out what tasks must be completed and turned in and what dates to do so. The current system is prone to delays, errors and requires unnecessary effort. The goal of this work is to develop a proposal to solve the problems described, by means of an application, with a simple interface, that can manage, create and edit students, their information, their grades and their deliveries, manage, create and edit curricular units and the related information, manage create and edit academic teachers and their functions. In other words, it is intended that the application is able to facilitate the management of all course processes and document a student's academic path.

This will provide workers with a better quality of life, reducing the probability of error and generating gains in quality and efficiency in the management of student processes, thus improving the professional life of those who use the application.

Keywords: Bureaucracy; Management Application; Student Management; Course Management; School Management; Web Development.

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List of abbreviations

HTML - HyperText Markup Language

CSS - Cascading Style Sheets

DSR - Design Science Research

DK – Design Knowledge

PHP – Hypertext Preprocessor (Personal Home Page)

XML - Extensible Markup Language

IT - Information Technology

XP - Extreme programming

App – Application

1. Introduction

1.1. Topic relevance

This report aims to describe the web application "Doc management" carried out within the dissertation scope of the master's degree in Computer Engineering at ISCTE - Instituto Universitário de Lisboa.

Computer management applications allow organizations to have the best possible performance in their activities and organization. This shows the importance of these types of applications and why they are being increasingly used.

The project's subject was presented, after having identified the problems that the management of Doctorate students brought to the institution.

The WEB application "Doc management" is a platform that allows the management of Doctorate students. This application allows the management of students, their grades, presentations and all the necessary interactions along their academic journey in the institution.

We can argue that each student is a "project" and that is why the management of his/her journey must be managed as such.

"The importance of project management tools is apparent for any project manager seeking to ensure project success" [1].

"Another advantage of having so much data and information which can be compiled and dissected instantly by your software is that potential risks can be calculated with a high degree of precision" [1]. This means that with a software we can decrease the risk of human error".

"Research suggests that regardless the activity or task, humans make 3 to 6 errors per hour and on average 50 errors per day… in comparison, technical or machine malfunction cause only a small percentage." [2].

Not only machines and software can reduce error but they can help improve the work's efficiency.

Project managers have used software tools to automate the administration of individual projects or small groups of projects for years [3] that prove their efficacy and efficiency.

According to a report titled The Sorry State of Digital Transformation in 2018 by Forrester, up to 22 percent businesses don't have process excellence and workflow automation yet. These are critical aspects for customer satisfaction [4].

"Business process automation is the use of technology to execute recurring tasks or processes in a business where manual effort can be replaced. It is done to minimize costs, increase efficiency, and streamline processes" [4].

1.2. Motivation

Due to a problem found in the management processes of Doctorate students, it was proposed the development of an application that, in addition to help managing these same courses, not only could minimize human error, but could also help to improve the lives of those who use them.

It is with this goal and the desire to improve processes and help people that it was decided that should be an application to help those responsible to do a better job and have a better quality of life.

It is necessary to check the level of employee satisfaction with the features performed, with the workplace, salary, team relationships, among other aspects [5].

It isn't always possible to be fully satisfied with all these aspects. But it's critical that people feel appreciated, motivated and respected within the company [5].

The goal and motivation for this project is the attempt to improve the quality of life for those who use this system knowing that employees who feel good in the work environment and relate well with other employees are more motivated to work, are more dedicated and end up bringing better results to the company [5].

Some of the ways to improve the quality of life are:

- Work with something you like;
- Don't procrastinate;
- Only do what you are able to do;
- Meet your deadlines and schedules;
- Take time off to rest [5].

The application's main goal is to help workers have better quality of life and achieve the goals mentioned above by creating a web application with a simple interface that helps the user to know exactly what he/she needs to do and when he/she needs to do it, motivate the user to do his/her work and give the worker only the necessary tools in order to perform his/her duties.

Nowadays, the management of Doctorate students is manual, meaning that there is no application to help manage and comply with the necessary procedures for student and course management.

The people responsible for the management of these courses, as well as their students, use basic Microsoft Excel files towards this end. Albeit this seemed to be functional at the earlier stages of the programs, with its expansion in number of students

it became inefficient, effortful and therefore insufficient. This means that this type of work can be simplified and perfected.

When using this system, several problems are encountered, such as the difficulty in searching through a student's process and their information, the difficulties in realizing if a student is lacking documentation or finding out which assignments are due to completion and delivery and what are the respective expiry dates to do so.

This system brings a lot of workload to those who use it and, in addition, when managing with a system of this kind, there is a lot of susceptibility to human error, meaning that it is extremely easy for those who use it to make mistakes, that sometimes may be severe. This can bring harm to their own work or even to a student.

In addition to all of these difficulties, there are numerous other obstacles when using this procedure.

This application is also intended to tackle all these problems and difficulties, and at least, lowering unnecessary stress and workload.

1.3. Background

As mentioned, products whose goal is the management of something are increasingly important and their creation and implementation is something relatively simple and affordable, if we have the necessary knowledge. However, because there is a great demand for the implementation, price of these solutions it tends to increase, which harms all organizations where costs are extremely important and with the increase of these solutions many organizations lose the ability to implement them and with that the chance of improving all their business areas.

According to Pressman, software is seen as the engine which drives decision-making in different business areas. It is even being considered the key factor in differentiating modern products and services. We can argue that the use of software is practically inevitable nowadays [6].

Organizations always follow a similar lifecycle with regard to management requirements. Organizations rely on simple procedures, informal relationships and high uncertainty environment and with the expansion of these same organizations and with their maturation, it is necessary to formalize relationships and processes to deal with a complex design [7].

In organizational sciences, the increasing level of task diversification requires stronger work coordination [8] .

This formalization of procedures, engagement rules, inflows and outflows, became known as bureaucracy. Bureaucracy is a universal and important feature to all organizations, bureaucracy is related to how organizations build their identity and culture based on the rational-legal model. The basis of this organizational model is efficiency, that is, being able to maximize productivity. This is considered an ethical obligation to stakeholders [9].

However, as organizations become more complex so does bureaucracy tend to shift status from a means to an end. It can grow to the point of becoming counterproductive, as it consumes too many resources, delays the process and, ultimately, compromises organizational effectiveness [10].

In the case of universities, this is more likely to happen because they are focused on learning and innovation. Universities fall into the opposite quadrant of the culture of bureaucracy: the culture of innovation [11].

According to Mintzberg, universities are professional bureaucracies. This is because it has a highly qualified operational base, which is the core component of the organization, and uses standardization of qualification as the main coordinating mechanism as opposed to a mechanistic bureaucracies that rely on a low qualified workforce, strong standardization of work as the key coordinating mechanism [12].

Professional bureaucracies cannot escape the need to formalize control processes and therefore these configurations also incorporate a supportive administrative system to deal with all the bureaucracies and formalization requirements. This despite not being directly linked to teaching and researching support the workflow.

One of the problems with bureaucracy arises when employees do not understand how important bureaucracy is for the good functioning of the organization and try to find other ways of working.

Motta and Bresser-Pereira affirm that one of the first steps towards having a good bureaucratic organization is to define the importance [13].

Because of these dysfunctions that often occur, bureaucracy tends to have negative effects as it is badly used. When we have a badly used bureaucratic system, issues such as delays, avoidance of responsibilities, the search for power and even corruption may happen.

Therefore, in terms of conclusion, it is possible to say that it is very important to have a bureaucratic system and that people agree with the functioning of these systems. This will bring a much better functioning of the organization [14].

The growing attention given to quality and international standard certifications put pressure on the administrative system of universities that had to cope by setting finer and additional control and monitoring systems, fundamentally generating millions of new data.

Bureaucracy is more than a means to control and facilitate the formal management of administrative and management needs, Bureaucracy has gained the status of a critical function with regard to obtaining credit to operate and attract students [15] and for this reason, the bureaucratic system had to find ways to integrate all this information efficiently, with less probability of errors and within easy and reliable processes, for which information systems and digital tools are the right answer.

Without such facilitating tools, bureaucratic burden can become too costly and deteriorate the relationship with the students [16][17].

As Bruegge and Dutoit say, software that adds value needs to meet the user's needs and software which fulfils these needs usually has some complexity associated to it [18].

The key research questions of this project are:

- **How to minimize the error?**
- **How to improve/simplify the work of those who manage it?**
- **How to improve processes?**

It is based on these three key questions that an application was developed.

The application’s main goal is to have the necessary features to answer them.

To measure if the application can really help those who participate in these procedures, it is intended, based on the difficulties found in the current ways, to validate if there can actually be less and simpler work and respond to any needs that may, somehow, appear.

For that, the application should not only be able to answer all current problems, from the simplest to the most complicated, but also have the necessary features to help all of those who use it to have a simpler and less stressful job.

In order to build this application, it was necessary to explore some existing systems, but since it is a university tool, and having its goal in the management of students and courses, one of the main sources of information inspiration is the Fenix system.

Fenix is a system that allows students to manage their academic journey and, although it is not exactly what the application is intended to be, it is still a great source of inspiration, as it allows to understand how it works and to bounce ideas off it, creating a sketch of what needs to be done and how to do it.

So, with the understanding of the Fenix it is possible to understand what is necessary for the application to have at the BackOffice level so that it can have a good and responsive behaviour.

Besides that, it is a good source of inspiration when it comes to its design.

1.4. Goals

The main goal of making a proposal for a doctoral management system is to simplify and improve the work of those who manage doctorates.

This application's main goal is to minimize human errors, improve the process in the student's management, improve the work and make sure that those who use the application have their professional life improved.

Those are the main goals, but they are not the only ones. There are more people involved in this process who won't use the application directly but with the improvement of one person's work they will have their work more simplified too.

This application is a Backoffice application that aims to manage courses and Doctorate students, allowing to do all the management work in a simpler and effective way.

This Backoffice must have some features such as each student's information and his/her connection to the courses and subjects, the connection between the students and their presentations yet to be made, the possibility to have deadline alerts for tasks that are due for delivery and help in jury selections.

We can say that the main goal would be the management of each student's development.

1.5. Methods

Knowing the troubles and all the problems related to software development, it is necessary to apply the notion of process.

According to Silva and Videira, a process is featured by distinct and sequential stages that are divided into simpler elements called tasks and these into activities. Each task must be well defined and there should be a responsible individual for carrying it out. Each task has several goals associated and this should only be considered completed when those goals are reached [19].

The development stages are:

- **Planning** - General identification of needs, identification and selection of options and definition of the work plan.
- **Analysis** - Detailed identification of the system's features and the respective description (System Specification) so that the same requirements can be validated by the end users of the system.
- **Design** - Detailed definition of the global solution architecture (modules, tables, interface, machines, etc.).
- **Development** - Task in which the programming of the several components of the system is carried out.
- **Tests** - System as a whole is verified with the goal of obtaining user acceptance.
- **Installation** - Task where activities related to making the system available to its end users are carried out, and which is usually referred to as entering the system into production.
- **Maintenance** - Moment which corresponds to the lifetime of the system and during which all changes will be made after the product starts operating.

The general impression from the literature on this topic is that nowadays increasingly agile development methodologies are replacing traditional ones.

According to Sommerville [20], any agile methodology follows five basic principles:

- **Incremental development** - Supported by small and frequent system launches. The requirements are based on customer stories or scenarios that are used as a basis for deciding which features to include in each increment of the system.
- **Customer involvement** - Customers must be directly involved in the entire development process. Its role is to provide and prioritize new system requirements and evaluate system is iterations.

- **The people, not the process** - The skills of the development team must be recognized and explored. Team members must be free to develop their own working methods.
- **Change** - Understood through regular system launches for customers to test, avoiding code degeneration and progressive integration of new features.
- **Maintain simplicity** - Work actively to eliminate complexity from the system and focus on the simplicity of the software being developed and the development process.

The methodology presented and adopted for the development of the project is called Extreme Programming (XP). This methodology consists on obtaining feedback from the customer by delivering software in a fast, progressive and quality way.

As mentioned by the “inventor” of this methodology XP is a light, efficient, low risk, flexible, predictable, scientific, and fun way to develop software [21].

2. Literature review

2.1. Web Applications

First of all, it was necessary to understand that there is a difference between Web Page and Web application. They are often confused and although they are related, they are not the same thing.

A website or WebPage is a group of globally accessible, interlinked web pages which have a single domain name. It can be developed and maintained by an individual, business or organization. The website aims to serve a variety of purposes like Blogs and the main goal is to deliver information. A Website is hosted on a single or multiple web server. It is accessible via a network like the Internet or a private local area network.

A Web Application is a software or program which is accessible using any web browser. Its frontend is usually created using languages like HTML, CSS, Javascript, which are supported by major browsers. A web application stores (Database, Files) and is used by a team or single user to perform tasks over the internet.

The Table 1 shows the comparison between a web application and a web page, always comparing systems with the same goal or task.

Table 1: WebApplication vs WebPage (fonte: [22])

Parameter	Web Application	Website
Created for	A web application is designed for interaction with the end user	A website mostly consists of static content. It is publicly accessible to all the visitors.
User interaction	In a web application, the user not only reads the page content but also manipulates the restricted data.	A website provides visual & text content which the user can view and read, but will not affect it's functioning.
Authentication	Web applications need authentication, as they offer a much broader scope of options than websites.	Authentication is not mandatory for informational websites. The user may ask to register to get a regular update or to access additional options. This feature is not available for the unregistered website visitors.
Task and Complexity	Web application features are quite higher and complex compared to a website.	The website displays the collected data and information on a specific page.
Type of software	The web application development is part of the website. It is itself not a complete website.	The website is a complete product, which you access with the help of your browser.
Compilation	The site must be precompiled before deployment	The site doesn't need to be pre-compiled
Deployment	All changes require the entire project to be re-compiled and deployed.	Small changes never require a full re-compilation and deployment. One just needs to update the HTML code.

