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NAPP v2.0: Integration of freshmen students in Instituto Superior Técnico Campus Taguspark

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Resumo

O Programa de Mentorado do Instituto Superior Técnico foi criado em 1996, e teve várias mudanças desde então. No campus do Taguspark, no ano académico de 2011/2012, houve uma renovação com a integração da monitorização dos resultados dos primeiros testes, dos alunos do 1º ano ao que resultou num impacto positivo nos alunos. Um dos fatores que se percebeu ser necessário otimizar foi a parte da comunicação entre Mentorandos, Mentores e Coordenador. Assim e com este intuito foi criada em 2017, uma aplicação móvel denominada de NAPP. A aplicação móvel NAPP é um componente que deve ser usado como ferramenta por mentorandos e mentores para otimizar e tornar mais eficiente a comunicação entre mentores-mentorandos-coordenadores. As funcionalidades desenvolvidas na primeira versão da aplicação móvel NAPP tinham aspetos a melhorar, nomeadamente na satisfação e necessidades do utilizador. Posto isto, com o aprimoramento da aplicação móvel NAPP serão abordadas a criação de novas funcionalidades e melhorando as já existentes, de modo a que a comunicação da informação seja a mais eficiente possível alcançando uma versão melhorada.

Palavras-chave: Programa de Mentorado, Sucesso Académico, Aplicação Móvel, Apoio ao Estudante

Abstract

The Mentoring Programme at Instituto Superior Técnico was created in 1996, and has underwent several changes since then. At Taguspark campus, in the academic year 2011/2012, there was a renewal with the integration of the monitoring of the results of the first exams, of the freshmen students, which resulted in a positive impact on them. One of the factors that need to be optimized was the part of the communication between Mentees, Mentors and Coordinator. So, for this purpose, a mobile application called NAPP was created in 2017. The features developed in the first version of the NAPP mobile application had aspects to improve, namely in user satisfaction. That said, with the improvement of the NAPP mobile application, the creation of new features and improving existing ones will be addressed, so that the communication of information is as efficient as possible, achieving an improved version.

Keywords: University Group Mentoring, Students' Academic Success, Mobile Application

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Chapter 1

Introduction

The Student Support (AE) presently belongs to Taguspark Academic and Human Resources (AGRHT) on Taguspark campus. AE mission is essentially based on promoting the integration, accompaniment, and academic success of freshmen students on campus, through the Mentoring Programme. The Mentoring Programme was first applied in 1996 on Alameda campus, starting in 2011 on Taguspark campus, and underwent several modifications ever since. Currently its mission involves many actions such as: improvement of the relationship between the school and its students; development of all kind of initiatives that contribute to better student integration; strengthening the support for student initiatives, thus translating effective support from the school; promote academic success and development of welcoming actions for all students, with special focus on 1st year students and mobility students. ¹

AE main project is the Mentoring Programme. The Mentoring Programme is focused on welcoming, integrating and assisting the freshmen students and international mobility students. This personalized service is provided by AE Coordinator and mainly by volunteer mentors. Mentors are students from different courses and from advanced years with more experience and knowledge of how the Instituto Superior Técnico works. This support does not last only the first day of students' enrolment, but mentors will provide assistance throughout the whole year to mentees.

The Mentoring Programme in Taguspark (MP-TP) *campus* changed some strategies began from 2011 and now offers some differences from the one in Alameda *campus*. The most relevant difference in MP-TP is that the students are closely followed by the AE coordinator, to promote academic success, by keep a track of students first tests or exams marks. Yet, the involvement between mentors and mentees is such that mentors feel responsible for the success of their mentees. This impact differentiates in a positive way, strengthening the importance of a continuous follow up by all people and entities involved.

MP-TP depends on communication, which is the most important aspect to this Mentoring Programme. To succeed their goals, the three parties involved (AE coordinator, mentors and mentees) need to collaborate, strongly among them, to achieve these goals and all the parties benefit as well.

Among the three parties, mentees have to be active in communicating primarily with their mentor. The communication that they need to have is on reporting their marks. Monitoring mentees' marks

¹<https://agrhat.tecnico.ulisboa.pt/en/apoio-ao-estudante/>

will help mentors and mostly the coordinator, to understand the performance of mentees during the semester.

AE coordinator is responsible to closely follow and analyze mentees' marks along the semester with the help of a Dashboard, that was developed previously by Catarina Cepeda [1]. This Dashboard is integrated with NAPP mobile application developed by Pedro Veiga [2]. The coordinator is able to fast analyze which are the mentees that are at risk of failing the current semester.

When it happens, the coordinator decides the best approach to help the mentee, which can include some specific help from the corresponding mentor, or a personalized interview to understand the possible causes of the failure.

In the academic year of 2018/2019 a grading report made possible by NAPP Dashboard, and a first attempt to use NAPP Dashboard and make the most of it. A part of the main goal, reporting marks, was then achieved, but not totally. The first version of NAPP core feature was functional but the implemented solution was not the desired one.

The NAPP v1.0 mobile application does not offer the desired functionality to both mentors and mentees so that they can use it more often. The goal is to integrate freshmen students and enhance their academic success. Features as visualize their own progress throughout the semester, through progressive graphs, makes it easier to analyze what can be improved in the next assessments. In integrating freshmen students, the events that take place at IST are an asset to students acquire other knowledge other than in the classroom context. This feature and reporting marks, enhanced with a notification service, will streamline the use of the mobile application.

1.1 Key contributions

Multiple enhancements were made to NAPP v1.0 mobile application. The design was totally rebuilt with the main objective of providing a better user experience. The new implemented features in NAPP v2.0 were the following:

- Graphs - Mentees and mentors can follow their progress throughout the semester in each curricular unit.
- Notifications - Users become aware of important actions that take place in the mobile application.
- Feedback - Mentors can give their input to evaluate their mentees. Thus, they have quick feedback from their mentor, who is responsible for helping their mentees to integrate into the university environment and try to enhance their academic success.
- Filters - Those can be applied to filter their activity center, where it shows every action that happened on NAPP.
- Events - Every NAPP user can now be aware of IST related events, allowing to integrate and engaging freshmen students to participate in them.

The tasks and reporting marks features of NAPP v2.0 had small improvements but their core functionalities remained the same.

The NAPP v2.0 mobile application underwent a usability test and also was performed a two week beta tests with users. This test allowed to recognize some bugs that were found by the users.

1.2 Thesis Outline

This thesis structure will be the following: chapter 2 introduces the related work, that includes a study that evaluates the importance of mentoring programmes. Also, it includes three mentoring software solutions, in particular one is focused on a mobile application. It also introduces NAPP v1.0 framework, and an analysis of the used technologies. Chapter 3 explains all the work that was done to improve NAPP and Chapter 4 presents the various phases of evaluation. Lastly, Chapter 5 presents the conclusions of this work and outlines future work.

Chapter 2

Related work

Corporations and organizations can face unique challenges when it comes to developing or using a mentoring software to help the participants having a better experience in the context they are in. These mentoring software solutions are increasingly used around the world. The focus of these systems mostly emphasizes communication among mentees, mentors and yet provides data to programme coordinators for them to assess the progress and have results about the planned programme.

There are plenty of software systems for mentoring. But most of them are focused on corporations. Mentoring programmes, at universities, that involve technology built and shared among parties is not as common as it could be expected. The importance of combining these software solutions with programme goals, is a good omen that the programmes goals results will be achieved.

In the following subsections is presented a review of a comprehensive study made in the United Kingdom about the different type of mentoring programmes, and a summary on software solutions that support mentoring programmes, which include NAPP v1.0.

2.1 Peer Mentoring Programmes

Each institution can have a different definition of mentoring [3] and the used approaches into these mentoring programmes aim to strengthen student engagement and relationship building to improve the academic performance [4, 5]. In this section, is described a comprehensive study about the differences of some mentoring programmes in the United Kingdom.

2.1.1 Aston University study

A study about student retention was published in November 2011 by Aston University[6]. This study was initiated by Paul Hamlyn Foundation and the Higher Education Funding Council for England. The seven projects in the programme, involving twenty two Higher Education Institutions, have been evaluated based on effective strategies to help students to succeed in universities. This study makes clear that peer mentoring programmees needs to be well thought and can work with a modest investment, while the benefits in terms of students' academic success at transition can be considerable.

Many students do not know what to study when the transition year comes to move from High School. The reason behind is mainly because they do not know what they really like, as they have never had work experience or many are driven by pressure from parents or those close to them to follow a path they have always dreamed. It is within this environment of doubts that issues of retention arise. Therefore, it was studied the value of peer mentoring for students in five United Kingdom universities (Aston University, Bangor University, Liverpool Hope University, London Metropolitan University, Sheffield University) and one in Norway (Oslo High University Institute). This study was divided in three stages. The first stage took the form of a survey administered across all involved Higher Education Institutions in 2009/2010. The second stage was followed by another survey focused on pastoral peer mentoring in 2010/2011. The third and last stage was focused on qualitative interviews to mentors and mentees. The following subsections show the different stages in two types of mentoring: Pastoral Peer Mentoring and Writing Peer Mentoring.

Pastoral Peer Mentoring The transition period between High School to university is widely acknowledged as being crucial to students' academic success [7, 8]. By looking at what students concerns are, this study shows that social aspects of university life that concern students the most. Despite such worries before starting this new stage, most of students feel confident and committed to succeed academically. Also, this short-term or long-term transitional peer mentoring quickly helps students feel integrated into university environment and works better when the mentors and mentees build a relationship that does not end in a few weeks but instead continues in the first university year.

The main difference between short and long-term transitional peer mentoring is the pairing. For short-term mentoring the pairing can be made by interests, or based on other demographic characteristics like religion or language. In long-term mentoring, the commitment and the effort that is made by the mentor is much higher so the pairing is made to optimise and potentiate the chances of success.

The academic support is another point focused on most of mentoring programmes. Most students do not know how to study at university, because the amount of material given in classes is much higher than at the High School. This is where the role of mentors comes in, where they can be input value in teaching the new students of how they can learn faster, as these mentors already have some experience in university. Consequently, mentors in doing this kind of tasks also bring benefits to themselves such as improving their leadership or communication skills, as well as a sense of satisfaction that they have helped a new student.

To support the statements made in previous paragraphs, results of the surveys made in the transition period say that around 70% of 374 surveyed students concerns about making friends, agreed that peer mentoring helped them to feel part of university and are confident to succeed academically.[6]

Aston and Sheffield university method to promote their mentoring programmes is via e-mail. In contrast, the most effective method of promoting peer mentoring in Bangor university took place at the first weeks of the beginning of the academic year.

Writing Peer Mentoring In this strand of mentoring the mentors, that are students of the corresponding institutions, are hired to provide their help during 6 to 8 hours per week. These mentors are carefully selected, trained and managed by a staff member. This strand of mentoring is more formal and focused

on a one-to-one relation.

The focus is providing support in all aspects of writing (sentence structure, punctuation, use of paragraphs and organize writing for studying)[9, 10] providing a environment in which students find someone who can validate their writing. Moreover, this mentor is focused only on one student at time, as opposed to Pastoral Mentoring where mentors have to focus in a group of mentees.

The challenges experienced by both parties were about finding a balance on what mentors and mentees may or may not expect. Mentees expect mentors to proofread the content of their work but sometimes mentors are not in a position to do so. Yet, mentees very often seek advice on a last minutes basis. For this type of mentoring, where time is essential to help the mentees in their writing, mentees need to be cautions to seek advice about their writing in plenty of time. [6]

Type of Peer Mentoring	Form of Mentoring	Constituents
Pre-entry peer mentoring	Generally offered via social network sites or e-mail	<ul style="list-style-type: none"> - Targeted or generic [all first years] - Offered on an opt-in or opt-out basis
One-to-one Peer Mentoring at transition	Generally offered to particular individuals or groups depending on individual and institutional needs and norms	<ul style="list-style-type: none"> - Resource intensive in terms of organisation and administration - Requires careful 'matching' in terms of cultural and, if appropriate, academic requirements. - Usually offered on an opt-in basis
One-to-group Peer Mentoring at transition	Often known as 'Peer Guiding' this form of Peer Mentoring has the advantage of providing a 'friendly face' upon arrival, making transition positive for students (and in many cases their parents)	<ul style="list-style-type: none"> - Often offered on an 'opt-out' basis whereby all new students are allocated a mentor - Institutional, School or Departmental - Can be 'targeted' depending on institutional and student needs - Some matching may be possible - Generally one mentor to four or five mentees (in some cases this is higher)
One-to-group Transition+ Peer Mentoring	A synthesis of transition and longer term peer mentoring. This form of mentoring has the advantage of enhancing transition whilst then continuing to provide on-going support thereby helping deal with issues around retention.	<ul style="list-style-type: none"> - Offered on an opt-out basis as above - Centrally organised and managed but operated at a school level. - Allows for 'targeting' of specific groups if required. - One mentor to around five mentees. - Social focus at the beginning but evolves into providing study skills support
One-to-one longer term Peer Mentoring	Pastoral in nature this form of peer mentoring tends to be carefully managed. It can involve an element of informal peer counselling.	<ul style="list-style-type: none"> - Resource intensive - Needs close allocation / supervision of student pairings - Student peer mentors may additional support - Usually involves students from a 'higher' year mentoring those in years below - Can be cross-university or school / subject focused - Relationships often last throughout the mentees university career and beyond.
One-to-group longer term Peer Mentoring	Pastoral in nature this form of peer mentoring tends to be less formal than one-to-one longer term mentoring. Often School or subject focused.	<ul style="list-style-type: none"> - Less resource intensive than one-to-one peer mentoring - Mentors may need support with group dynamics - Usually put in place within [across] a year group
'Partnership-led' Peer Mentoring	Two nominated 'peer mentors' lead a small group of between four and ten (possibly more). Can be long or short term. In some cases, it is appropriate to appoint two mentors for one mentee.	<ul style="list-style-type: none"> - Can be offered on an inter or intra year basis - Offered on a long or short term basis - Particular useful at transition into university - Particularly useful for international students who may require a mentor from their own country and a UK mentor
Group Peer Mentoring	A group of students specifically placed together with the purpose of mutual support. This form of mentoring relies on group cohesion and reciprocity.	<ul style="list-style-type: none"> - Can be resource intensive as management of peer support groups may be problematic - Generally School or subject focused. - Usually offered on a short term basis [one term or less]

Figure 2.1: Typology of peer mentoring according to [6]

Many other types of mentoring were identified in these Higher Educational Institutions (see Fig. 2.1) where they share a key criteria which is the students' academic success and their involvement in the university environment. Yet, as the result of the interviews and surveys that were made to students, an ideal Peer Mentoring Approach was developed called Transition+.

Transition+(see Fig. 2.2) main features are the following:

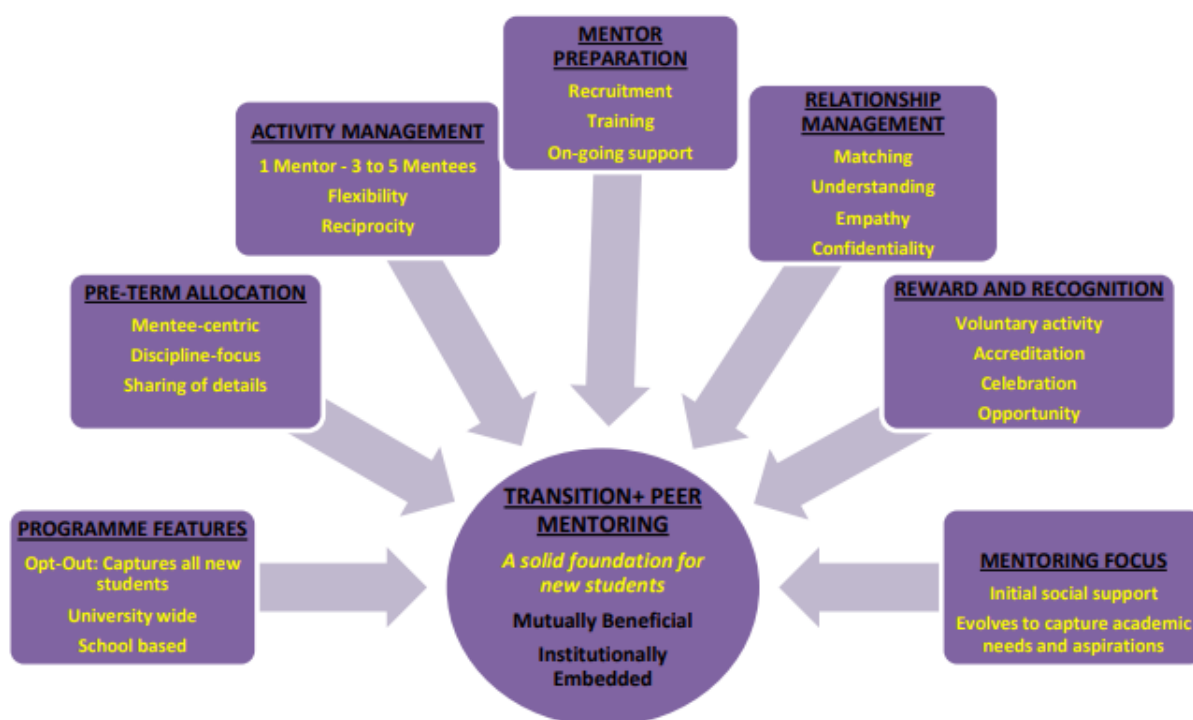


Figure 2.2: Transition+ Peer Mentoring: The feature of an Ideal Mentoring Programme according to [6]

- Programme Features: Freshmen students are on an opt-out basis, meaning that deliberately can leave the Programme. Also, it is centrally managed but each faculty has Peer Mentoring Coordinators;
- Pre-Term Allocation: Early matching between mentors and mentees enables them to exchange contact details, leading to a fast pairing;
- Activity Management: Small groups of three to five mentees enable their mentor to have more time to help his/her mentees;
- Mentor Preparation: Recruitment occur in the last academic semester and the training in the next one. By training next year's mentors from the current year's mentees, mentors can guide the next cohort. Hereupon, Transition+ becomes self-sustained. Mentors and mentees have a member of staff as being responsible throughout the year to give on-going support;
- Relationship Management: Mentees are asked if they have any preference for their mentor, such interests, gender, region, among others;
- Reward and Recognition: Peer mentoring should always be a voluntary activity for both parties. The contribution of each mentor, can be recognized with a university certificate. Also, since mentors work is recognized in the university, mentors are often used to guide open days or events;

- Mentoring Focus: Initially the focus is helping students to settling in university. After that, mentors focus is to help mentees with academic issues such as: advising on how to study a subject or how to use the library.

Different types of mentoring programmes exist in different universities and more specifically, with the study done by Aston University, it can be observed that mentoring programmes change a lot between universities. Also, in several or even in these same universities, there is a great diversity of programmes to support the integration of students into the academic environment. The perfect formula does not exist.

It is curious to mention that the Peer Orientation Transition+ programme, studied by Aston University, is quite similar to MP-TP's one. MP-TP uses this method because it seems to be the best fit and most beneficial for all the parties involved.

The pairing method that is in use at Taguspark *campus* can be improved with some interesting ideas. Aspects such as geographic area or interests can be used to link mentors and mentees and help to create a faster, stronger and direct connection instantly. The strategy for obtaining this information from students who are transitioning from High School to university, could be implemented in Instituto Superior Técnico during the enrollment period. Since freshmen students must fill in a survey with questions about hobbies, interests, geographic region and among others, hereupon, during this week of sign up, pairing could be done more carefully and not so randomizedly. At the end, what all Peer-Mentoring programmes want is to connect people.

Writing Peer Mentoring is an interesting tool that could be tested on Instituto Superior Técnico because many students fail to clarify and structure their thinking when writing it down. Consequently those ideas that are not so well structured and described can be a cause of lower marks in projects and laboratories. The biggest concern with this strand of mentoring is that students have to be hired, which implies an economic investment by Instituto Superior Técnico to employ write peer mentors. Yet, all the training and follow-up of these mentor writers has to be superior to mentor peers because they have an added responsibility to help students with writing difficulties.

2.2 NAPP v1.0

2.2.1 Architecture of NAPP v1.0 framework

The architecture of the NAPP v1.0 framework consists of two applications: NAPP mobile application and a Dashboard web application. Mobile application is used exclusively by mentors and mentees. Dashboard is exclusively used by AE coordinator.

In the mobile application, mentors and mentees can use multiple features (such as sending marks) that will be performed by REST API calls sending information into NAPP databases. This information is then possible to visualize in AE's coordinator Dashboard. Dashboard offers the ability to:

- Visualize graphs with the respective marks of the different evaluations by discipline;
- Visualize graphs with total number of tasks performed by the mentor;

- Add the subjects of each semester with their respective assessments, allowing mentees to submit their marks.

2.2.2 NAPP mobile application

NAPP v1.0 mobile application was developed during the Master's degree thesis of Pedro Veiga, to try to tackle the communication problems of MP-TP.

In NAPP v1.0, mentors login through FenixEdu's Central Authentication Service¹ (see Fig. 2.3) and insert their mentees.