2.2. Tools and technologies

For the development of this type of products, its technologies, tools and programming languages have evolved, this way they are helping computing to evolve.

This chapter shows the development of tools and languages that are considered important in the development of this type of products and that are used in the development of this project.

Creating web applications is a complicated task involving many moving parts and interacting components [23].

Data bases

Databases are basically a set of structured, organized and stored related data.

A DBMS (Database Management System) is the interface between the data in the database and the user [24].

MongoDB

MongoDB is a source-available cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with optional schemas.

The main features that MongoDB has are:

- Rich JSON Documents.
- Powerful query language.
- Multi-Cloud Data Distribution [25].

MYSQL

MySQL is the DBMS (Database Management System) chosen for the project.

MySQL is one of the database management systems that has a great capacity to create powerful databases and has some very interesting features that make it one of the best and most used, such as:

- Presenting great speeds in WEB applications.
- Innovation and constant updating.
- Portability (supports almost any current platform);
- Easy to use [26].

We must use a programming language and the language that was used in the project is MySQL. Although the other options are equally good options, MYSQL is more suited

to the type of application that “Doc Management” is meant to be, and the main reason that MYSQL was used in this project it was because of the high speeds in WEB applications and mainly because of the support and all the documentations that is easily find in the web.

Apache

The Apache server is used to make it possible to run a web page.

The Apache server is an open-source project that allows requesting HTTP services, its functionality is maintained through a module structure.

This type of server has the function of interpreting code such as PHP and processing it in HTML so that it is visible in all browsers, another feature is the establishment of links between pages and databases.

The Apache Server was created in 1995 and in the last survey carried out in Portugal, Apache is used in 58.57% of all domains [27].

Server2Go

Server2Go is a web server that runs without any installation, has intuitive configuration menus, and has a wide support community, with the plus of presenting the same graphical interface whatever the operating system, so the user does not have to adapt when changing computers.

Xampp

XAMPP is a completely free, easy to install Apache distribution containing MariaDB, PHP, and Perl. The XAMPP open source package has been set up to be incredibly easy to install and to use [28].

For the use of an apache server, Server2Go was used, XAMPP could be a great option too but due to the Server2Go wide support community and possibility of portability and using it in different operations Systems it was a better option.

2.3. Programming languages

HTML

HTML (HyperText Markup Language), opposed to popular belief, is not a programming language but a markup language, is used for the creation of web pages that consists of using tags, elements and attributes to ensure the proper formatting of text and images, so that browsers can display all elements correctly.

HTML was originally created by Timothy John Berners-Lee in the early 1990s [29].

CSS

CSS (style sheet language) as HTML is not a programming language but a style sheet language with the goal of defining styles, formats and layouts in the language of XML or HTML, that is, in HTML we structure and elaborate content and CSS is used to format that same content [30].

JavaScript

JavaScript is a programming language that allows to create content that is updated dynamically, control multimedia, animated images, and everything else that is interesting in a Web application. In addition, it allows to store useful content in variables, run the code in response to several events that occur on a web page, use APIs and mainly allows to help with application security.

PHP

PHP (Hypertexr Preprocessor), formerly called Personal Home Page, is one of the most used programming languages, whose main goal is the development for web applications. It is a language known for being open source and working on the server side through its PHP module and generating a web page to be viewed by the client, it executes a request to the server and it responds through an HTML page [31].

For this type of web application, there were countless ways to program. After some study on “how to make web applications” it was noticed that there are two ways to build applications. There is the traditional way that Web apps can be built by coding and there are many options such as using programming languages like outsystems, java, Python, etc. and there’s a simpler way that is No-code tools such as Bubble. Bubble is a great way to learn how to create a web application. Simplifying the design, development, and deployment of a web app makes it easier and faster to get your idea off the ground [23].

But after researching and reading some articles and in combination with what the application is intended to be, it was possible to realize that the best option would be to use the languages described above, namely HTML, CSS, JavaScript and PHP.

Additionally, another source states there are other ways of using code to create web applications such as software-as-a-service resources like Squarespace or Wix but the application will never be really and 100% ours [32].

As stated, it was decided to use the traditional way and for that reason one of the first steps was to understand what language to use. The first step was to visit help pages on

the subject of “Building Web Applications” regarding backends and there were some options like .NET, Java, Node JS, Python and PHP [33].

After this first part it was decided to look for articles that would help to understand in general how a web application should be built and it was there that was realized that nowadays, there are so many options for construction and that the best ones are HTML - Hypertext Markup Language. HTML is the standard markup language for creating Web pages. It is what you use to add basic content to your page, like text, images, and buttons. All content will go in between two HTML tags, and those tags specify what the content is meant to be like. Even general stuff about how the app acts online and on different devices can be included.

CSS and HTML are like friends. Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation of a document written in a markup language. This looks a bit different than HTML, but it’s related to the written HTML, and exists in .css file. The main goal is making the text look nicer.

With HTML and CSS, we have content on the Web app and it looks fairly nice.

JavaScript is another friend to HTML and CSS, and together, the three form a powerful squad. JavaScript (commonly called JS) is an object-oriented computer programming language used to create interactive effects within web browsers.

It is usually responsible for anything that has to do with animation, movement, or sending/receiving external information [32].

There are some important issues pertaining to JavaScript. HTML, CSS and JavaScript work hand-in-hand, but the Web app won’t actually be online yet. For that to happen, one need to interact with a server.

These reasons lead to adopt PHP. PHP is a programming language used to create dynamic contents with the database. Basically, PHP is used to develop Web Applications.

The main reason why PHP was chosen are that: PHP is open source and free. Likewise, PHP has the advantage of:

- Having a short learning curve compared to other languages such as JSP, ASP etc.
- Having large community document.
- Most web hosting servers support PHP by default unlike other languages such as ASP that need IIS. This makes PHP a cost-effective choice.

- Being regular updated to keep abreast with the latest technology trends.
- Being a server-side scripting language; this means it only needs to be installed on the server and the client computers requesting for resources from the server do not need to have PHP installed; only a web browser would be enough.
- Having in built support for working hand in hand with MySQL; this doesn't mean one can't use PHP with other database management systems. PHP can still be used with:
    - Postgres
    - Oracle
    - MS SQL Server
    - ODBC etc [34].

2.4. Web application – Steps

For the creation of a WEB application one of the methods is to divide it into stages. As Joe Johnston says, we can divide the creation of a web application into 12 steps divided by 4 different stages.

The first stage is **the Ideation Stage**.

In this stage the intent is to **Source an idea** where the main goal is to understand what it's intend on building, and more importantly why? The idea should stem from solving someone's problem. **Market Research** where one should research if whether the idea has a market and if there are similar products. And finally **Define the web apps functionality** where everything the app should do is listed.

The second stage is the **Design Stage.**

The first step on this stage is to **Sketch the web app** for which the best and the quickest way is to use a notebook (with no lines) and pen/pencil. Old school! The main goal is to think about things such as:

- Navigation
- Branding
- Forms
- Buttons
- Any other interactive elements

Then one must **Plan the workflow of the app** for which one has to be in the shoes of the users. It's time to think about:

- How do the users signup?
- Do they receive a verification email?

- How do the users login?
- How do the users change their passwords?
- How do the users navigate throughout the app?
- How do the users change their user settings?
- How do the users pay for the app?
- How do the users cancel their subscription?

The third step on this stage is **Wireframe the UI.**

It's now time to turn those sketches and that new-found understanding of your web application into a wireframe/prototype.

Wireframing is the process of designing a blueprint of the web application. Prototyping is taking wireframing a step further, adding an interactive display.

After Sketching the app, Plan the Workflow and Wireframe the UI it's time to **Seek early validation**. Now that the wireframe/prototype is ready and describes the web app, it's time to show the wireframe to the world. At this stage the goal is to get constructive feedback.

The third Stage is the **Development stage.**

The first step is to **Architect the database.** It is now time to determine what information will be stored in the database, which type of database will be used and how it will be made.

We also need to **Develop the frontend**. The Frontend is the visual element of the web application. It defines what is seen and interacted with. The frontend is developed with HTML, CSS, and JavaScript.

After the frontend, we need to **Build the backend.** The backend is typically what manages the data. This refers to databases, servers, and everything the user can't see within a web application. Building a backend is one of the toughest parts of web app development.

The last stage is the **Launch stage.**

This Last Stage has two steps. The First step is to **Host the web app**. Hosting involves running the web app on a particular server.

The Final step in the Final stage is to **Deploy the web app**. The idea has been sourced, validated, designed and developed, and chosen your hosting provider. Now it's time to be deployed [35].

3. Planning

3.1. Methodological development

This next chapter explains the methodological procedures used in the development of this project.

After an extensive analysis of development methodologies and according to the project's need, the extreme programming methodology was chosen, because it is a methodology with short and simple iterations, and with much easier feedback.

After all the research part for this web application, the practical part has started.

During the practical part, usually every two weeks, a status check is made to evaluate the development of the web application according to the initial plans.

At these points of situation, the advances, delays, new features to be added or removed were evaluated. And when possible, tests were also carried out.

3.2. Stages of development

In a first stage the focus was on collecting and raising the requirements and needs for the type of application to be designed.

After identifying the problem, the first step was to identify possible solutions. Then it was necessary to identify all people directly or indirectly connected to the processes. After we identified all these people, we started talking with those who would directly use the application.

In order to have a work base and somewhere to start from, and before any meeting, it was crucial to elaborate a small plan of what it would be necessary to do and for the application to provide.

The first steps were to understand what systems exist and explore them, to understand how to do something with the same goal.

Then it was necessary to identify where to collect the required data related to the project, which means to identify the sources of data collection. With these sources identified, it was necessary to inquire about routine and exceptional processes, which administrative processes and people participate in the decision, and which official documents are used.

After mapping all the steps, a review of some features was also made.

In the end, a sketch of the data structure was made to be used as a base for the work.

Stakeholders

After identifying a person who would be directly connected to the use of this application, a freestyle interview was carried out. The conversation was divided into four parts.

First, it was necessary to understand what existed, that is, to understand what the current process is and how it was managed until today. After realizing what existed, it was important to understand the process weaknesses from the point of view of those who use it and how the weaknesses could be improved. Then we moved on to discussing the existing features that could be improved so that the process would be as perfect and flawless as possible.

After these three steps, some ideas were discussed about what the application should be. The best way to do it was by brainstorming ideas of layouts, and features.

Plan

After understanding what the essentials for the application should be, a plan of the activities was carried out and the expected dates for each of the activities were scheduled.

The initial plan foresees the design of an initial prototype and assessment by the web application direct user. After this assessment one should review all process stages and what features the application should have.

Then, a meeting should be held with the application indirect users but who are yet part of the process. The main goal is to understand their actions and withdraw ideas and advice for the application development.

As mentioned, it is also intended to regularly deliver/present small parts or changes in features in order to have constant feedback from those who will use the application.

Schedule

The Table 2 aims to demonstrate the planning thought for the design, research and development of the application.

Table 2:Schedule

Ativities/Dates		October				November				December				January				Fevereiro				March				April				May				June				July			
		Weeks				Weeks				Weeks				Weeks				Weeks				Weeks				Weeks				Weeks				Weeks				Weeks			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Ideation Stage	Project Definition		X	X	X																																				
	Information search				X	X	X	X	X	X																															
	Initial planning				X	X	X																																		
Design Stage	Establishing contacts				X	X	X																																		
	Data collection				X	X	X	X	X																																
	Literature review					X	X	X	X	X	X	X																													
	Initial meetings				X	X	X	X																																
	Process collection				X	X	X	X																																	
Development stage	Information search					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
	Initial graphic part													X	X	X	X	X																							
	Connections to DBs																X	X	X	X	X																				
	Addition of features in the application																			X	X	X	X	X	X	X	X														
	Interactions with DBs																				X					X	X	X	X													
	Login System																												X	X	X	X									
Launch stage	Tests																																X	X	X	X	X	X			
	Error detection																																	X	X	X	X	X			
	Bug fixes																																		X	X	X				
	Improvements																																				X	X	X		

4. Web Application – Doc Management

4.1. Methodology used

In the process of making this work, a methodology called Design Science Research (DSR) was used.

The term Design Science appeared in the sixties and the first authors to use it were Fuller (1965) and Gregory (1966). Both agreed on the need to look for a more systematic way to design artifacts or improvements, and that is how DSR emerged [36].

In DSR we differentiate between design and a design theory, where design focuses on the "use of scientific principles, technical information and imagination in the definition of a structure, machine or system to perform pre-specified tasks with the maximum economy and efficiency" and design theory is "a prescriptive theory based on theoretical underpinnings which says how a design process can be carried out in a way which is both effective and feasible" [37].

DSR is fundamentally a problem-solving paradigm. It seeks to enhance human knowledge with the creation of innovative artifacts and the generation of design knowledge (DK) via innovative solutions to real-world problems.