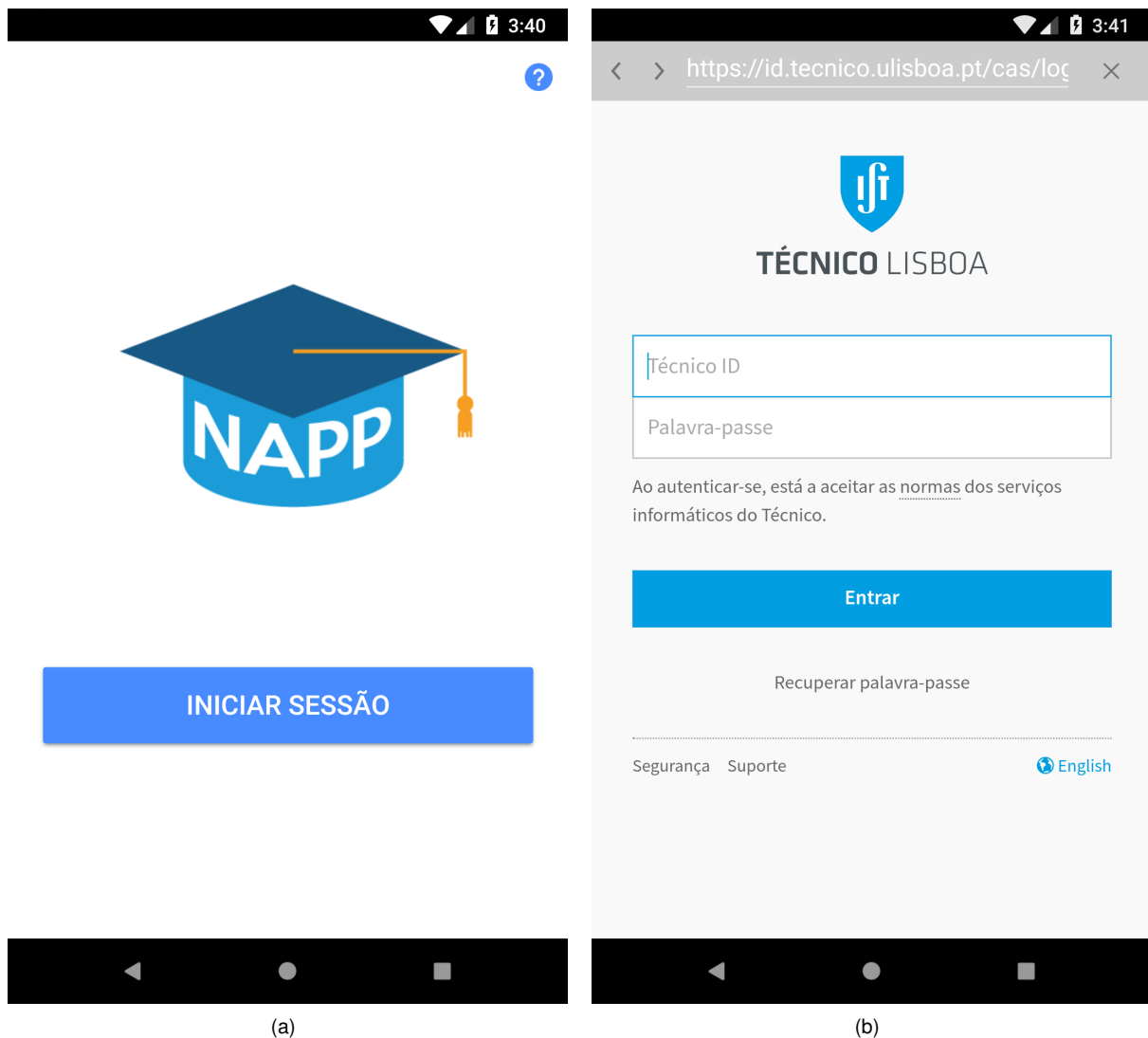


Figure 2.3: (a) NAPP entry screen and (b) FenixEdu login screen

After that, mentors had a feature that enabled them to create tasks for their whole mentee group or send a task to a particular mentee where he could point out when this task was done. This functionality was created as a notification service to advise or warn mentees to send their marks as soon as possible. Since it is an extra step that should be avoided because it involves mentors in a process that could be

¹<https://fenixedu.org/>

handled, in a automatic and more efficient way, as a notification service. Yet, mentors in this first version do not have a mechanism to closely follow theirs mentees marks. This is not only an interesting feature for mentors but also essential for preventing and detecting errors when reporting marks to the NAPP system.

Mentees can report their marks whenever they are graded in each particular project, exam or other assessment moment (see Fig. 2.4).

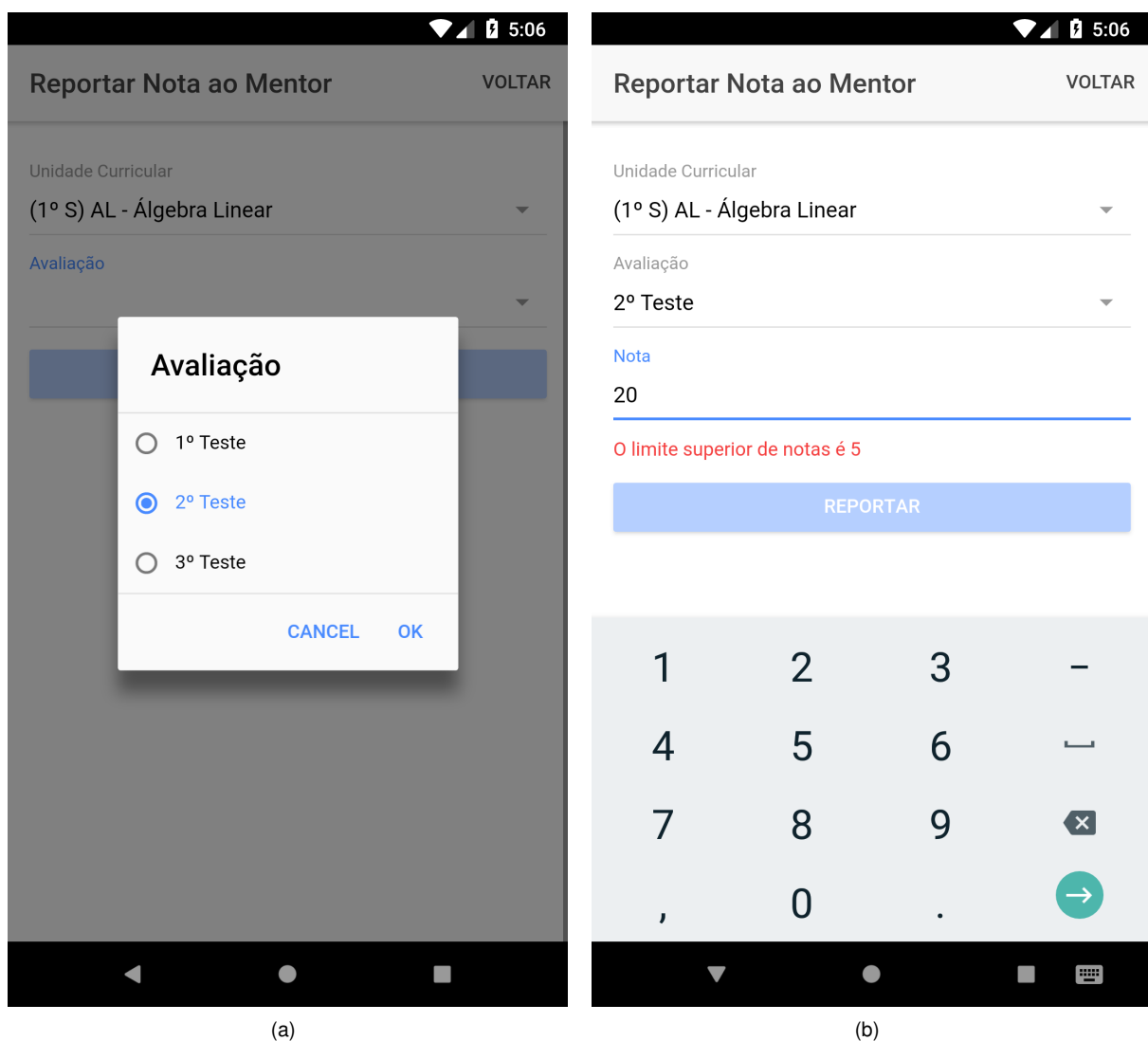


Figure 2.4: (a) Selection of mentee evaluation method and reporting grade (b).

AE's coordinator shall schedule in the system when these assessments occur and the mentees reported marks after they are available can be graphically visualized in the NAPP v1.0 Dashboard.

2.3 Existing Mentoring Softwares

2.3.1 Xinspire

Xinspire² was created by Xuan Wu who has developed a mentoring software behind Stanford Alumni Mentoring Program from 2008 to 2013. Near of the end of grad school, Xuan founded Xinspire to bring the benefits to other universities.

This software platform has been implemented in universities such as University of Pittsburgh, Griffith University and Northwestern University.

Xinspire is flexible and scalable. Universities have dozen of mentoring programmes running across different departments, each with their own goals. Bring it all together under one platform with our institutional brand, without sacrificing each programme's uniqueness.

Xinspire is a Web application and the main features, for mentors and mentees, included on this software platform are:

- Artificial Intelligence (AI) suggestions based on similar interests of mentees and mentors;
- Forum based communities where mentees and mentors can interact and search for specific topics;
- Milestones created by mentors to help meentees to reach their goals;
- Mentors and mentees have collaboration tools, these means that they can schedule meetings and share documents through the platform.

Coordinator can choose between three matching models for mentoring:

- Semi-Automated Matching has algorithms that present one-to-one or group matching to the coordinator which facilitates matches between mentors and mentees;
- Ranked matching where mentees apply to mentors, and then mentors review and rank their applications;
- Search & Request, mentees search for and request mentors where is not involved any algorithm for matching.

Coordinator can gain insight over programmes by creating surveys and view results.

2.3.2 Chronus

Chronus³ was founded in 2007. It is a software platform targeted to the business world or for the universities.

Four types of academic mentoring programmes are offered by Chronus namely, Peer Mentoring, Career Mentoring, Alumni Mentoring and Flash Mentoring.

²<https://xinspire.com>

³<https://chronus.com>

Chronus has been implemented in some universities such as RMIT University, University of Washington, Clemson University and University of Colorado Boulder.

This mentoring software main features are:

- Finding the perfect match between mentees and mentors is a task that is not easy to achieve because students will bring various competencies, backgrounds, learning styles and needs. Chronus for finding ideal matches uses; MatchIQ® technology that uses critical information provided by the students such as specific topical interests;
- Some Mentoring relationships will take off and thrive but some may not. One best practice is to ensure all mentorships have goals and action plans. Chronus allows administrators to create goals, workflow plans, tasks, provide help resources and establish checkpoints;
- At the end of the programme, mentors and mentees can answer to a survey which helps to get some feedback about the programme's success.

2.3.3 Tyfy

Tyfy (Third Year, First Year)⁴ was founded in 2017 as a response to the growing need to connect students together all via their own smartphones.

Tyfy have been implemented in Nottingham University Business School.

As in the case of MP-TP's programme, mentors can not be in their first university year. Mentors are previously selected, by the coordinator programme, to use Tyfy tools and mentees have to register in Tyfy.

Mentees can engage in the programme through a mobile application and to be allowed to use Tyfy tools they have to register and select the modules that they are studying or need help. After that, are matched mentors with the same studied modules where mentees have access to ask questions. These questions can be posted on a forum or by chat to the selected mentor. To assure the quality help given to the mentee, after each question, the mentee can tick the question as solved and give written feedback about mentor's advise. Also, rate in a scale of one to five if the response was fast, helpful and the knowledge demonstrated by the mentor. With that, mentors are allowed to demonstrate their characteristics to an employer through numbers. Yet, any conversation can be reported and the programme's coordinator will be able to review the issue and act accordingly.

This mentoring software offers some monitoring and management features to be used by programme coordinator such as:

- Visualize reported issues when mentees ask questions to mentors;
- Have access to create and delete forum topics where students can ask their questions;
- Feedback that mentees gave to mentors;
- Inform students of events happening at the university.

⁴<https://tyfy.co/>

Furthermore, for every interaction they have with Tyfy they get points that can then be redeemed for vouchers to help local economy or university events.

A last feature is also available which is to sell text books that have already been used.

2.4 Discussion

One of three the software solutions presented in the previous subsection has a more direct focus on mobile aspects. For this reason, this discussion will focus more on the comparison between Tyfy 2.3.3 and the work done in NAPP v2.0.

The focus of the Tyfy application is quite different from the focus of NAPP v2.0. The core of Tyfy is to ensure that freshmen students, who are enrolled in the application, are able to clear questions, as soon as possible, with students who have already had these courses in previous years. With this, students see their questions clarified but much maintenance and moderation is required because without moderation there will be a problem of validation. Also, STEM (Science, Technology, Engineering, Mathematics) approach and the office hours provided by teachers are always strongly advised to be attended within MP-TP context. The main objective, with NAPP v2.0, is for mentors to feel engaged and to be able to motivate their mentees to achieve better school results.

Mentors at NAPP aim to accompany and integrate their mentees throughout the school year, being responsible for a group of mentors who are assigned before the first semester begins. For better follow-up and to be able to help their mentees, mentors can access the assessments results that their mentees had (when they send the respective marks) giving quick feedback about it. At Tyfy, as the answer to a question posed by mentees is the most important, the feedback is given in reverse, that is, the mentee evaluates the mentor if the mentor was able to help with the question under consideration. One of the objectives of the MP-TP is to integrate students in the academic environment and that they can make the transition smoothly. The feedback in NAPP v2.0 aims to make the mentees feel that their mentors keep up with them and that they motivate them in some way.

NAPP v2.0 has taken the idea from Tyfy of events creation. This feature can have a very strong impact on new students because many of them want to participate in other activities created by the university to feel that they are integrating and that they are absorbing more knowledge through other sources and not just through lectures. Thus, students have one more tool where this kind of information is available since Taguspark *campus* is a small one and information is scattered in many formats from flyers and posters, that are distributed in every amphitheater, to digital platforms like Facebook ⁵ or Instagram ⁶.

Tyfy offers two more interesting features: selling used books and discount vouchers. Starting with the sale of used books, this feature is interesting for courses that are quite dependent on books to be able to complement the material that is given in theoretical classes. In the case of IST Taguspark courses, teachers always recommend an additional bibliography but the necessary knowledge to obtain in the

⁵<https://facebook.com>

⁶<https://instagram.com>

course is always given by the teachers, either with parts taken from the books that were recommended or by slides produced by the teachers. The NAPP v2.0 also has no focus on expanding and implementing such features yet, since the improvement of MP-TP comes first. Discount vouchers can be an interesting feature to make NAPP alive. The way it works in Tyfy is by gamification. Mentees using NAPP could earn points. When they reach a certain amount, it could be possible to change for discount vouchers where they can be used in some IST services or restaurants. The gamification of an application must also be well thought out because it is necessary that, in some way, keep students using the application but that they do not use it only with no end behind it, other than to obtain points to obtain discounts. To implement something like this in this phase of the NAPP would be to distort the purpose of this thesis.

2.5 Analysis of NAPP v1.0 Technologies

There are 3 major groups where a mobile application can be developed:

- Mobile Web Applications - Mobile Web Applications have a simple objective which is to reach the largest audience possible because mobile web applications are platform independent which means that any smartphone or tablet with a web browser installed can run a mobile web application. Mobile Web applications can access a limited amount of device's native features and it may be more time spending to produce a mobile web application with quality because there is a greater variety of web browsers than mobile operating systems.
- Cross-Platform Applications - Cross-platform applications are those that are developed through a "shared operating environment", such as Ionic Framework⁷. The great advantage of Cross-Platform development is that it is more time efficient since the mobile application only needs to be produced once.
- Native applications - Native applications are those that are developed through their native operating environment as Swift/Objective-C for iOS or Java for Android. This approach results in investing more time to develop an application for each environment. Native applications are able to take advantage of the capabilities of a smartphone, since it has access to all the features it contains.

NAPP v1.0 was built using Ionic Framework, which is a framework that provides tools to develop Cross-Platform Applications using Web technologies like CSS, HTML5 and JavaScript.

Comparing with the development of native mobile applications, the big advantage here is that the developer requires a lower development time.

Despite of a single codebase for all platforms, the application has to be distributed through native Application Stores, such as iOS App Store and Google Play.

The NAPP v1.0 framework architecture (see Fig. 2.5) is described below.

The server-side was using Apache CouchDB⁸ database. CouchDB is an open-source, document-oriented NoSQL database. CouchDB database, which was running, on the server stores all the data

⁷<https://ionicframework.com>

⁸<https://couchdb.apache.org/>

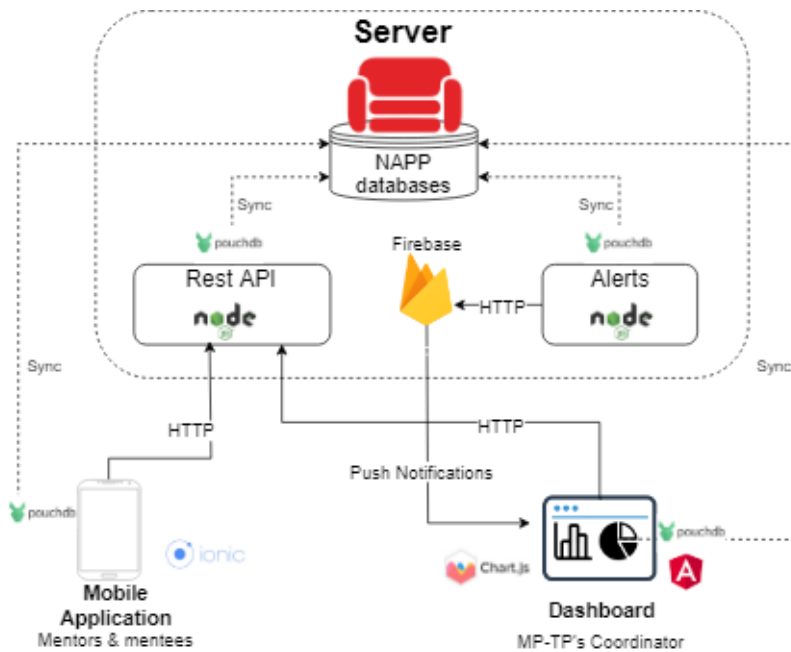


Figure 2.5: NAPP v1.0 framework architecture

related with the NAPP v1.0 framework (Dashboard and Mobile Application). PouchDB⁹ was used to managed the local data storage on the Dashboard and the mobile application. PouchDB is an open-source JavaScript database. PouchDB, as CouchDB, is a document-oriented NoSQL database. It was created to help developers build applications that work as well offline as they do online. PouchDB stores data on the device, and then syncs those data to the server-side CouchDB database when an Internet connection is available. For this automatic and reliable sync, Couch Replication Protocol is used. Used technologies in the NAPP v1.0 framework are not the most appropriate and have some issues that are going to be explained in Section 3.1.

⁹<https://pouchdb.com>

Chapter 3

Implementation

3.1 Approach

The first objective of this thesis, after analyzing NAPP v1.0 mobile application technologies in Section 2.5, was to make a new design for the mobile application that was more appealing, with better performance and user-friendly so that the application becomes more pleasant and generates more engagement among mentors and mentees.

Ionic Framework uses web technology to deliver a native-like experience. This web technologies are wrapped by Apache Cordova¹ which is an open source framework that takes the application and renders it in a WebView². WebView's time render scale according to the number of graphics components in that same container, thus causing a potential performance degradation [11]. Another downside is the absence of Hot-Reloading³. For the developer, whenever changes are made, the whole app has to be refreshed, causing a slower development process.

To improve pointed Ionic Framework issues, React Native is the solution. React Native is an open-source mobile application framework created by Facebook. The big advantage, unlike the Ionic Framework, is that it has a Javascript thread that interprets the JS written code (React-Like) and publishes events to the Main Thread which refreshes the UI and calls native code thus increasing performance. Other advantages it offers are Hot Reloading and React-Native developer community is larger than Ionic Framework. Yet, comparing React Native with Native App Development for Android and iOS, the effects on performance are not relevant [11].

Using PouchDB integrated with CouchDB, as database technologies, instead of being a REST API developed specifically for NAPP v1.0, users of the mobile application (mentees and mentors) must have access to the remote database password. What happens, at this moment, is that users after being authenticated receive the password from the NAPP v1.0 database so that they can have access to it. Accessing this password is not a good practice as a malicious user may have access to the database and thus have access to all data from the NAPP database. Hereupon, using CouchDB as a database

¹<https://apache.cordova.org/>

²WebView is an application component that is used to display web content within a native application

³Hot reloading allows the developer to apply changes without reloading the whole app

running on the server loses the viability of choosing it as a server database because it was chosen by the synchronization functionality between the different local databases.

MongoDB is an open source cross-platform database software that is written in C ++. It has a document-oriented NoSQL database which focuses on scalability, performance and consistency. This choice also comes to solve two important issues. The first issue is that the library developed for Node is quite simple and practical to make queries. The second issue is to correct a serious flaw that CouchDB does not offer, which are transactions. Transactions in databases allow correct recovery from failures and keep the database consistent in cases of system failure.

In Figure 3.1 it is possible to see a schematic of the system architecture. Users that use most features, will make calls to the REST API. If one of the four actions (Tasks, Events, Marks, Feedback) is performed, the Firebase Cloud Messaging service is called, thus sending notifications to the respective users. Users also have the option to use the mobile application in offline mode. Requests that are made in the application while the user has no network, are sent to a queue and are sent when the user reaches a stable network again. In the following sections, such as libraries, features, database and the most important REST API endpoints for the realization of this project are explained in more detail.

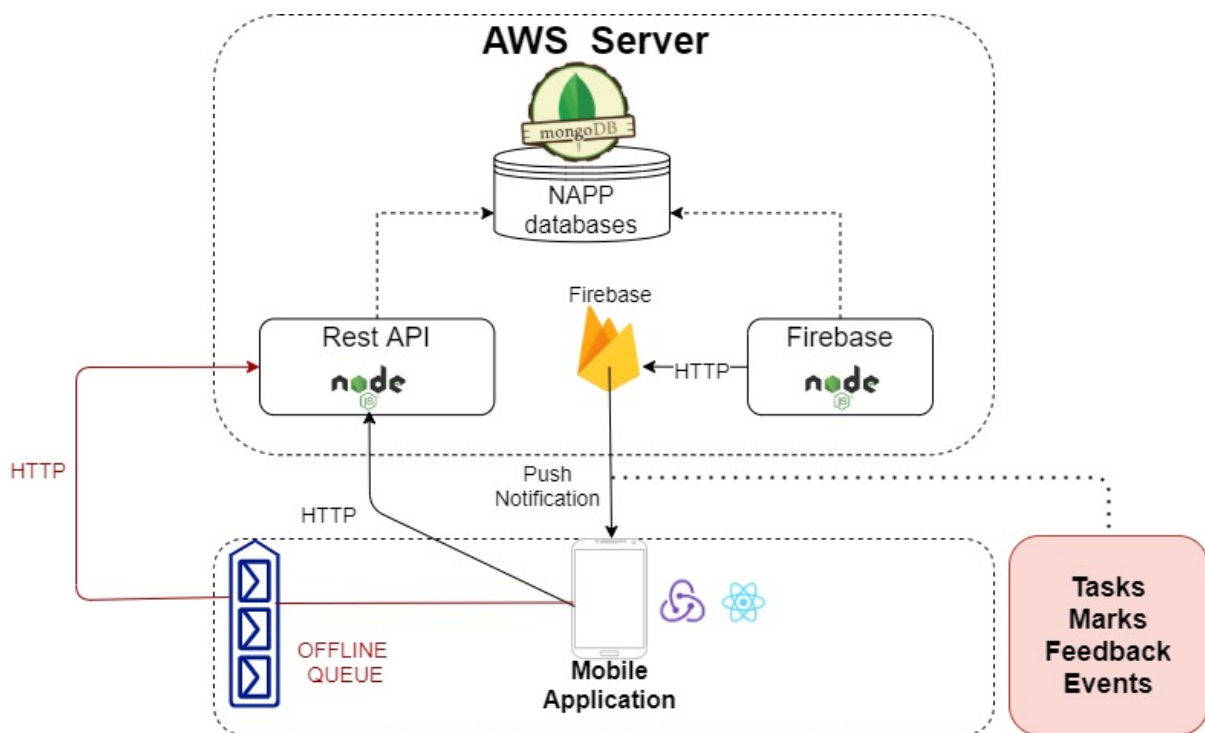


Figure 3.1: NAPP v2.0 architecture

3.2 React Native and NAPP v2.0 core libraries

The following sections are dedicated to explain some of the libraries that were important to develop APP mobile application, but some fundamentals of React Native have to be explained before.