A DSR research project's goal is to extend the boundaries of human and organizational skills by designing new and innovative artifacts represented by constructs, models, methods, and instantiations (Hevner et al. 2004, Gregor & Hevner 2013). DSR aims to generate knowledge of how things can and should be built or arranged (i.e., designed), usually by human agency, to achieve a desired set of goals; referred to as design knowledge [38].

The performance of DSR projects has been based on several process models.

The mostly widely referenced model is one proposed by Peffers, Tuuanen, Rothenberger, & Chatterjee (2008). The design science research methodology (DSRM) process model is shown in the Figure 1 [39].

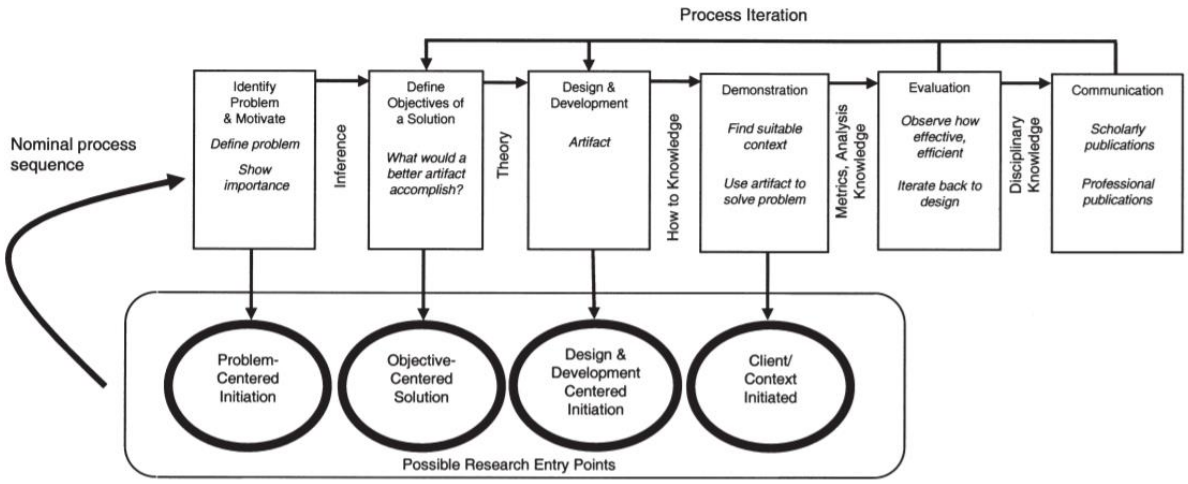

Figure 1: DSR Process Iteration (fonte: [39])

This DSR process includes six steps:

- Problem identification and motivation;
- Setting the solution goals;
- Design and development;
- Demonstration;
- Evaluation;
- Communication.

And four possible entry points:

- Problem-centered initiation;
- Objective-centered solution;
- Design and development-centered initiation;
- Client/context initiation.

By using this methodology in the making of this project, one of the first tasks was to answer to these 6 steps.

STEP 1 – Problem identification and motivation

Nowadays, the management of Doctorate students is manual, meaning that there is no application to help manage and comply with the necessary procedures for student and course management.

The people responsible for the management of these courses, as well as their students, use basic Microsoft Excel files for this purpose. Yet, this is not enough, meaning that this type of work can be simplified and perfected.

When using this system, several problems are found, such as difficulty in searching through a student's process and his/her information, trouble realizing if a student is lacking documentation or great difficulty finding out which assignments are due to completion and delivery and when are the expiry dates to do so.

This system brings a lot of work to those who use it and, in addition, when managing with a system of this kind, there is a lot of susceptibility to human error, meaning that it is extremely easy for those who use it to make mistakes, that sometimes can be serious, when doing something. This can bring harm to their own work or even to a student.

The application’s main goal and the motivation to do a project like this is to help workers have better quality of life and achieve the goals mentioned above by creating a web application with a simple interface that helps the user to know exactly what he/she needs to do and when he/she needs to do it, motivates the user to do his/her work and gives the worker only the necessary tools to perform his/her duties.

STEP 2 – Setting the solution goals

The main goal that is intended to fulfil with this proposal is to simplify and improve the work of those who manage doctorates.

This application’s main goal is to minimize human errors, improve the process in the student’s management, improve the work and make sure that those who use the application have their professional life improved.

Those are the main goals, but they are not the only ones. There are more people involved in this process who won’t use the application directly but with the improvement of one person’s work they will have their work more simplified too.

STEP 3 – Design and development

This application is a Backoffice application that aims to manage courses and Doctorate students, allowing to do all the management work in a simpler and effective way.

This Backoffice must have some features such as each student's information and his/her connection to the courses and subjects, the connection between the students and their presentations yet to be made, the possibility to have deadline alerts for tasks that are due and help in jury selections.

We can say that the main goal would be the management of each student's journey.

STEP 4 - Demonstration

The application was designed and programmed based on the needs of those who use the system and so after the first stage of development a demonstration was made with the main goal of validate if this solution would actually be able to answer to the problems found and improve all the processes that have been identified to improve.

This was a very important stage because it was based on a demonstration that was possible to find flaws and possible improvements.

STEP 5 - Evaluation

After the demonstration stage, all necessary corrections were applied.

After the final development stage, an evaluation was carried out, that is, it was validated how the created solution can solve the identified problem. In this activity, a comparison was made between the initial goals and the actual results. After this comparison we concluded that this app answers to all identified problems.

STEP 6 - Communication

At the end of all stages, the final solution and all problems to be resolved were communicated to all interested parties.

DSR Evaluation

The process of conducting DSR has been further developed in many ways, specifically paying attention to the evaluation activities and allowing for a more concurrent and fine-grained evaluation of intermediate steps in the design process. While it is well-understood that Peffers et al. (2008) process should and would be conducted iteratively, evaluation only takes place after design, development and demonstration activities; missing out on the opportunity to inform the design in an early stage of the research process.

Sonnenberg and vom Brocke (2012) conceptualize concurrent evaluation according to different aspects of design as shown in the Figure 2. They build on prior work describing DSR activities within the overall DSR process, arguing that each of these activities progresses toward the intended artefacts differently and thus offer potential for concurrent (or formative) evaluation. Such evaluation can mitigate risk (Venable, vom

Brocke, & Winter 2019), as early feedback on the minute steps leading to the eventual artefact can be incorporated into the design process. The authors also assert that this type of evaluation can be more specific and better directed if the evaluation focuses on the different aspects of design when relevant decisions are being made during the design process [38].

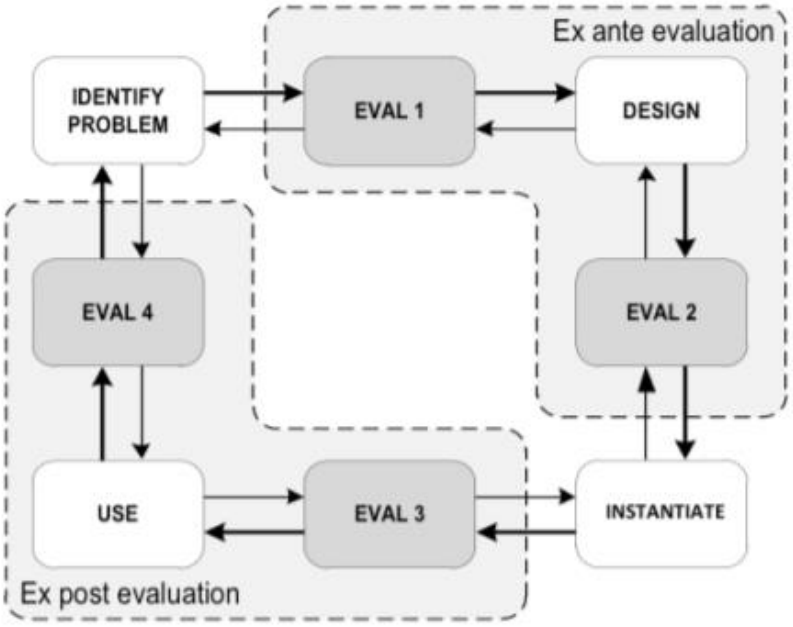

Figure 2:DSR Evaluation (fonte: [38])

The Figure 2 shows a cyclic high-level DSR process that includes the activities of problem identification, design, construction, and use. The Figure 2 suggests that each DSR activity is followed by an evaluation activity, as follows:

- Eval 1: Evaluating the problem identification; criteria include importance, novelty, and feasibility.
- Eval 2: Evaluating the solution design; criteria include simplicity, clarity, and consistency.
- Eval 3: Evaluating the solution instantiation; criteria include ease of use, fidelity with real-world phenomena, and robustness.
- Eval 4: Evaluating the solution in use; criteria include effectiveness, efficiency, and external consistency.

When designing the project, the conclusions drawn regarding the evaluation were:

- Eval 1: The identified problem is correct, and it is very important that it be solved. The possible solution was quite viable.
- Eval 2: The solution proposal was simple, but it would solve the problems and improve the processes.
- Eval 3: The solution is simple and very easy to use without losing the necessary functions.
- Eval 4: After implementing the solution and using the application in a real environment. We see that all previous assessments were correct, and that the application is effective and efficient.

The Design Science Research Grid

The DSR Grid (vom Brocke & Maedche 2019) enables researchers to effectively plan, coordinate and communicate their DSR projects. The DSR Grid intends to put an entire DSR project on one page, highlighting its essential components in order to reflect and communicate its scope. Such representation of a DSR project helps to better plan and communicate a DSR project as well as to receive feedback from different stakeholders in an early stage and to question and update the scope as the project progresses. As shown in the Figure 3, the DSR Grid consists of the six most important dimensions of a DSR project [38].

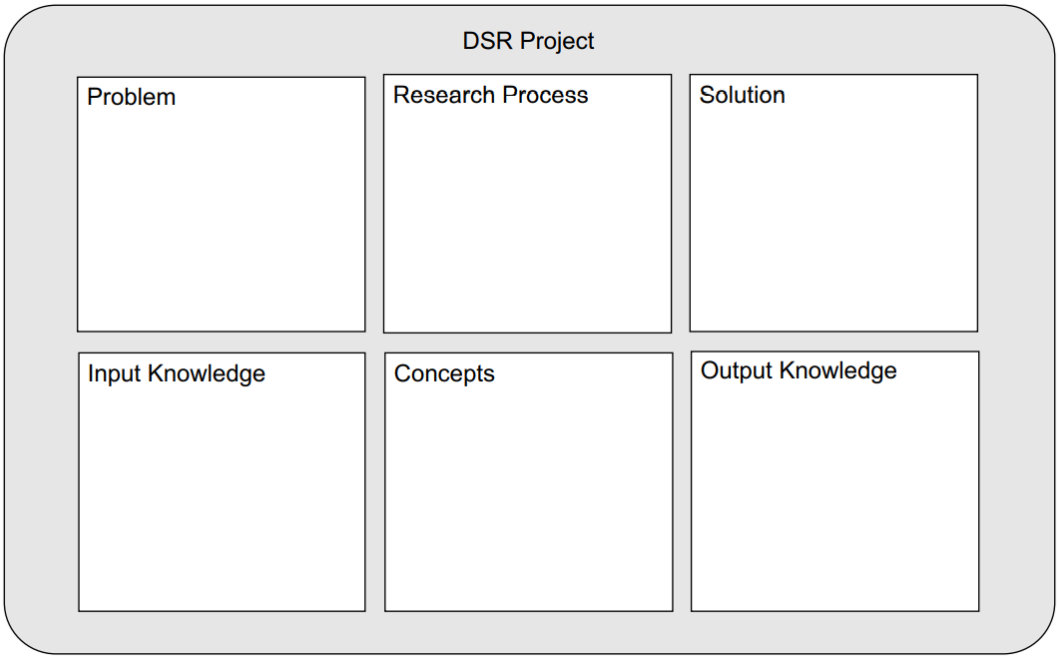

Figure 3: DSR Grid (fonte: [38])

Problem Description:

The management of Doctorate students is manual using basic Microsoft Excel files, which creates unnecessary workload burden those who do the job nowadays as well as higher susceptibility to human error.

Input Knowledge:

For the design of this application, in addition to all the study already done, some knowledge already acquired was applied, which required further improvement with the ongoing study.

Some of this knowledge was:

- How to make an application
- Programming languages
- Technologies and tools to make a web application

Research Process:

For the design of this application there were some essential activities that had to be planned. Especially at the research level.

A deep research on all topics needed to design an application was necessary. Not only new concepts had to be studied but also known concepts already available. A major literature review had to be conducted because it was an area with a vast array of information.

Key concepts:

The key concepts used were:

- How to search
- Better languages, technologies, tools and ways of programming
- What is and how to make a web app
- Research and development methodologies

Solution Description:

The desired solution is the creation of a WEB application that solves all the problems. It is intended to create an application that is a Backoffice aiming to manage courses and Doctorate students, allowing to do all the management work in a simpler and effective way.

This Backoffice must have some features such as each student's information and his connection to the courses and subjects, the connection between the students and their presentations yet to be made, the possibility to have deadline alerts for tasks that are due and help in jury selections. And all the features that the people who manage these courses need to do their jobs.

Output Knowledge:

At the end of the whole process, it is intended to have two types of Output Knowledge.

A theoretical Output Knowledge where it is intended to have all the necessary information on how to make a web application, from methodologies to languages and tools. Additionally, a practical Output Knowledge, where it is intended to show the results of the application. In other words, the results of it, that is, the validation between the created solution and the problems solved by it.

4.2. Work Done

For the application development it was necessary to gather all the knowledge acquired in previous stages and apply it as a whole. For the design of this application was thought of as a base and inspiration, the creation of a web application with a Frontend, a backend and a database to support all the data necessary for the application to work. It was also necessary to think about the types of users that use the application.

Pre-Development

According to the methodology chosen for the development of the application, before any development, a first meeting was held with the people that will be directly connected to the use of this application. A freestyle interview meeting was carried out with the main goal of understanding what existed, that is, to understand what the current process is and how it was managed until today.

Then it was discussed ideas about what an application should be what features were needed and this was doing by brainstorming ideas of layouts, features, etc. with the person who uses and will use the System in order to be noticeable what was really needed.

After that it was necessary to pass on all the generated ideas to a kind of prototype to understand what was really needed, what was not needed, what were probably good ideas but was not on the brainstorm and what was incomplete. So basically, a summary was made of what the application would look and would be like.

Of course, there were changes throughout the design of the project but a solid foundation is the most important but the success of something.

After these first steps and having a kind of low-fidelity prototype, there was another meeting for the validation of this prototype before the beginning of the development stage.

Development stage

According to the previously detailed development methodology, the best way to develop a web application is to do small deliveries and validations, that is, use a more Agile methodology. The main goal is to keep it simple, to have the stakeholders connected as much as possible to the project and quick insight in case something needs to be changed. It was based on this that all the development was done. After some study, and with the work to be done organized, it was necessary to divide the work and plan what had to be done for each deliverable.

The first step was **Database architecture** in which it was necessary to start designing the entire data model where the application would be based. After the data model it was necessary to start with Frontend to organize the application structure. With the **Frontend** completed, the entire core of the application began to be made, that is, the **Backend**, which is one of the most important parts of the application since it is responsible not only for the features but also for the connection with the data.

Application – Conclusion

As stated, the application was developed and all developments were shared regularly. Thus, it was possible to get feedback on what was already done and the next steps, making the entire development as close as possible to what the user intended to be.

After the end of the development stage, it was necessary to validate everything done to see if everything went as planned and make a final validation with who would use an app.

A final structure will be detailed below.

Users

One of the first steps in designing the application, as mentioned, was to understand the features and after that it was to understand which users and types of users would be called for.

It was decided that there should be two types of users:

- Main User/Admin – These are the app's main users. These users can manage user accounts do all the management of the course, such as creating and editing students, subjects, teachers, grades, academic information about students, etc.

- Secondary User/Report – These users only have permissions to access a page to make an information request or to contact the administrator users. These users are able to create a kind of ticket which will be shown to administrators on a specific page and an email alert will also be sent.

4.3. Frontend/Backend

In the first stage of the project's idealization, in addition to the login and registration page, it was thought to make only the page for the course and students management and a page to make the necessary settings, but we concluded that a page of requests for information or contact with the administrators of the application would be important.

Login/Registration

The login page, as shown in Figure 4, is a simple page and the app's main page evaluates the user. Evaluates who is trying to login and in addition to authenticating it also authorizes that is, it validates if the user exists, if the password is correct and what permissions the user has.

In the registration and login features, HASH is always used for passwords so that they are kept confidential and for greater security.

There is also a user registration page, shown in Figure 5, which will not exactly be a registration page. This page is a pre-registration that any user can make. It is then up to users with administration roles to accept the registration and make it permanent or not. This page always validates if, for example, there is already that user or email registered in the app or in a pre-registration.

Figure 4: Web App Login Page

Figure 5 : Web App Pre-Registration

Report

The reporting page, shown in Figure 6, is a page that only users without the admin role can access. This page's main goal is to get in touch with people with administration roles, either to, for example, get some information about a student or to correct or add some type of information.

When adding a report on this page, in addition to creating a kind of a ticket, an email alert is also sent.

On this page the user can also reset his password.

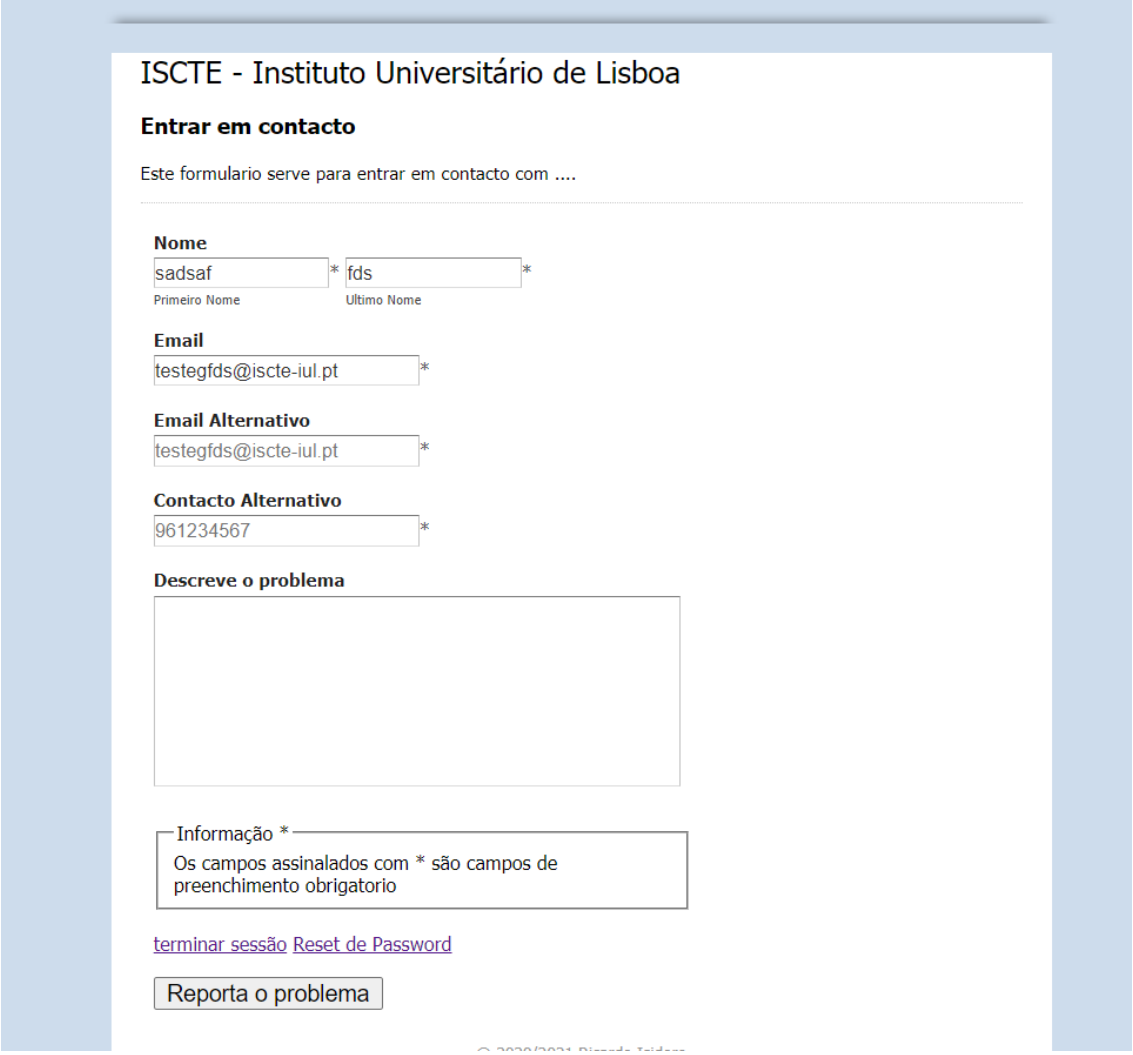

Figure 6: Web App Report Page

Manage

The management page is a page that only users with the administration role can access.

In this part of the application in addition to the password change page, there are four different groups of pages. On all pages within each group, and even globally, we tried to keep the same layout, features, etc. to be easy to use all the application's features.

The four groups are **Created "Tickets"**, **Application Users**, **Student Management** and the **BACKOFFICE Settings**.

In the **Created "Tickets"** group, shown in Figure 7, it is possible to see all open "tickets", and of course it's possible to use filters to make the research easier. Here it is also possible to delete tickets (they are not actually deleted but just changed their status) and edit the "tickets". When editing "tickets" we can add comments and change the status between solved and unsolved, as shown in the Figure 8.

Figure 7: Web App Report manage Page

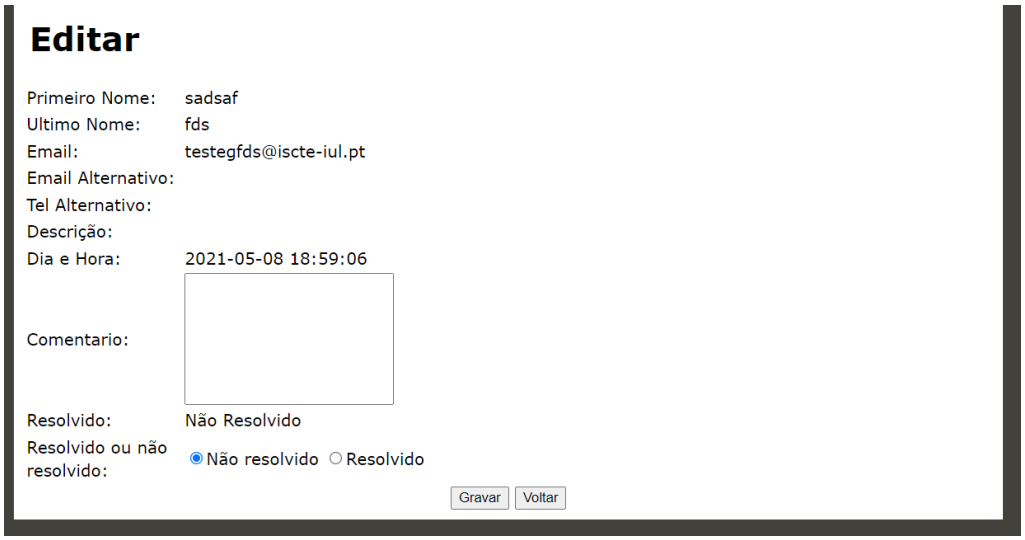

Figure 8: Web App Report edit Page

In the **Application Users** group it is possible perform all of the operations related to the users of the application. This is very important menu as it allows the control over who uses the application and what permissions they have.

In this menu, as shown in Figure 9, it is possible to change the status of the registered users in the application and the permissions (i.e. if they have admin roles or not), register new users and accept or reject pending registrations.

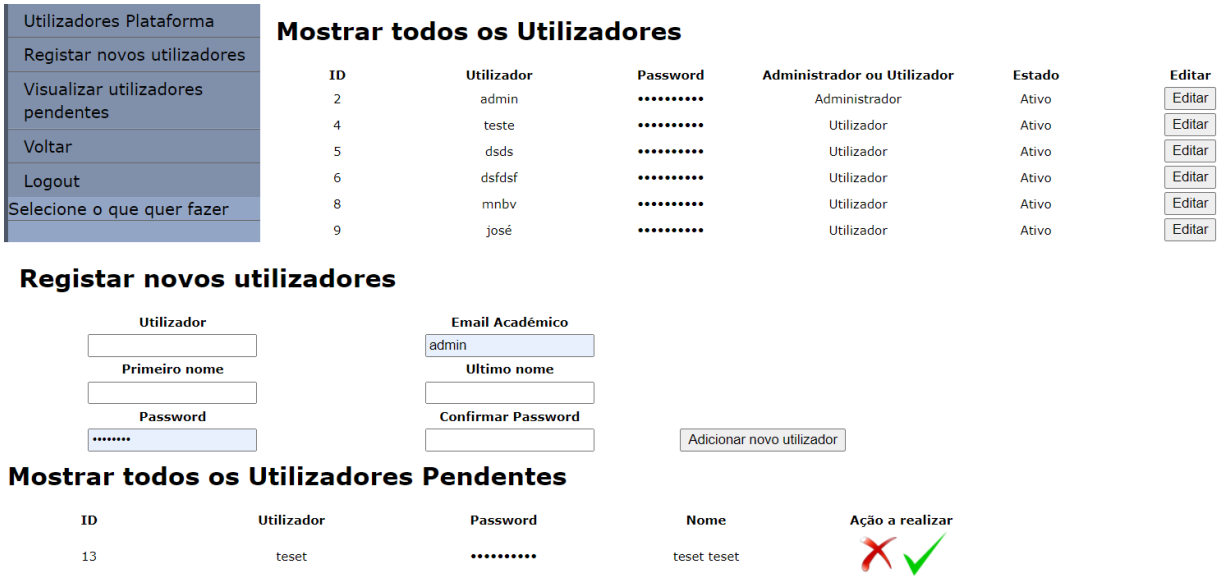

Figure 9: Web App Application Users Group

The **Student Management** Group is the most important group of menus/features in terms of using the application because this is where everything happens. It is here that we manage the students and their academic journey. Here we are able to edit all data relating to students and their academic information from starting their studies until they finish the course and with this, we have always an up-to-date database of students and their academic journey.

Inside of **Student Management** group we have:

Global Dashboard – This will be the main menu because this is where all the information from the rest of the menus in this group is summarized with the possibility of editing, in addition, this is also where the alerts regarding student delivery deadlines are summarized, for example it is possible to see which students have missing or late deliveries with enrolments, documents, curricular units, among others, as shown in Figure 10.

Figure 10: Web App Students - Global Dashboard

Unlike the **global dashboard** all other menus are for editing information individually.