React Native runs on React⁴ which is an open source library for building user interfaces with JavaScript and it has three fundamental concepts:

- Components - A component is an element in react-native where it can be divided in many other small components making the code clean and easy to understand. Comparing with a website, a component is a single web-page of a website where that can have other components to build that single page.
- Properties - Properties lets customize how React components render. With that, each component can be customized with their own properties
- State - State acts as a component data storage. It is used to handle data that changes over time or that come from some user interactions. This data is not easily shared with other components, leading to use some libraries to manage that data.

NAPP v2.0 mobile application needs to share data among the components since many of the data needs to be easy and fast accessed in many different components. Hereupon, some useful libraries were used for this purpose. Some of the most important ones will be described in the following subsections.

3.2.1 Redux, Redux-Thunk and Redux-Persist

As mentioned earlier, each component as its own state where it is particularly difficult to share among all other components of the mobile application. To solve this problem, Redux was created.

Redux⁵ is a predictable state container for JavaScript apps and to be understood there are also three concepts that it uses:

- Actions - Actions are JavaScript objects where they must have a type property, defined by the developer, that indicates which action will be performed. These actions are dispatched synchronously, resulting in fast UI changes.
- Reducers - Reducers are functions that will change application's state based on an action that receives.
- Store - Only one store is allowed by any Redux application. This store holds the application state.

It means that the state of the an application is kept in a single store, where each component can access any state that it needs from this store. Also, with this centralization of all application data, it becomes easier to check what data the application contains. A flow chart can be visualized on Figure 3.2 to easily understand how React works with Redux.

In most of the interactions that mentors and mentees perform, NAPP v2.0 make API calls resulting in asynchronous calls in the mobile application. With this, it can be verified that the use of only Redux is not possible, since the actions are dispatched synchronously. To overcome this problem, Redux-Thunk was used.

⁴<https://reactjs.org>

⁵<https://redux.js.org/>

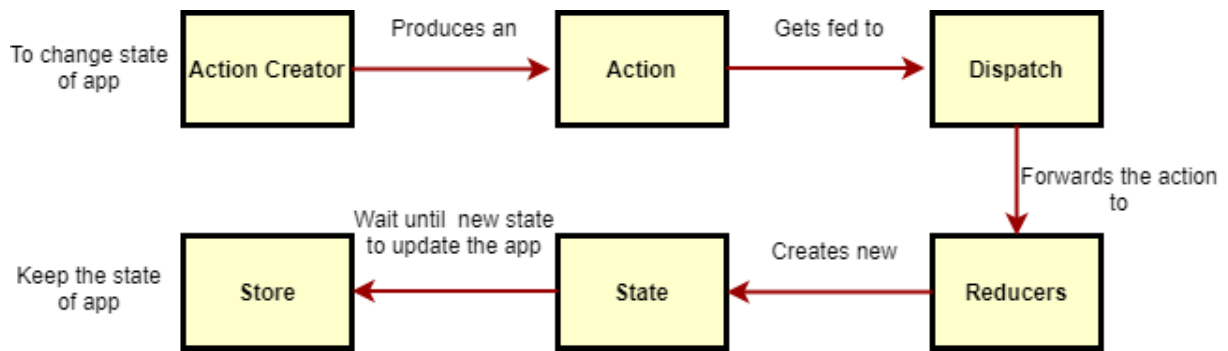


Figure 3.2: React with Redux flow

Redux-Thunk is a library that allows returning a function asynchronously instead actions. Thus, when this action is intercepted before reaching the reducer, it is up to the developer to act according.

All the changes that are made in NAPP v2.0 are kept in memory, meaning when mentors and mentees leave the application for a while, all the Redux Store has a reset to its default state. With this, the user has to perform the login again and fetch all the data again. In mobile applications, local storage is most of the times used to prevent unnecessary data fetches to the server. Also, mobile applications network is very fragile reinforcing to use a local storage. React-Native offers AsyncStorage⁶ which is an unencrypted, asynchronous, persistent, key-value storage system that is global to the mobile application. To persist Redux Store, even when the user closes the app, Redux-Persist library was created.

Redux-Persist always keeps the Redux store, when it undergoes changes, making AsyncStorage always up to date with the latest data. This library allows you to save and access data in a faster way as it offers an abstraction layer where the developer does not have to worry about saving, removing or updating specific AsyncStorage data.

3.2.2 React-Native-Offline

Some mentors and mentees may want to use NAPP v2.0 mobile application in offline mode or they may encounter internet connectivity problems. For this reason, React-Native-Offline⁷ was used.

This library, in the first instance, allows the detection of whether users have a internet connection, thus showing the data that is stored in AsyncStorage mobile phone.

In second instance, when users are not connected to the internet, it allows that all made requests when the user does not have access to the network, these will be pushed to a queue. This queue requests are dispatched when internet connectivity exists.

The combination of this library with those mentioned in Section 3.2.1 allows to solve the issues that existed in the CouchDB and PouchDB database technologies.

⁶<https://reactnative.dev/docs/asyncstorage>

⁷<https://github.com/rgommezz/react-native-offline>

3.3 NAPP v2.0 design

The design of the NAPP v2.0 mobile application was thought to become intuitive and that the user could use its features as easily as possible. In Figure 3.3 it is possible to view the home page with several sections, which are explained below:

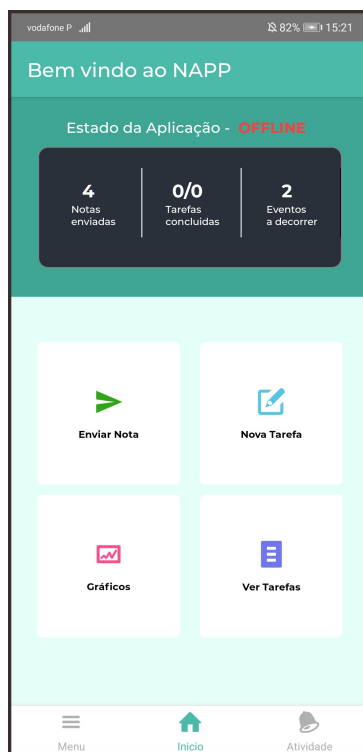


Figure 3.3: Home screen of NAPP v2.0

- Each screen of NAPP v2.0 mobile application, it has at the top the information of which page is displaying to the user, indicating where the user is.
- In the home screen, it has the "Estado da Aplicação" (State of Application) where it informs the user if he is connected to the internet (ONLINE) or not (OFFLINE). Also, it has a section with three respective areas that indicate the status of the application, that is, what is missing or not yet done. In the case of the mentees, on the left side they will have the total number of evaluations that have been submitted, in the central section they will have the number of tasks to be completed/tasks completed and in the section on the right side it will contain the total number of events taking place. In mentors, the only variation is in the first section where it contains number of feedbacks to be made/number of feedbacks made.

The functionality of "Estado da aplicação" (State of Application) is to be able to inform the user, in a quick way, with a few clicks, of what can be accomplished by the user. Under "Estado da aplicação" (State of application), the Home screen contains four quick actions for mentors and mentees. Both share three of four quick actions which are "Nova Tarefa" (New Task), "Gráficos" (Graphs) and "Ver Tarefas" (Show tasks). The top left corner action, is the one which varies between them. Mentees can perform "Enviar

Nota” (Send Mark) and mentors can visualize all the feedbacks that they have to do. Also, NAPP v2.0 mobile application has a bottom menu that contains three sub menus within it:

- Menu - It contains all the features that the user can use in the mobile application, being able to scale as the application contains more features.
- Início (Home) - Home screen menu that contains an information box with the current status of the application, informs the user whether it is in online or offline mode and contains four features for quick access.
- Atividade (Activity) - In this menu the user can view, per item, information related to each activity that happened in the application. Which are, information about events, tasks or feedback. Given the possibility of containing a lot of information in this menu, it is also possible to filter the different data with different types of filters.

3.4 Data models

3.4.1 Users database

The users’ database has as main objective to store a document for each NAPP v2.0 user where it contains data about them. In Table 3.1 is shown the data that is stored in each document, following a brief description of each one.

Key	Value Type	Description	Observation
_id	string	The user’s unique identifier	Field generated by MongoDB
istID	string	The user’s unique istID used for login	-
roles	Object	Object containing information about user role	As defined in Listing 3.1
grades?	Array	Array containing reported grades of a mentee	As defined in Listing 3.2
degree	string	The user enrolled degree	Possible values: "LEE", "LETI", "LEGI", "LEIC"
name	string	The user’s name	-
password	string	The user’s password to login in NAPP v2.0	-

Table 3.1: Fields of a document in Users database

```

1  roles:{
2      roles: string, //"mentor" or "mentee"
3      mentees?: Array[], //if roles:"mentor" then Array of istID of mentor mentees
4      mentor?: string, //if roles:"mentee" then istID of mentor
5  }
```

Listing 3.1: The structure of each user roles field in the users database

```

1  grades:[
2      {
3          _id: string,
4          courseName: string,
5          evaluationName: string,
6          grade: number,
7          time: string,
8          comment: string,
9          status: string,
10     }
11 ]

```

Listing 3.2: The structure of a mentee `grades` field in the users database

3.4.2 Tasks database

The Tasks database aims to store all tasks that are assigned from the mentors to their mentees or the mentees creating the tasks for themselves. Table 3.2 contains the fields for each document in the Tasks database with a brief description. In addition, a more explicit explanation of the `status` and `type` fields:

- In the `status` field, the default value is "pending". The value changes to "completed" when a task is marked as completed by the corresponding mentee or by a selftask created by the mentee.
- In the `type` field, it is necessary to identify whether it was a mentor or mentor creating a task because the mentors should not have access to the tasks that the mentees created for themselves.

Key	Value Type	Description	Observation
<code>_id</code>	string	The tasks's unique identifier	Field generated by MongoDB
<code>author</code>	string	<code>_id</code> of the user who created the task	-
<code>target</code>	string	<code>_id</code> of the user for whom task was assigned	-
<code>description</code>	string	Task Description	-
<code>dataCreated</code>	string	Date in which task was created	-
<code>status</code>	string	Task status	Possible values: "pending" or "completed"
<code>type</code>	string	Task type	Possible values: "mentor" or "mentee"

Table 3.2: Fields of a document in Tasks database

3.4.3 Logs database

Logs database keeps a record of some actions that NAPP v2.0 users perform while using NAPP V2.0 mobile application features. Each document in the database stores information about a specific action performed by a mentor or mentee. Logs database was mainly created to analyze when mentors and mentees use NAPP v2.0 mobile application features.