"Alunos Info" – Here is only for creating new students or editing student information. We can edit information such as name, number, place where they are studying, supervisors, state of enrolment, etc. As shown in Figure 11, this is basically where we find all the registered students and where it is possible edit them especially the information regarding their enrolment status.

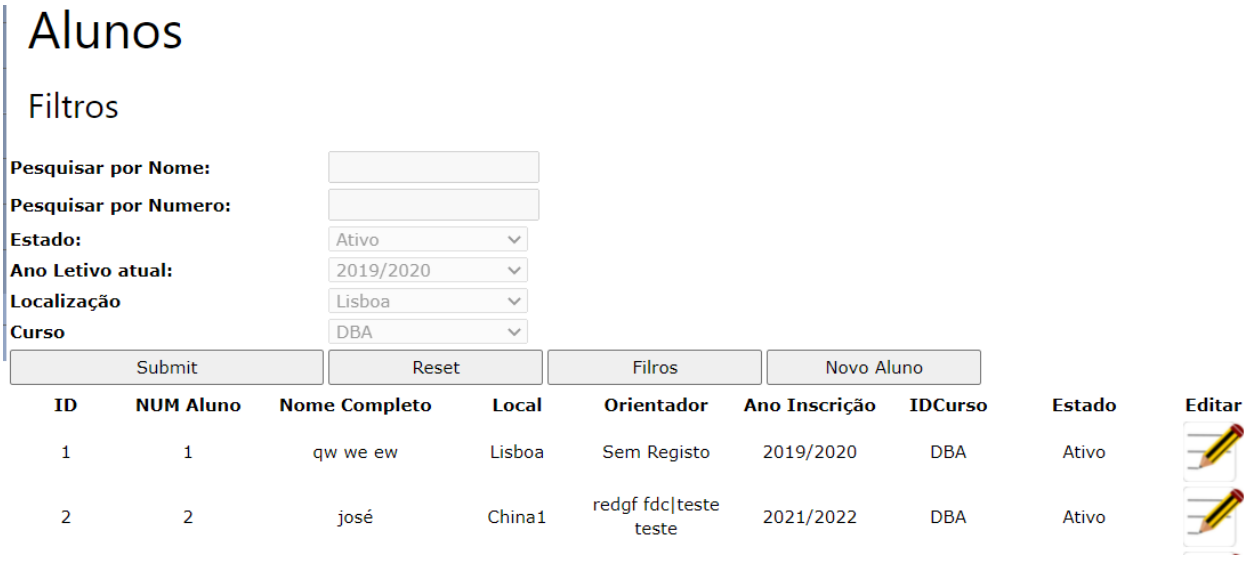

Figure 11: Web App Students - Student's info

“Matriculas” – In this area, as shown in Figure 12, the main goal is to register/edit if a student has already done the enrolment or not and if he/she has already delivered the necessary documents. It is a very important area because it is here that one can validate whether or not students can continue their studies because the documents that must be delivered and the enrolments that must be delivered are registered here.

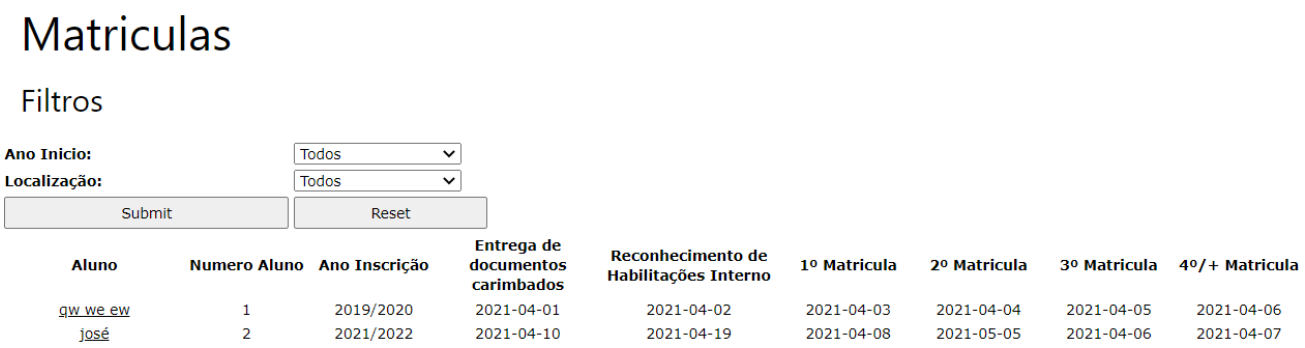

Figure 12: Web App Students - Students enrollment

“Notas UC” – As the name states and shown in Figure 13, this area is where the grades of the curricular units are shown/assigned. Here you can edit a student's grades individually or edit the grades of students enrolled in a curricular unit. It is also given the possibility to export the data. In other words, this is the place where the students' grades are shown.

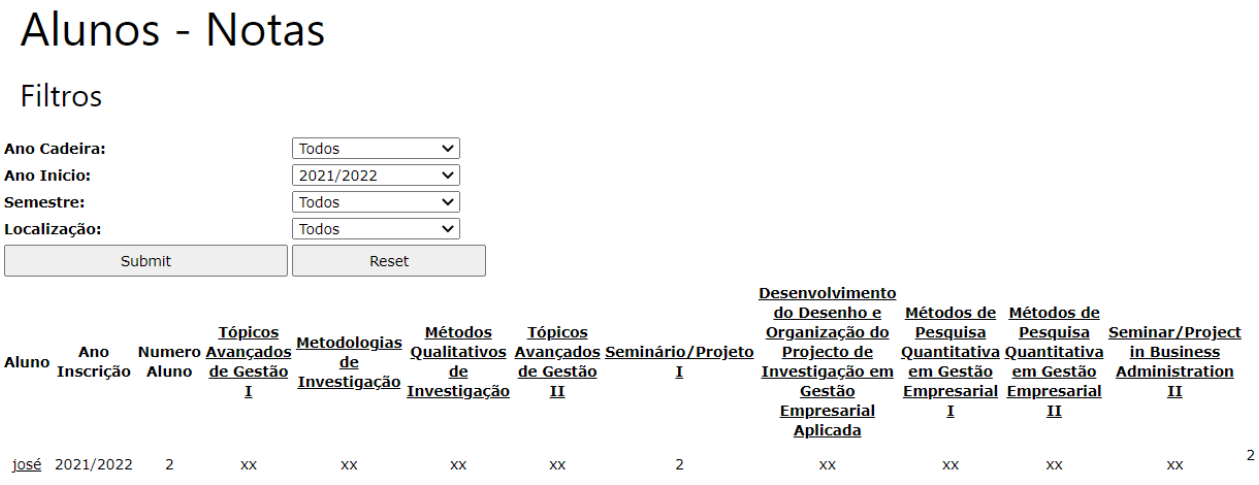

Figure 13: Web App Students - Students Grades

“Tese” - This is the main area relating to the students' thesis. As shown in Figure 14 this is where we can edit all the information related to a student's thesis such as Theme, title, date of submission of mandatory reports, juries, and its status.

Figure 14: Web App Students - Student’s dissertation

The **BACKOFFICE Settings** group is where we do all the configuration of the app, as shown in Figure 15, so that it can be used. This is perhaps one of the most important menus because the entire app will be configured like curricular units, teachers, important dates etc.

Here we can create/edit curricular units and can edit some fields such as names, ECTS, Year/semester when it is taught and the professors associated with the subject, as well as any information pertaining to curricular units.

We can also create/edit teachers, in addition to information such as name, contact and other information. we can also add their duties or roles as being teachers, member of a jury, or supervisors.

In the date menu, the main goal is for each academic year to define beginnings and location, defining the dates for delivery of reports, and expected end of curricular units. This information will be used in the student dashboard mentioned.

One of the menus also allows you to choose the current school year, which will make it easier to use the app. In that way, in several menus, the application knows that by default it must display data for the defined year.

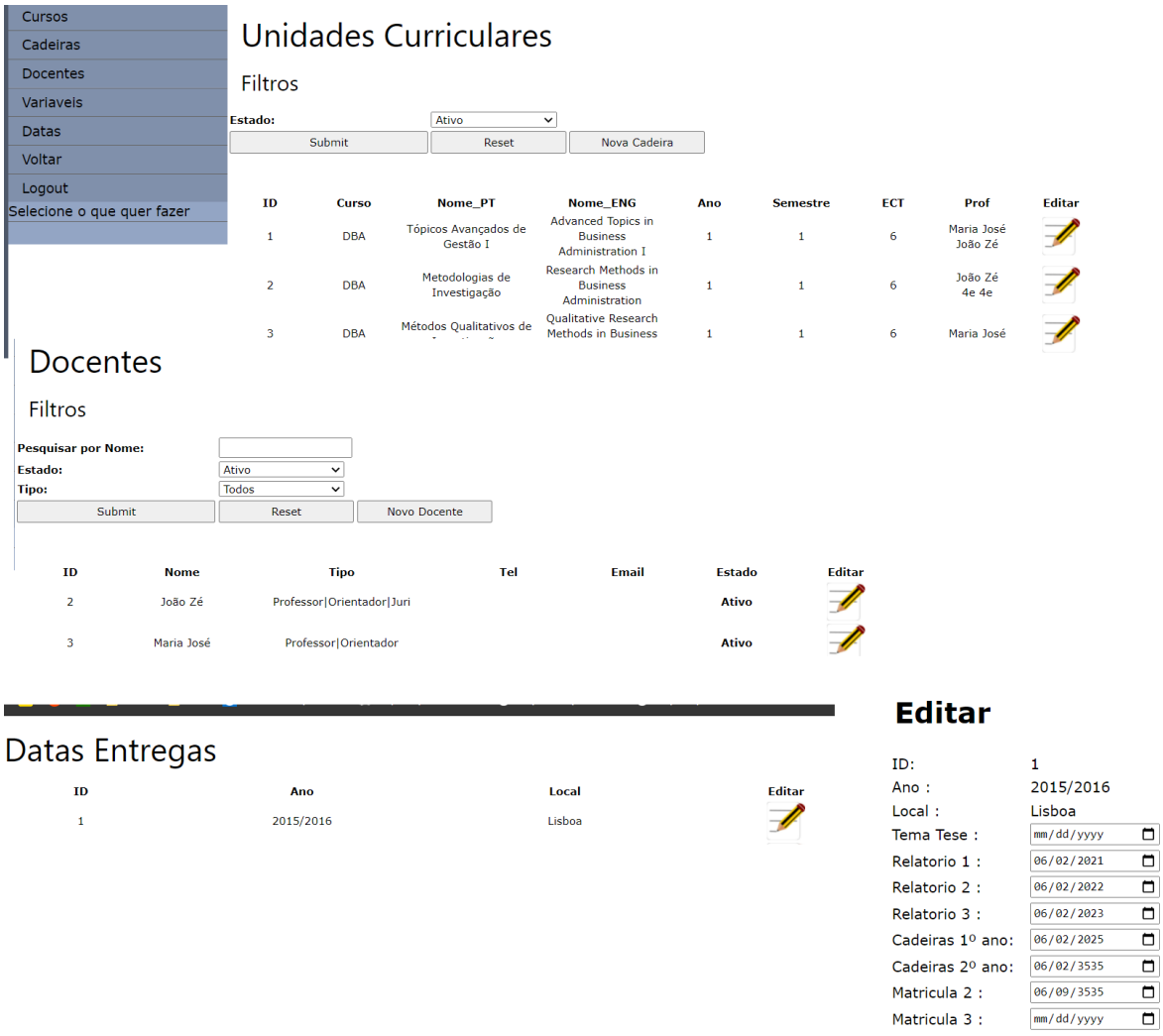

Figure 15: Web App BackOffice Settings

As stated, in the different menus/features the tasks are similar for example there is always the option to use filters, as shown in Figure 16. This option is very important because with the large amount of data it is sometimes necessary to search for something in specific and this way we can easily find the desired data.

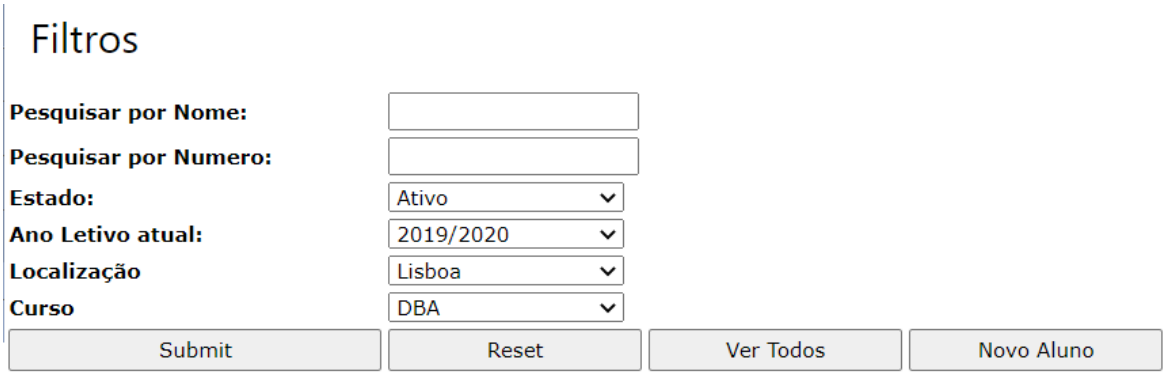

Figure 16: Web App Filter Example

In addition to the layout, other similarities between different menus/features are the options to edit the tables presented, whether on a specific button or by clicking on the student's name or number, as shown in Figure 17. In this way, we were able to quickly edit the necessary information regarding that selected row.