A document in the Logs database has the fields shown in Table 3.3. From the features provided by NAPP v2.0 mobile application, five relevant actions are recorded, which are represented by the following values of the actionID field.

Key	Value Type	Description	Observation
_id	string	The log's unique identifier	Field generated by MongoDB
actionID	string	An identifier for each different user action	Possible values: "NEW_TASK", "COMPLETE_TASK", "FEEDBACK", "NEW_GRADE", "NEW_EVENT"
timestamp	string	Time in which log was created	-
user	string	_id of the user who generated the log	-
detail	string	_id of the action performed by the user. Value varies based on actionID	_id can be about a task or a reported grade

Table 3.3: Fields of a document in Logs database

3.4.4 Events database

The Events database aims to keep each document with the information given about an event. All documents that this database contains are made available to users when they enter the application. Table 3.4 is shown the data that is stored in each document.

Key	Value Type	Description	Observation
_id	string	The event's unique identifier	Field generated by MongoDB
beginEvent	string	Date that an event begins	-
endEvent	string	Date that an event ends	-
description	string	Event description	-
contact	string	Contact to users get more information about that specific event	-

Table 3.4: Fields of a document in Events database

3.4.5 Devices database

The devices table (see Table 3.5) was created with the intention of registering the Firebase Tokens that are assigned to users, after they log in to the application for the first time. The registration of Firebase Tokens is necessary because the server has to search for the token that identifies the cell phone of user and has to send the respective notification. The active field has the function that when a user logs in, this value has the value "true" indicating that he will receive notifications. If the user logs out, the value changes to "false" and does not receive notifications. The user can have the NAPP v2.0 mobile application installed on multiple devices, so a user can contain multiple firebase tokens, making it possible to receive notification on multiple devices simultaneously.

Key	Value Type	Description	Observation
_id	string	_id of the user device firebase token	Field generated by MongoDB
user	string	istID of the user	-
fcmToken	string	Firebase Token that user received in his own device	-
active	boolean	If user is logged in or not	User receives notifications if <code>boolean:true</code> . If <code>boolean:false</code> means that user logged out
createdAt	string	Date that user logged in for the first time with that Firebase Token	-

Table 3.5: Fields of a document in Devices database

3.5 NAPP v2.0 mobile application

For mentors and mentees to register, they must provide their `istID` which must be inserted in the Users database 3.1 previously. This is to prevent users who are not part of the MP-TP from being able to register and access the features of the mobile application. In Figure 3.4 can be seen the registration fields that have to be filled to enroll in NAPP v2.0. Users must then insert their `istID`, their first and last name, select one of the predefined courses in the application and a password to be able to log in to the mobile application. All fields are checked if they are not null and the `istID` field is checked if it follows the rules of a `istID`. After this step, only mentors can log into the application.

For mentors to login to the application, mentors must first log in to the application and add their mentees to their `istID` in the "Adicionar mentorandos" (Add mentees) menu. To add them just insert your `istID`, click on the "+" and do "Adicionar mentorandos" (Add mentees) (see Fig 3.5). After this step, the mentees can then register and login.

Another feature that the NAPP v2.0 mobile application contains is being notified about events that are occurring at IST. For this, the AE coordinator has to provide data for the fields contained in the Events database 3.4 which will then be added to the database, thus notifying all users who are enrolled in the mobile application. Users receive a notification, as Figure 3.6 states, that a new event is taking place and they can access more information in the "Atividade" (Activity) menu by clicking on the "Ver mais" (Show more) button. By clicking the button contains various information, including a contact for them to ask for more information about it.

Users have all the information about the different functionalities (tasks, feedback and events) all in the "Atividade" (Activity) menu, which can make it difficult to find something specific. For this, filters were created so that you can filter the "Atividade" (Activity) panel. The filters, can be seen on Figure 3.7 that can be applied are those that can be filters are per enrolled user, complete tasks or not, feedbacks, among others. When the user applies filters, they will last till the user unselect the filters that were previously selected.

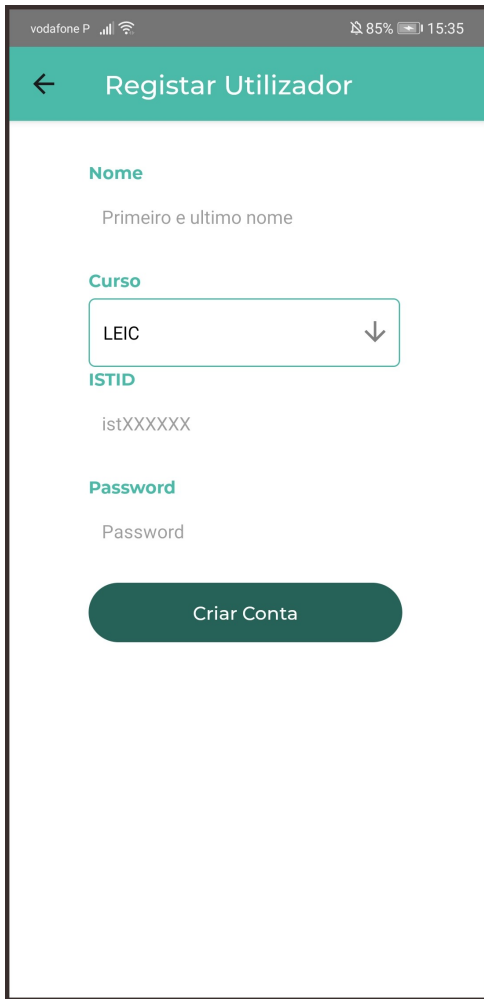


Figure 3.4: User register screen

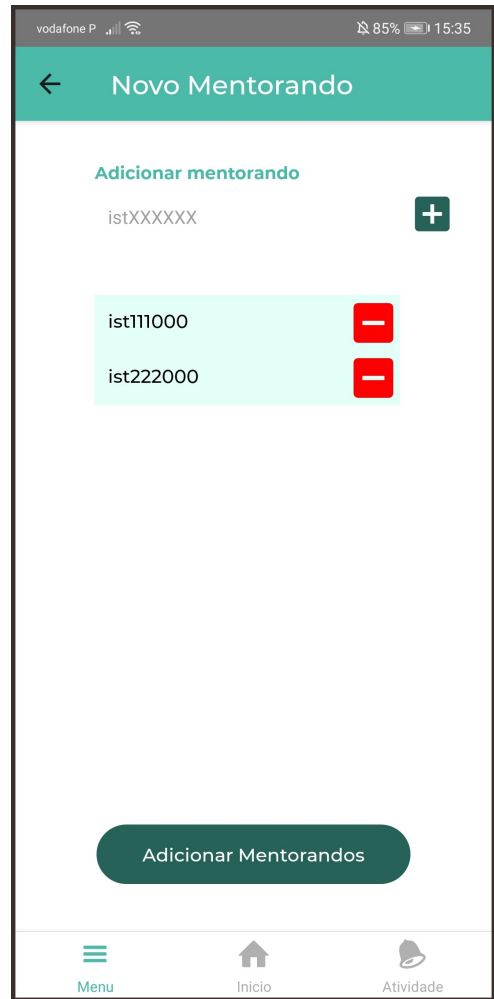


Figure 3.5: Add mentees screen

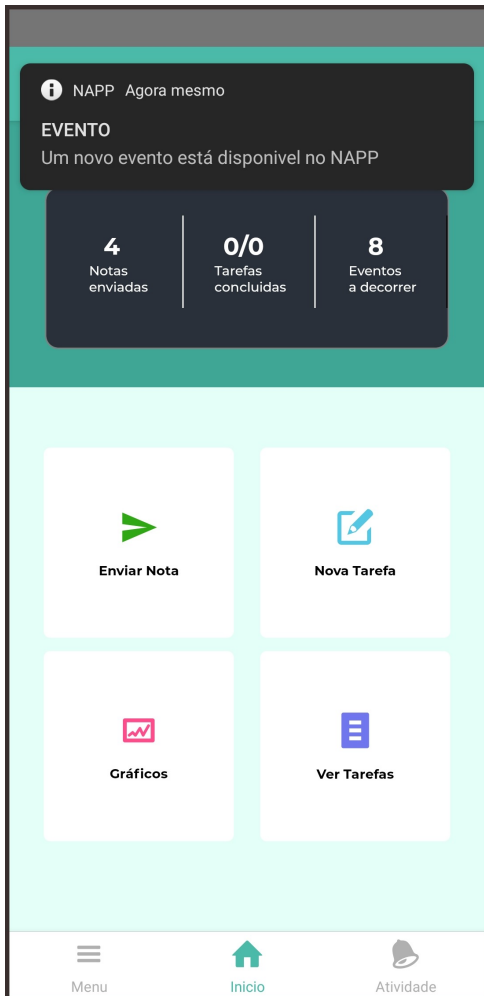


Figure 3.6: Example of a push notification with an event

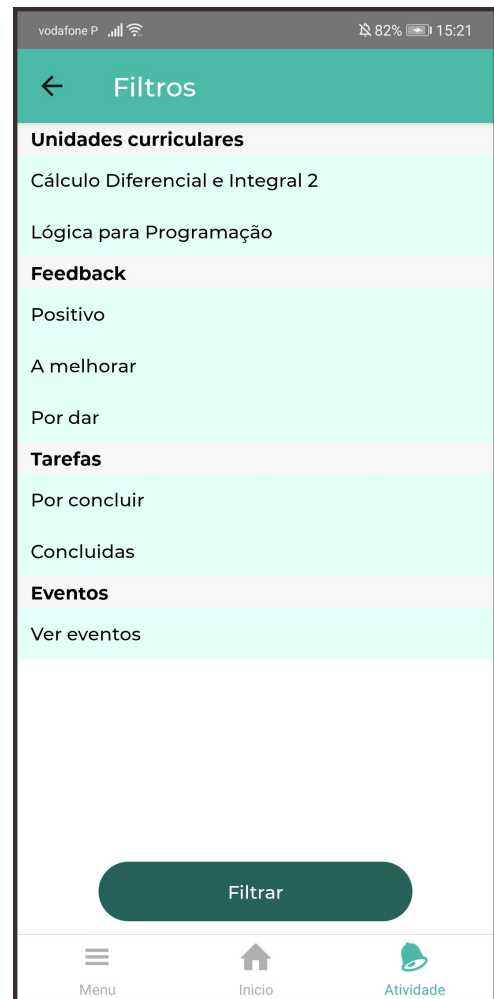


Figure 3.7: Filter that can be applied on activity center

3.5.1 Tasks feature

Tasks feature was created with a focus on mentees, since they are in a new environment where their study method has to be more rigorous. This feature helps mentees organize their study. Also, this feature allows mentors to be able to help mentees by creating tasks for them. In Figure 3.8 and Figure 3.9 examples of tasks which can be created by the mentors or by mentees themselves can be seen.

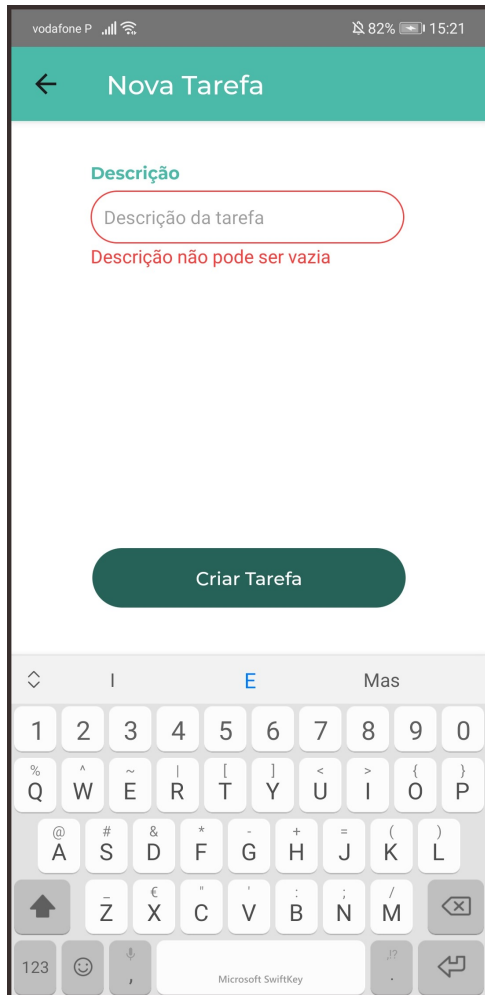


Figure 3.8: Task creation by mentee

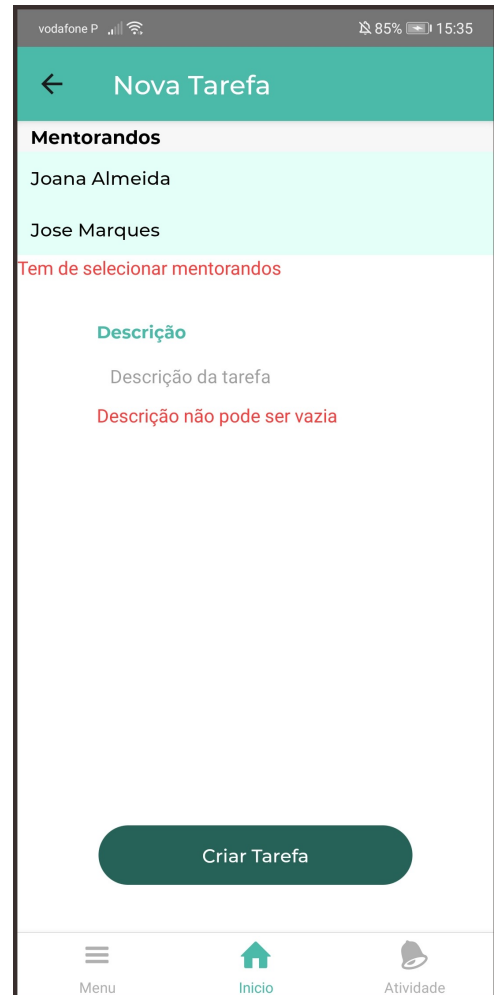


Figure 3.9: Task creation by mentor

The only rule to create a task is that it can not have an empty description field, otherwise an error will appear asking the mentor or mentee to fulfill the empty space. In addition, the mentor will have to select the mentees who will receive the task that has been described. To create the task, users have to click on the "Criar tarefa" (Create task) button. Each task can be viewed in the "Atividade" (Activity) menu. By clicking on the "Ver mais" (Show more) button, four more information are available:

- Data (Date) - Describes when this task was created, allowing to check if it is a recent or old task.
- Aluno ISTID (Alumni ID) - Describes the istID of the task creator, allowing users to check if the mentee created the task or the corresponding mentor.
- Tipo (Type) - It has the default value "Por concluir". If it is completed, the value will be "Concluidas".

- Descrição (Description) - Describes information about the task to be performed.

Still in the "Ver mais" (Show more) menu of the respective task, the user can close the window by clicking on "Fechar" (Close) button or can complete the task by clicking on "Concluir" (Finish) button, if it is still "Por concluir" (Unfinished) state (see Fig 3.10). Finally, when the user completes a task, the "Menu de Estado" (State menu) changes the total number of tasks that have been completed.



Figure 3.10: Detailed information of a task

3.5.2 Notifications feature

Of all the implemented features, the Notifications feature is the most important of all because it aims to alert mentors and mentees of status updates that happen in the entire NAPP v2.0 mobile application. With this, it was thought that notifications should be received by users reaching the conclusion that they should receive notifications from four different actions:

- Novo evento (New Event) - Users receive a notification whenever a new event is added to the Events Database. 3.4.

- Nova tarefa (New Task) - When the mentor creates tasks for their mentees, they receive a notification to alert them that a new task has been assigned by their mentor.
- Feedback - The mentor always receives a notification when one of his/her mentees sends a new mark, with the aim of the mentor to provide feedback regarding this mark as soon as possible.
- Feedback realizado (Accomplished Feedback) - The mentee receives notification when one of their grades received feedback from their mentor.

Also, when a task is completed by the mentee, the status update of that task is sent by notification to the respective mentor but without a message. This decision was made because the mentees can have several tasks and can complete all of them quickly, thus preventing their mentor from receiving multiple notifications of the various tasks completed, which would be quite elusive. In this case, all notifications have the object `data` from Listing 3.4 with data to be sent to the respective user, thus updating the status of the application whenever any type of event happens. In the case of completed tasks (see Listing 3.3), the `notification` object is empty, showing no push notification to the user for the reasons mentioned above. To send any type of notification, one of the events mentioned must happen. When making this call to the API, a search will be made for the tokens that are stored in the Devices Table 3.5 with the value `active true`.

```

1   body:{
2     data:{
3       dataObject ,
4       type:"COMPLETE_TASK"
5     },
6   }

```

Listing 3.3: The structure of a notification when task is completed

```

1   body:{
2     data:{
3       dataObject ,
4       type:string //This field is mandatory to identify which type of notification
                    it was on client application
5     },
6     notification:{
7       title:string ,
8       body:string ,
9     }
10  }

```

Listing 3.4: The structure of a notification

3.5.3 Graphs feature

The graphs feature is available for both mentors and mentees. The creation of this feature comes with the need of the mentees to understand more clearly how their progress has been developing throughout the semester, in a given curricular unit. When viewing a graph it becomes much clearer and more noticeable how the evolution has been throughout the semester.

To create these graphs, the library react-native-chart-kit⁸ was used, which has several types of possible graphs to represent. To reach the previous stated objective Bezier Line Charts were used.

For users to access this feature, they have to click on the "Gráficos" (Graphs) button available in the "Home" menu or by clicking on the "Menu" menu in the "Visualizar Informação" (Visualize Information) section. The mentees, when clicking, a page will show to select the "Unidade Curricular" (Curricular Unit) that they want to visualize the respective graph. Mentors to view the graphs of the different curricular units, first have to select which mentee they want to check the evaluations and then the respective curricular unit. In Figure 3.11 can be seen the progression through the semester of a mentee in a specific course unit. If there are no reported evaluations, the page does not have any graph warning the user with a message "Sem informação a ser disponibilizada" (No information to show).

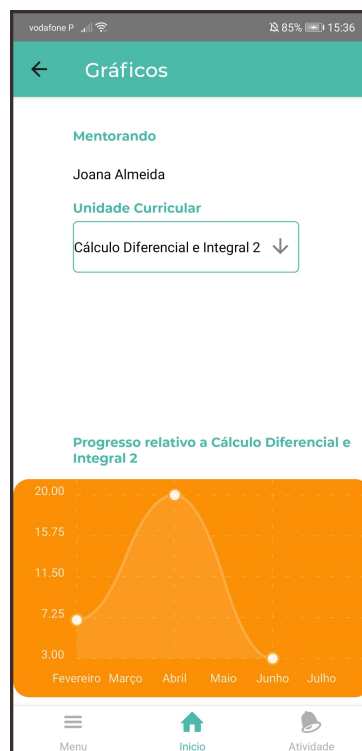


Figure 3.11: Graph showing Cálculo Diferencial e Integral 2 (Differential and integral calculus 2) marks of a mentee

⁸<https://www.npmjs.com/package/react-native-chart-kit>

3.5.4 Report grade feature

This feature allows mentees to report their evaluations to their respective mentor to be able to follow the academic path of their mentees. With this, the mentors are able to be aware of a faster and instantaneous way of the course they are doing throughout the school year. Thus, when mentors are able to verify the score of their mentees' assessments, they can act by helping their mentees to obtain better marks in the next assessments or understand, with the mentee, the reason for the classification obtained.

To use this feature, the mentee has to click on the "Enviar Nota" (Send Mark) button, available in the "Home" bottom menu or in the "Menu" bottom menu in the "Estudo" (Study) section. The fields that the mentee must fill in to submit an assessment are in Figure 3.12. Below is an explanation of each field:

- Unidade Curricular (Curricular Unit) - Contains the name of the Course Unit of the respective assessment.
- Avaliação (Type of Evaluation) - Set of previously defined evaluations that correspond to the evaluation to be submitted. Contains the "Outro" (Other) option where the mentee will have to indicate what type of assessment corresponds.
- Data de avaliação (Assessment date) - The mentee clicking on the date will open the calendar corresponding to the operating system of their smartphone, and must select when the assessment occurred. This field is important for a correct functioning of the Graphs Feature 3.5.3
- Nota (Mark) - On a scale of a number between [0,20], with a maximum of two decimal places, the student must insert the corresponding assessment grade.
- Outro (Other) - This field is dependent on the selection of "Avaliação" with the option "Outro". In this field, the mentee will have to indicate the type of assessment he intends to submit.
- Comentários (Commentaries) - In this field, the mentor can optionally make comments on the assessment mark in question.

The "Nota" (Mark) field must be a number between [0,20] and if it contains a period followed by a maximum of two decimal places. If this rule is not followed, an error appears to the user. The "Outros" (Others) field in the absence of text, an error appears to the user to notifying that the type of evaluation must be mention. To send the evaluation, the user must click on the "Enviar" (Send) button.



Figure 3.12: Screen of "Enviar Nota" (Send Mark)

3.5.5 Feedback feature

This feature was created for mentors, with the intention of being able to follow the progress of their mentees and to be able to give a quick feedback regarding the evaluations that they have throughout the school year. For mentors to provide feedback, mentees must report their assessment results as mentioned in the subsection 3.5.4. After receiving the grades, it will be visible in the "Atividade" (Activity) menu where it can be viewed some information about the assessment. To use this feature, the mentor has to click on the "Ver mais" (Show more) button of the respective assessment where four more information fields are available. These fields are described below:

- Unidade Curricular (Curricular Unit) - Contains the name of the Course Unit of the respective assessment.
- Aluno ISTID (Alumni ID) - It contains the istID of the mentee who sent the grade, allowing to verify the istID of the respective mentor.
- Tipo (Type) - It has the default value "Por dar" (To provide), letting the mentor and mentee know that this evaluation does not have any kind of feedback. If the mentor clicks on the "Positivo" (Positive) button, the feedback is from that evaluation will have the value "Positivo" or if the "A melhorar" (To improve) button is clicked, the value will be "A melhorar" (To improve) (see Fig 3.13).
- Descrição (Description) - Describes the information about the evaluation sent by the mentee, indicating the name of the mentee, grade and under what evaluation.