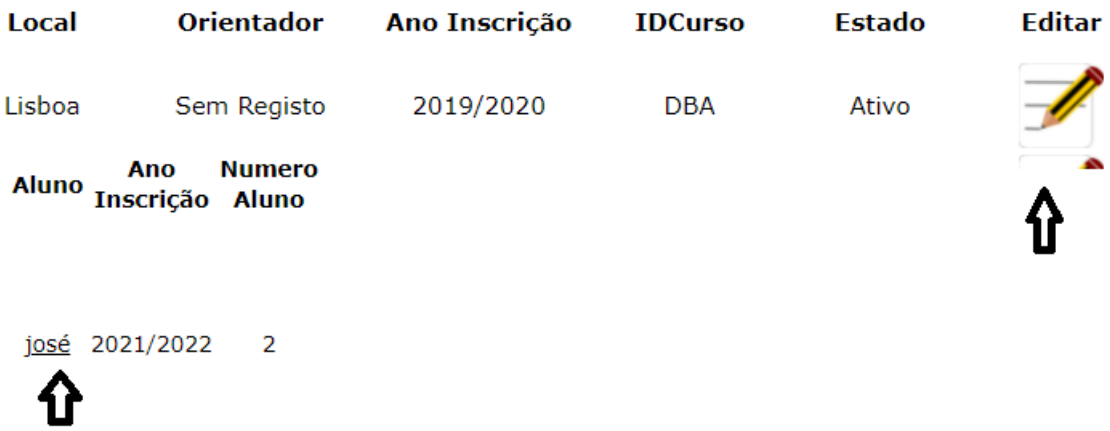

Figure 17: Web App Edit Option Example

Another option in most menus is to export data, as shown in Figure 18, from tables in Excel format. This option will help users to quickly download data to their computer. This option is important if the data is needed for some kind of report or to send it for academic reasons.

Figure 18: Web App Export Option Example

The Data editing pages, as shown on Figure 19, also have always a similar format. On these pages we always have the option to edit the data and save or go back. Whenever data is saved, it is always validated.

Figure 19: Web App Edit Page Example

4.4. Database

The database and its architecture were one of the first things to be thought of.

First it was thought which tables would be needed and then it was thought about the tables that would be necessary for the connections and after that a base of the structure was created.

Of course, during development there were changes in which some tables were added, others removed and others simply changed.

It was thought that there should be four groups of tables. The individual tables that would support the application's functionalities, the registration, login and ticket creation tables, the student, notes and all the necessary information in the student's journey and finally the tables to manage the course such as Curricular units, teachers, or their responsibilities.

The final structure is shown in Figure 20.

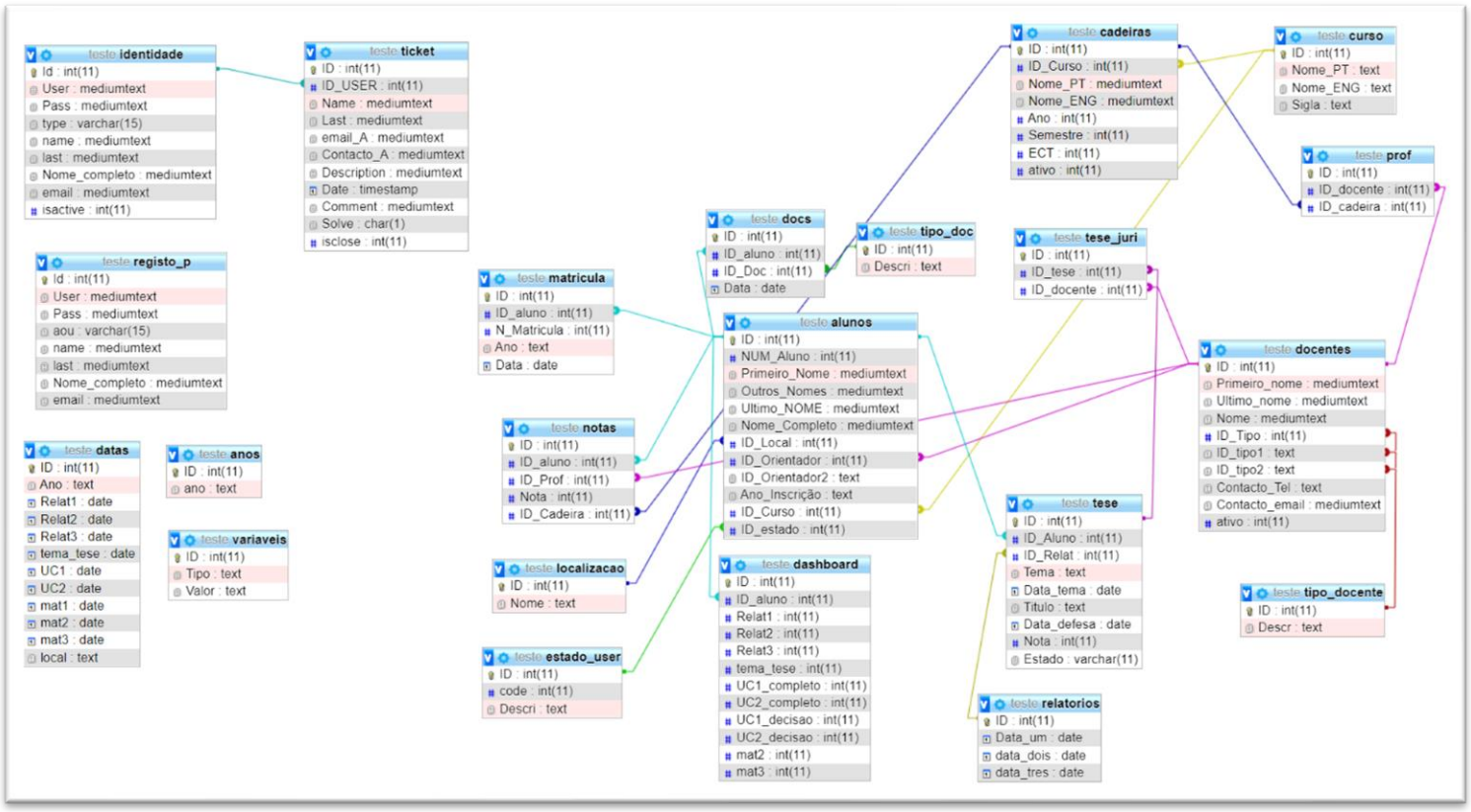

Figure 20: Database

5. Evaluation of the proposed solution

When proposing a solution to something, one of the last and perhaps most important steps is the evaluation of our proposal for the solution of that same problem. This is important because it will allow us to know if our solution meets what is necessary for the problems to be solved. When the customer chooses our product or not, it makes all the difference that it has already been tested and evaluated in order to have a perception of our product.

The evaluation of something is hardly just the question "did it work?" The evaluation involves detailing the problems that the solution intends to solve for the group that will carry out the evaluation and, based on that, let that same group evaluate the product.

Regarding the evaluation itself, it is very important to evaluate the product at different levels. It is important to visually evaluate, number of clicks to go from point A to point B, functionalities, product performance, etc. And it's these metrics and a few more that will help you evaluate the product.

With regards to this proposal, it was decided that there should be an evaluation by three types of people. The evaluation will have to be done by people that have educational background in computer sciences, people without computer experience and by the person who will use the application (although that person already has knowledge of the application and having tested and monitored the developments).

The main objective is to try to understand if the application:

- Solves the problem?
- Meets all of the solution criteria?

The first step was to talk to a small group of experts in the area of computer information. It was explained what the app was and the problems it intended to solve. After that a test was carried out by these people, that is, a call was made with a shared screen, and after that, all people were able to use the application with complete freedom, during that time they were asked to go to certain menus and to perform certain operations. The evaluation by people with training/experience in the area is very important because it allowed us to understand how the application was in terms of functionalities. After the test, a questionnaire was made to these people in order to understand and register what they really think about the application.

After talking to experts in this area, it was necessary to talk to people without training in the IT field. And this group of people was also explained what the app was and the problems it wanted to solve. A test was also made by these people, allowing them to handle the application with complete freedom. During the time when people were handling the application, small actions were being asked to them. The main goal is to see if people could easily handle the application and get to the right menu to perform the intended action. By making the assessment with this group, it was possible to understand how the application was at the level of intuition. After the test/assessment the people were asked to answer a short questionnaire to understand what people thought.

Finally, was asked the person who was going to use the application to make a small evaluation of the product. Here, no questionnaire was made, there was just a conversation to see if the application met the requirements, if it was what was needed to solve the problems identified and if that person thinks it was a good application to work with on a daily basis.

After the questionnaires, a conversation was also held with some of those questioned about the application, this was a free conversation, with only some topics, and the goal was to better understand the opinion of these people. After the conversations and together with the results of the questionnaires, we reached some conclusions.

First of all, it must be said that about 80% of people never used any application like this. One of the questions asked to both groups was regarding intuitiveness, and it was noticed that more than 95% of people think that is an intuitive application and that on a scale of 0-10 in terms of simplicity they give an average score of 7.5, visually in a scale of 0-10 the average grade is 7.5. In terms of the features that the application has and the problems it intends to solve, 100% of respondents said that the features were enough to solve the problems. A very important question asked only to people trained in the IT area was about the number of clicks to do an action, there was very positive feedback which helps to really understand the simplicity of the application. Another thing that we think is good to have in the app is to have menus and similar operations throughout the app and in this evaluation it was perceived that it was a good option. Regarding the inexperienced respondents, the questions were focused on whether they could do a specific action and if they easily understood the operations that were possible in each of the menus, we had good feedback where in a scale of 0 to 10 they gave an average score close to 8 and they always said that they easily understood what we could do in each of the menus.

Overall, from 0 to 10, people rate the application with a score higher than 7.5.

These questionnaires and conversations also served to understand which improvements the application should have. And we arrived at important properties about possible improvements to the application like having an area for students to access, students also receiving alerts, or linking with other systems.

The results of this questionnaires can be seen in Appendix .

6. Conclusions and future work

6.1. Main conclusions

This master's thesis has the main goal of making a proposal for a doctoral management system to simplify and improve the work of those who manage doctorates. To this purpose, this dissertation was divided into three parts and in each of these parts a different study was carried out and, in the end, all these small parts contributed to this master's dissertation and its practical proposal.

First, it was necessary to understand the problem, that is, what difficulties existed and what was intended to be solved. It was then understood that there was a problem and a difficulty with the management of Doctorates courses at the school and that nowadays there was a person responsible for this management. This management was centralized and manual. This brought problems such as, for example, in the absence of the responsible person, no one else has the necessary information and it was very difficult to do this manual management using only tools like Excel. This, in addition to other difficulties, made the management of this same courses prone to errors.

Then it was necessary to study the problem, that is, being a bureaucratic problem, it was required to understand the procedures and rules that had to exist, formalized into the bureaucracy. Namely, also understanding whether it was a good thing or a bad thing and what points were positive and negative. After this, it was necessary to join the problems found with the possible resolution and realize that having a bureaucratic system was necessary to solve the problems found and that the advantages that would appear such as improved processes, simpler management and even a reduce susceptibility to human errors would be quite positive.

After having understood the problem and the solution, it was necessary to think about what would be necessary to create to make the solution happen and that is how the idea of designing an application appeared. Then some study was done on programming languages, technologies and even methodologies and with what was learned during the course and the study made we reached the conclusion that the ideal would be to design a web application for this management. After meetings with interested parties and some study, we realized that it was necessary for the app to be with a simple interface and that could manage, create and edit students, their information, their grades and their deliveries, manage, create and edit curricular units and related information, manage, create and edit academic teachers and their duties. In other words, it is intended that the

application manages all the management of the course and the entire academic journey of a student. And it was with the PHP languages accompanied by HTML, CSS, JavaScript and tools such as Server2Go and using the XP methodology and The Design Science Research that the app that will solve all the identified problems was developed. It is with this app that it will be possible to answer questions “how to improve the life of those who manage doctorates”, “how to reduce human error” and “how to make management simpler and more effective”.

These were the three parts into which the work was divided. We can now conclude that a well-established, functional and accepted bureaucratic system is important to an organization and will make an organization successful in its field. It is also concluded that applications whose goal is to manage something are increasingly important and bring countless improvements to an organization.

6.2. Limitations

In the final stage of the investigation of this proposal, it is intended to outline some limitations/difficulties found during this investigation and study.

First, it is necessary to say that there were two types of limitations, theoretical limitations and practical limitations.

Regarding theoretical limitations, one of the main limitations and initial difficulties of this investigation was to find and study other systems that aimed to solve the same problems as those found, that gave rise to this proposal. This happened because there is several similar software in terms of school management, but not with the same goal of this proposal.

Another limitation found was the fact that because currently there was no management system, even if it was basic, it became more complicated to understand all the necessary requirements and make the connection with the theories of bureaucracy.

There was also another limitation due to the fact that it was difficult and inadvisable to be or speak with people physically, communication was often not the best, which greatly limited the clarification of doubts.

Regarding practical limitations for this proposal, the biggest limitation was time, as some study and planning was necessary that made the design and development time shorter. As it was just one person's work, there were areas where some extra study was needed to make it possible to carry out a proposal as intended.

Limitations are something that at first point of view harms us and makes it seem like there is no way out, but in fact, these same limitations make us go beyond what we thought was possible or capable, that make us challenge to know more in order to overcome these limitations and achieve the necessary goal. Therefore, even with the limitations found throughout the investigation, different paths were always found, in one way or another, to achieve the objectives that were proposed.

6.3. Future work proposals

Regarding the future of this app proposal, there are many paths that can be followed. From the beginning, one of the thoughts was “What if there are no updates and maintenance” Because of this thought, the application was conceived and designed to work for one of the doctorates without maintenance or updates, that is, as long as there are no errors with files, with the database, etc. the application can work and be managed through FrontEnd for some time. Of course, everything in computing is always subject to errors and that can affect the operation of the application.

But this app has great potential and is prepared so that with some study and planning one can improve and move to the next level. One of the main features that the application can have is to serve all courses, that is, it is easily possible to take the application's core and adapt it so that it can be used for any course, without even having to make changes to the database. As the application is being used, it is possible that new features may be needed, also without much effort it is possible to create a new page, make the respective links and buttons in the menu so that you can access the page that will have the new functionalities. Another of the future actions to be considered regarding the application's new features is the possibility of importing/exporting data from/to another academic application, this can help even more in the management of these same courses and students. After evaluations and interviews, we also concluded that something like a dedicated page to students seeing the information itself could be good and the application can also be easily adapted for this functionality. Briefly, there are some planned changes and so the application was designed with them in mind and is ready to be adapted. But even if new features have not been thought of, the application will always “accept” new features that may be included.

Regarding maintenance, whether with the current application or even with an application with upgrades or updates, it will always be necessary to have some type of maintenance. One of the main reasons for these maintenances is the database part, as an application that deals with data, especially in a school where data is easily multiplied, the space that the database occupies tends to grow exponentially and is something that should be kept under consideration. Another thing is for example some names or information that the application shows such as menu names, field names, among others. There may be a reason and/or a need to change and then a direct change will have to be made to the application's core

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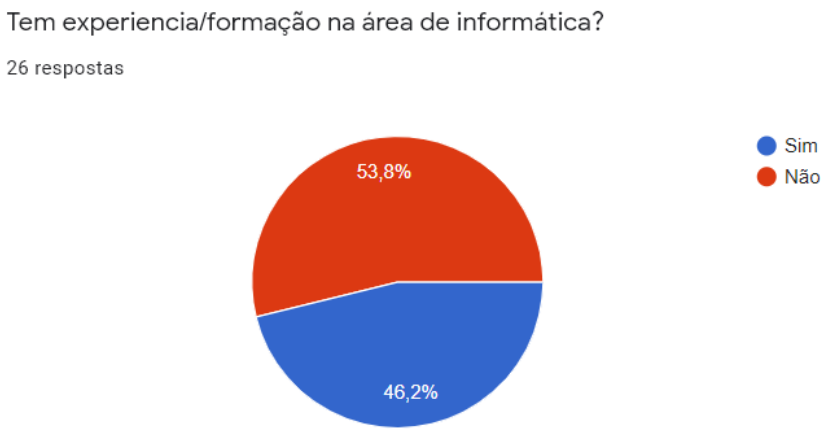
Appendix

Questionnaire done regarding the evaluation of the application.

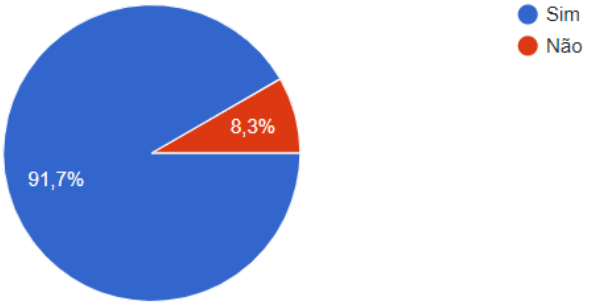
Questions and Answers



Experienced User

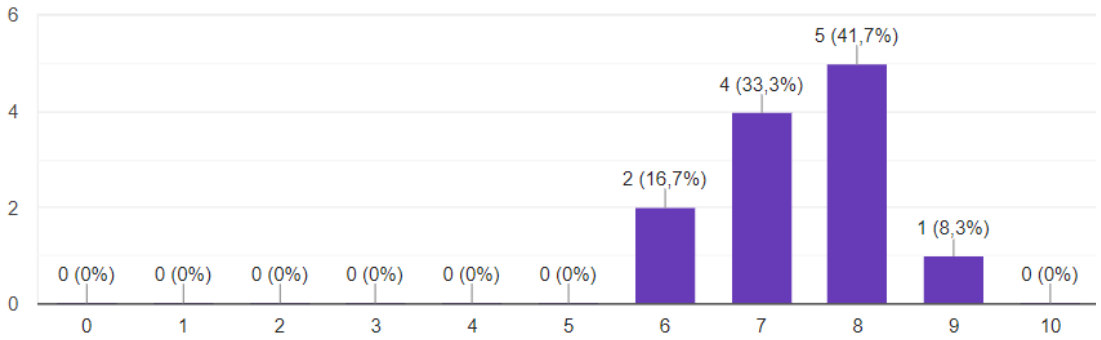
A aplicação é intuitiva?

12 respostas



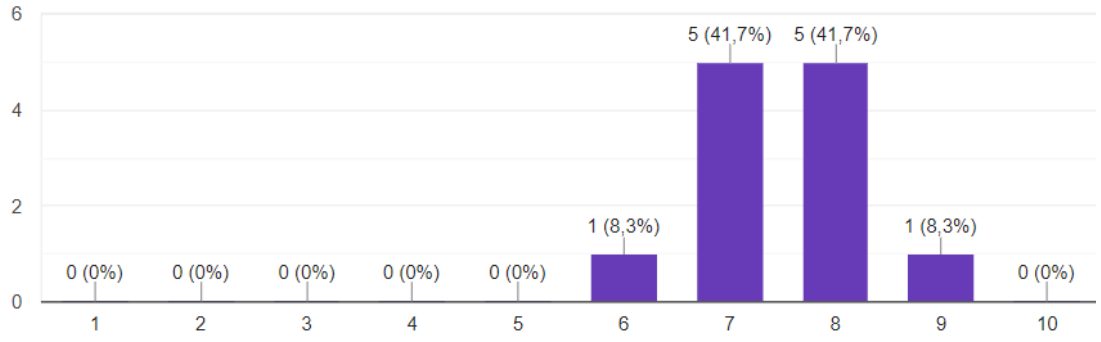
Avalia de 0-10 a simplicidade da aplicação

12 respostas



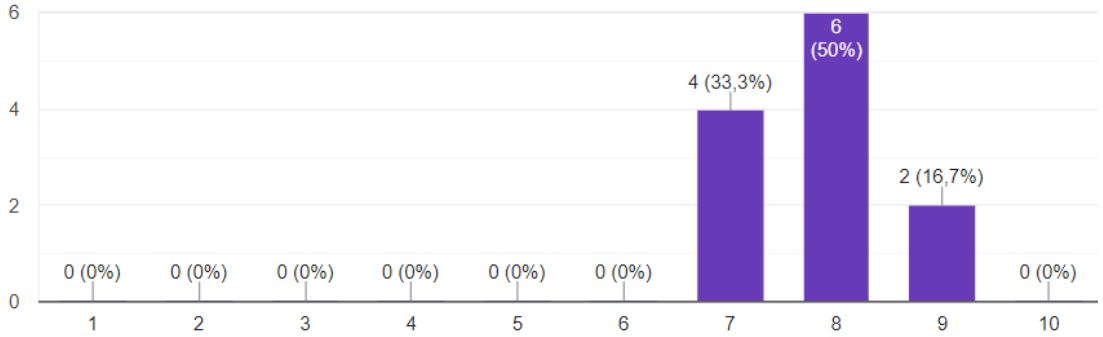
Avalia de 0-10 como esta a aplicação a nível visual, deves ter em atenção cores, tipos de letras

12 respostas



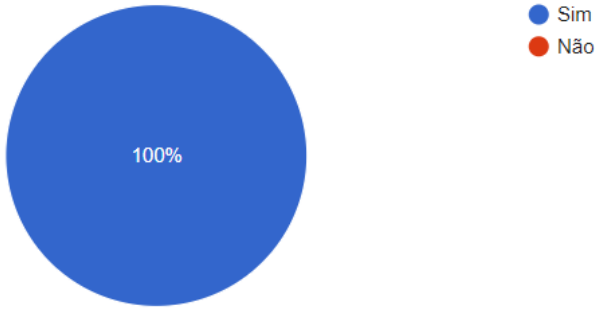
Avalia de 0-10 o numero de cliques necessário para ir da pagina principal ate fazer uma ação e voltar

12 respostas



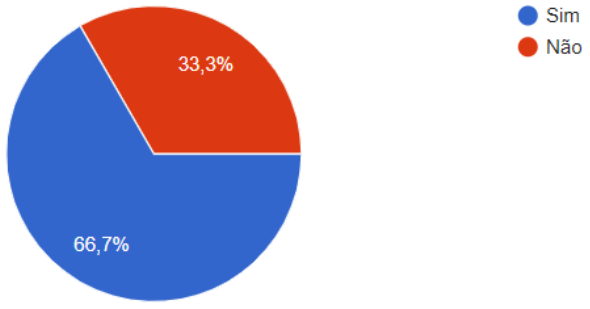
As funcionalidade da aplicação são as necessárias para resolver os problemas indicados?

12 respostas



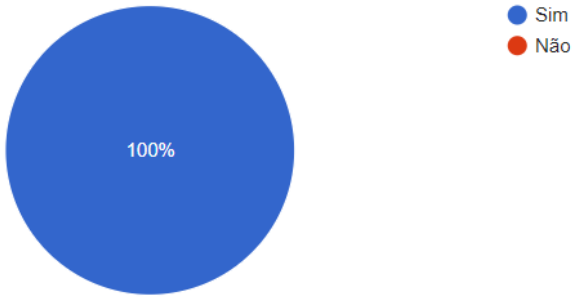
Achas que a aplicação deveria ter mais funcionalidades?

12 respostas



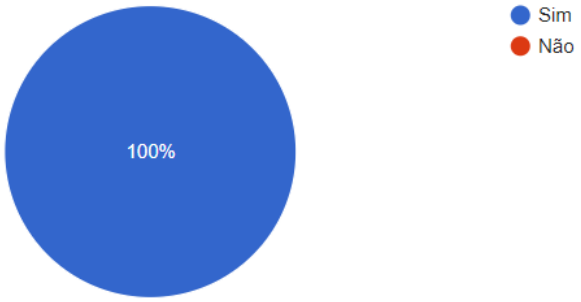
Conseguiste fazer todas as ações pretendidas durante o teste/avaliação?

12 respostas



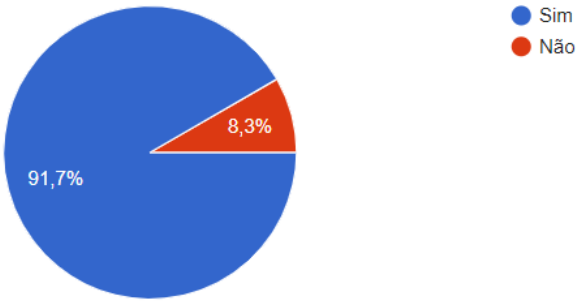
Achas bem a semelhança entre menus e ações (para cada funcionalidade ter opção de criar editar filtrar, etc.)

12 respostas



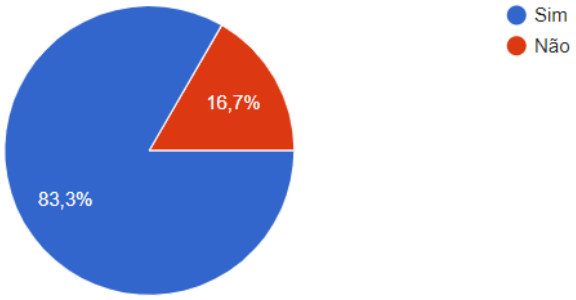
Existe possibilidade de executar a mesma funcionalidades em sítios diferentes ?

12 respostas



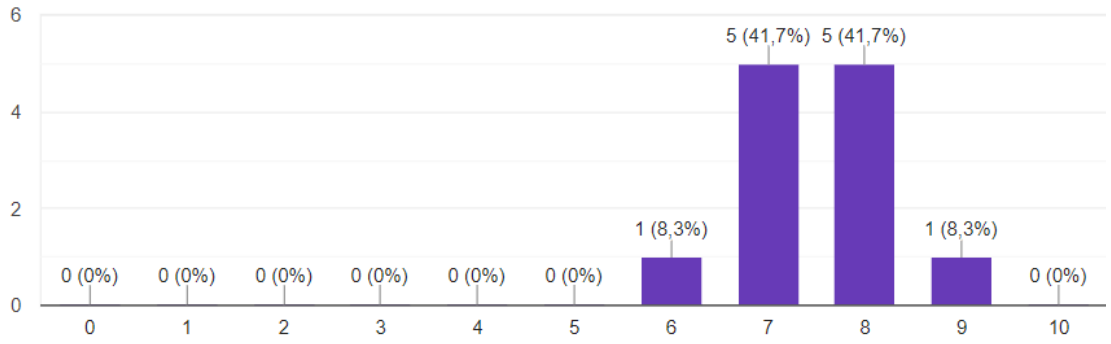
Achas possível melhorar a aplicação e torna-la ainda mais funcional e alargar o âmbito de utilização?

12 respostas



Numa forma global de 0-10 como avalias a aplicação

12 respostas



De uma forma global avalia a aplicação

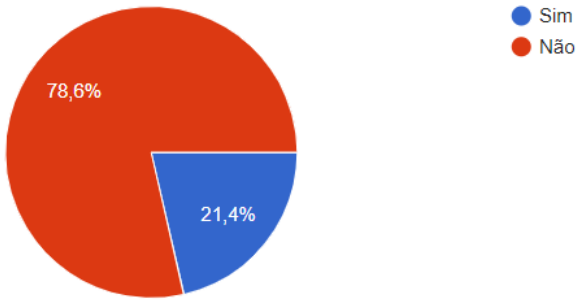
8 respostas

Podia ter uma interface mais moderna
Devia ter a opção da ligação com outros sistemas. Acredito que fosse possivel adicionar mais funcionalidades
Acho que a aplicação poderá ser expandida para varios cursos
Devia haver a opção para os aluno verem as suas informações notas etc
Alunos deviam conseguir ver as suas notas
Alunos tambem deviam ter alertas
Devia haver area para os alunos
Devia ser possivel gerir varios cursos. Devia haver uma areas para os alunos verem as informações . Deviam ter uma interface mais apelativa .

User without Experience

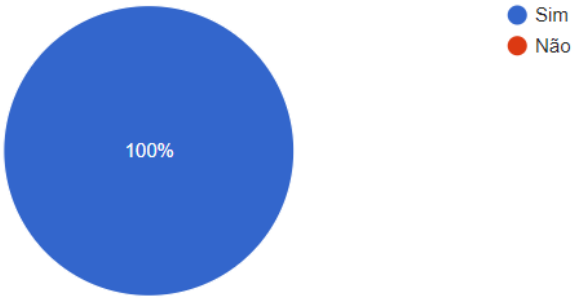
Ja usou uma aplicação semelhante antes?

14 respostas



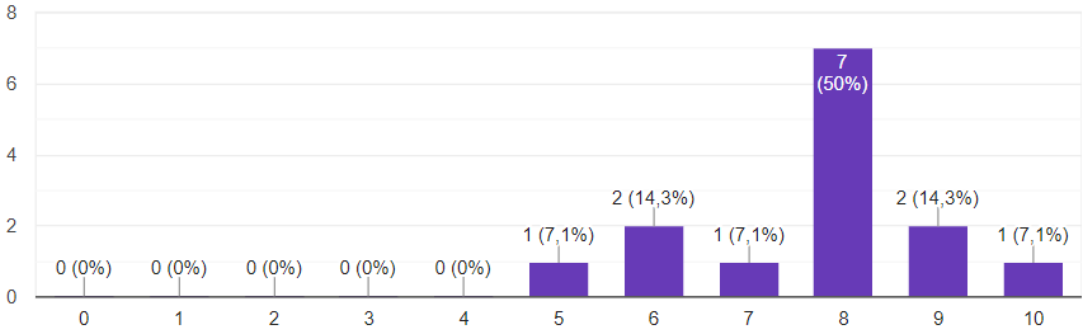
A aplicação é intuitiva?

14 respostas



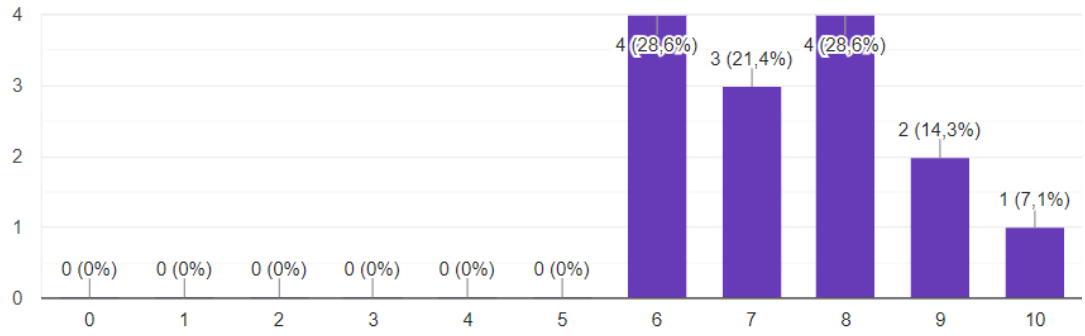
Avalia de 0-10 a simplicidade da aplicação

14 respostas



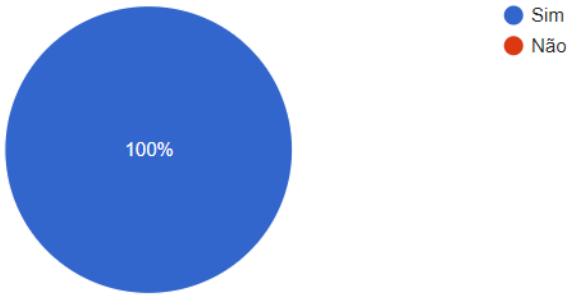
Avalia de 0-10 como esta a aplicação a nível visual, deves ter em atenção cores, tipos de letras tamanhos, etc.

14 respostas



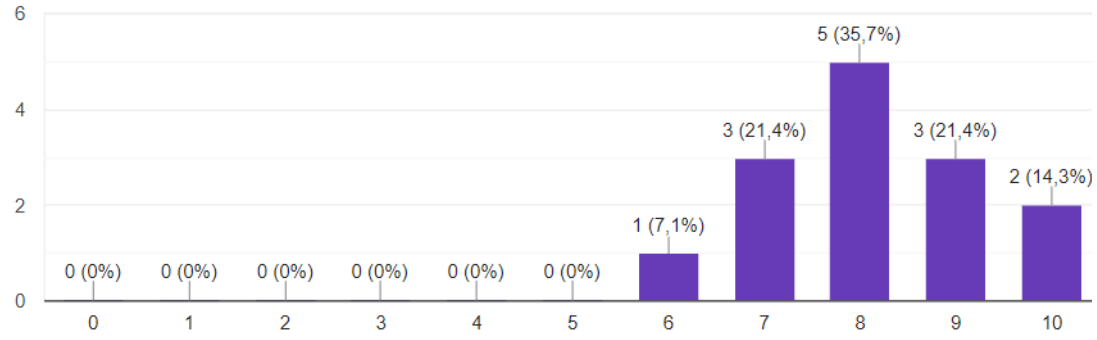
As funcionalidade da aplicação são as necessárias para resolver os problemas indicados?

14 respostas



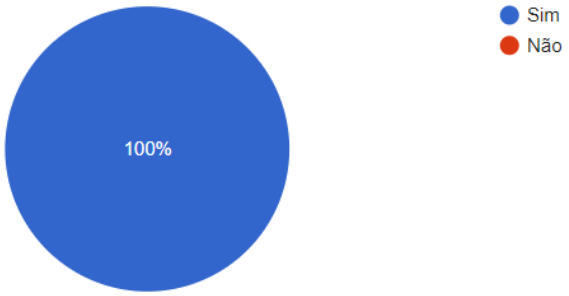
Avalia de 0 – 10 o quão fácil foi chegar aos menus de gestão de alunos

14 respostas



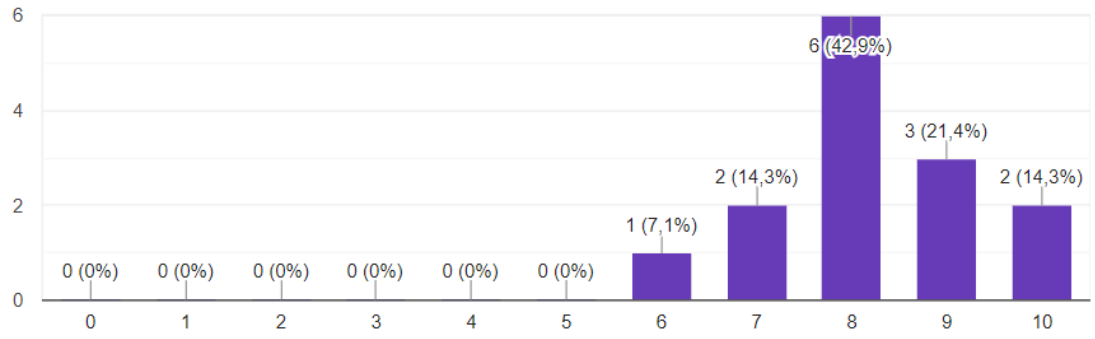
Dentro do grupo de alunos foi claro o objetivo de cada sub menu e fácil a sua utilização

14 respostas



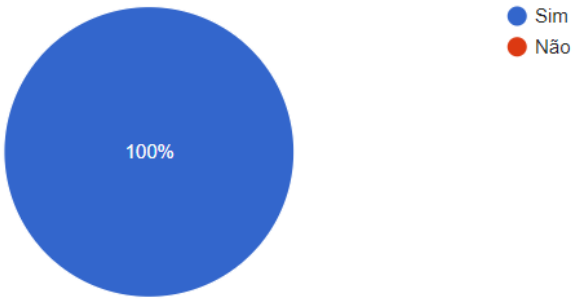
Avalia de 0 – 10 o quão fácil foi chegar aos menus de gestão do curso

14 respostas



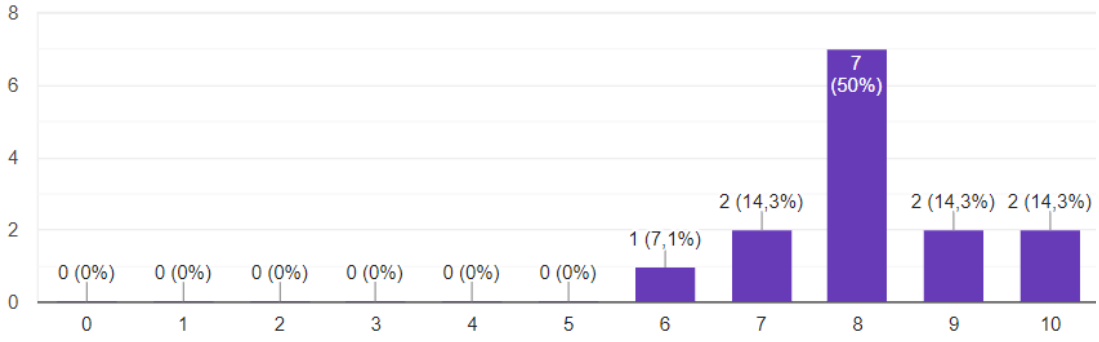
Dentro do grupo do curso foi claro o objetivo de cada sub menu e fácil a sua utilização

14 respostas



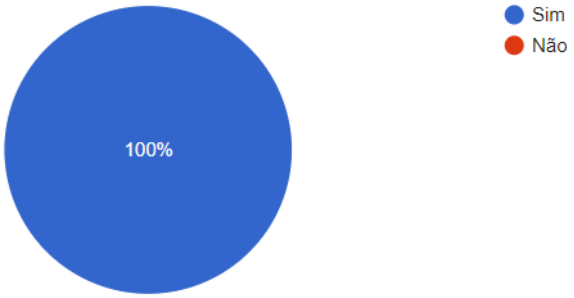
Avalia de 0 – 10 o quão fácil foi chegar aos menus de gestão de utilizadores

14 respostas



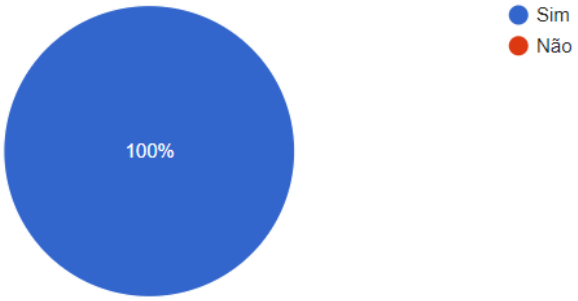
Dentro do grupo de utilizadores foi claro o objetivo de cada sub menu e fácil a sua utilização

14 respostas



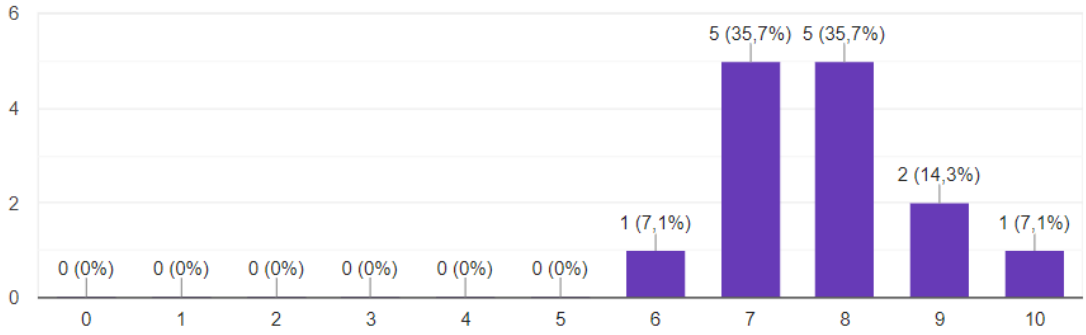
Conseguiste fazer todas as ações pretendidas durante o teste/avaliação?

14 respostas



Numa forma global de 0-10 como avalias a aplicação

14 respostas



De uma forma global avalia a aplicação

0 respostas

Ainda não existem respostas a esta pergunta.