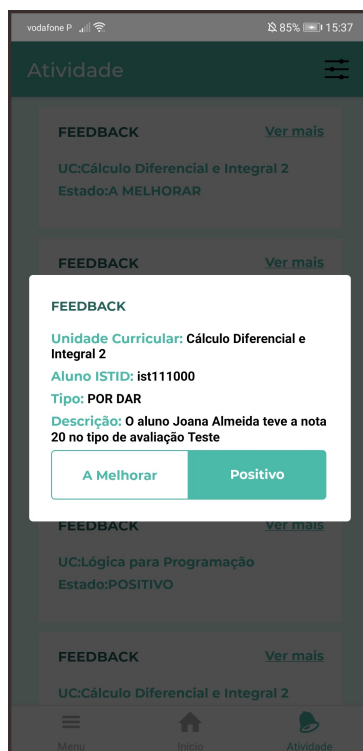


Figure 3.13: Information of a feedback

Also, in the "Tipo" (Type) values that the mentor can assign to a given evaluation, these were thought so that the mentee would not feel unmotivated when his mentor evaluate his assessment with a "Negativo" (Negative) value and could have a negative impact on the mentor's next evaluations. For this reason, the "A melhorar" (To improve) value was chosen to designate the role of an assessment that has been less positive or that can be improved from the mentor's perspective.

3.6 REST API

Most of the features that users can perform in the NAPP v2.0 mobile application, involve some type of request that has to be sent to the server. For this purpose, a REST API was created to allow different interactions between the Frontend and the Backend.

The REST API serves several purposes. The first is to allow users to register and have their identities validated when they enter the application, making it impossible for users who are not allowed to use the application to access it (registration and subsequent login). Then, it has the function of sending data to the database, writing or changing values in it, such as creating tasks (part of writing) and giving feedback to a mentoring grades (changing values in the database). Also, when users log into the application, they must be able to access the respective data so that the application can provide its functionality without problems. Therefore, its function is to be able to retrieve information from users.

All created endpoints are described in Table 3.6 with a brief description of each one.

Method	Endpoint Details	Used in
POST	<p>Path: napp/users/sendfeedback</p> <p>Body Parameters: TASKID, istID, status</p> <p>Description: Switches the default value, "POR DAR" (To provide), of that mentee grade to "POSITIVO" (Positive) or "A MELHORAR" (To improve) depending of what mentor selected.</p>	Activity Menu on a Task by mentor
POST	<p>Path: napp/users/newmentees</p> <p>Body Parameters: Array[istIDS]</p> <p>Description: When mentors add new mentees to their list.</p>	"Adicionar Mentorando" menu
POST	<p>Path: napp/users/register</p> <p>Body Parameters: istID, password, degree, nome</p> <p>Description: Register page for enrolled users.</p>	"Registrar" page
POST	<p>Path: napp/users/login</p> <p>Body Parameters: istID, password</p> <p>Description: Allows users to login. When they login, the server creates a JSON Web Token, which allows users to make API Requests for one hour. After that, the Web Token expires.</p>	Login Page
POST	<p>Path: napp/users/newmentees</p> <p>Body Parameters: Array[istIDS]</p> <p>Description: When mentors add new mentees to their list.</p>	"Adicionar Mentorando" (Add mentee) menu
POST	<p>Path: napp/users/grades/newmark</p> <p>Body Parameters: istID, courseName, evaluationName, grade, time, mentorID, comment, name</p> <p>Description: Allows mentees to report a mark.</p>	"Enviar Nota" (Send Mark) menu
POST	<p>Path: napp/users/grades/info</p> <p>Body Parameters: Array[istIDS]</p> <p>Description: Allows mentees and mentors to retrieve users Database data.</p>	"Enviar Nota" (Send Mark) menu
POST	<p>Path: napp/tasks/newtask</p> <p>Body Parameters: author, target, description, dataCreated, type</p> <p>Description: Allows mentors and mentees to create a new task.</p>	"Criar Tarefa" (Create Task) menu

Method	Endpoint Details	Used in
POST	<p>Path: napp/tasks/complete</p> <p>Body Parameters: task, type, author</p> <p>Description: Allows mentors and mentees to complete a task.</p>	"Atividade" (Activity) menu on a task
GET	<p>Path: napp/tasks</p> <p>Parameters: istID, type</p> <p>Description: Allows mentors and mentees to get their tasks from tasks database.</p>	On login, "Inicio" (Home) menu
POST	<p>Path: napp/events/newEvent</p> <p>Body Parameters: beginEvent, endEvent, description, contact</p> <p>Description: Allows creating a new event.</p>	By admin, making a request using a password
GET	<p>Path: napp/events/getEvents</p> <p>Parameters: –</p> <p>Description: Allows mentors and mentees to complete a task.</p>	"Atividade" (Activity) menu on a task
POST	<p>Path: napp/devices/registerToken</p> <p>Body Parameters: istID, FirebaseToken</p> <p>Description: After user performing login, their associated firebase token is saved on devices database.</p>	On login
POST	<p>Path: napp/devices/logout</p> <p>Body Parameters: –</p> <p>Description: Logout the user changing active parameter on Devices Database to false.</p>	on "Logout" in "Menu"

Table 3.6: Endpoints of REST API

Chapter 4

Evaluation

4.1 NAPP mobile application usability test

In order to be able to detect and correct flaws in its design, the NAPP v2.0 mobile application needed to undergo usability testing. The users were asked to perform a set of tasks using the application, where these tasks were representing realistic scenarios of usage. To perform the testing, mentors were contacted via email to participate in this usability test. This test occurred, on May 1st, via Zoom meeting, due to the pandemic situation, where all the students had to answer in private for each task they were performing because answers that could be send in public could influence the other testers to change his answer for a task. Each task was shared one by one, via share screen option in Zoom. After every user answered for that particular task, the next task would take place.

Four mentors participated in the usability tests during which they had to install the Android Package that was created and sent by email to them. Also, multiple equal test accounts have been created for mentors to be able to perform usability tests without any problems. The usability tests carried out were as follows:

1. **How many evaluations have missing feedback?** - Goal of verifying if the mentors used the "Estado da Aplicação" (State of application) on the Home page, analyzing how many feedbacks were missing.
2. **How many tasks do mentees have to finish?** - Goal of verifying that the mentors used the "Estado da Aplicação" on the Home page, analyzing how many tasks the mentees had to complete.
3. **How many evaluations of student Joana Almeida from the course Cálculo Diferencial e Integral 2 (Differential and Integral Calculus 2) have been sent so far?** - Goal of checking if the mentors went to the Activity page and used the filters "Joana Almeida", to find the student, and "Cálculo Diferencial e Integral 2" (Differential and Integral Calculus 2) to find the evaluations of this student in this course.
 - (a) **What is his mark in which has "Por Dar" (To provide) state?** - Goal of verifying that the mentors used the "Por Dar" (To provide) filter.

4. **How many tasks the student José Marques has to complete?** - Goal of verifying that the mentors used the "José Marques" filter, to find the student, and "Por Concluir" (Unfinished) to find the tasks with this type.
5. **Which is the contact to ask for more information about the event that takes place from 05/20 to 05/22?** - Goal of verifying that the mentors went to the Activity page and checked the information of all events.
6. **Visualizes the path of student Joana Almeida in the course Lógica de Programação (Logic for Programming). What is the value of her lowest mark.** - Goal of verifying that the mentors went to the charts and were able to analyze the mentor's evaluations.
7. **Create a task to Joana Almeida.** - Goal of verifying that the mentors could create tasks.
8. **Add a new mentee in form of (ist012X00)** - Goal of verifying that the mentors were able to add mentees.
9. **Which is the name of the mentee that sent the mark?** - Goal of verifying that the mentors received a notification and were still able to verify the information that was made available in it.

During tasks 1 and 2, only one user made a mistake in the answer, giving the total number of completed tasks instead of the ones that were missing, this because he did not understand, by the suggested text that they were the ones that were already given. Different users failed to answer, but the error was the same, due to the suggestive text.

In task 3, it was where there were more mistakes, only one did the task successfully. The other users either did not use filters, thus making it difficult to verify which student and course unit in question or did not apply the filters to just view the suggested student's assessments.

During task 4 all users performed the task successfully, except one because they did not use one of the filters, thus obtaining a wrong answer. All other tasks were performed without problems by the users.

After the set of tasks was concluded, users answered to a SUS[12] survey to get feedback on the usability of the system. The functioning of this questionnaire is based on ten questions where the scale for question is from 1 to 5 where 1 corresponds to "strongly disagree" and 5 "strongly agree". When answering these questions, a formula is applied, explained below, where the result will vary from 0 to 100:

- $X = \text{Sum of the points for all odd-numbered questions} - 5;$
- $Y = 25 - \text{Sum of the points for all even-numbered questions};$
- $\text{SUS Score} = (X + Y) \times 2.5$

The SUS survey score result was 90.1, indicating that there is a high satisfaction level from users using the NAPP v2.0 mobile application.

4.2 NAPP mobile application beta tests

Great value comes from beta testing, since such tests can provide more objectivity and additional insights on NAPP v2.0 mobile application. The obtained feedback aim to identify and fix important issues, and suggest user’s experience improvements.

Two main aspects of the new NAPP v2.0 mobile application had to be tested:

- Quality and Performance - To understand if NAPP v2.0 mobile application function flawlessly on various devices and environments.
- Usability - Verify that users are able to accomplish what they want in an intuitive way.

The API that was being used on localhost to test the application, had to be migrated to an Amazon AWS (Free Tier) server, where all the necessary components were installed to make it work, that is - MongoDB and Node.js. The beta tests were conducted only for Android because for iOS there were crucial features that were not fully functional. Thus beta testers with Android smartphones were included.

To beta test NAPP v2.0 mobile application, circa ten Mentors where contacted via email and four of them confirmed that they and their mentees could participate in the testing of the application. In total, fifteen users used NAPP v2.0 mobile application for two weeks in a row - three mentors who had three mentees and one other mentor had two mentees. The Android Package was created to install the application on different smartphones. After the Android Package was created, it was then emailed to the mentors and mentees that would participate in the beta tests.

A PDF (see Appendix A) was sent to the mentors and their mentees with a tutorial on how to install and each functionality they had at their disposal in the mobile application. During the two weeks of testing, which occurred from May 1st to May 14th can be seen in Figure 4.1, the distribution of the activity logs in each day. Also, by analyzing every action that was performed in Table 4.1, the most used functionality was the creation and completion of tasks where of the twenty five activity logs generated, twelve and six correspond respectively to the two functionalities. In the second week there was a greater use of the application by the users that tested the application.

After the beta testing phase ended, a second session, on May 22nd, was organized via Zoom where any of the participants could give feedback of their own experience. The feedback given revealed that one feature that was missing was the possibility of mentors to create a task to be send simultaneously to several of their mentees and not just one. Also, it was reported by a mentee the report grade feature had a small issue. To send a mark, with a decimal part, the user had to use a comma instead of a dot and the numpad keyboard of some operating systems only shows the dot.

Action Type	Occurrences
Create Task	12
Complete Task	8
New Grade	3
Feedback	2
TOTAL	25

Table 4.1: Occurences of each action in beta tests

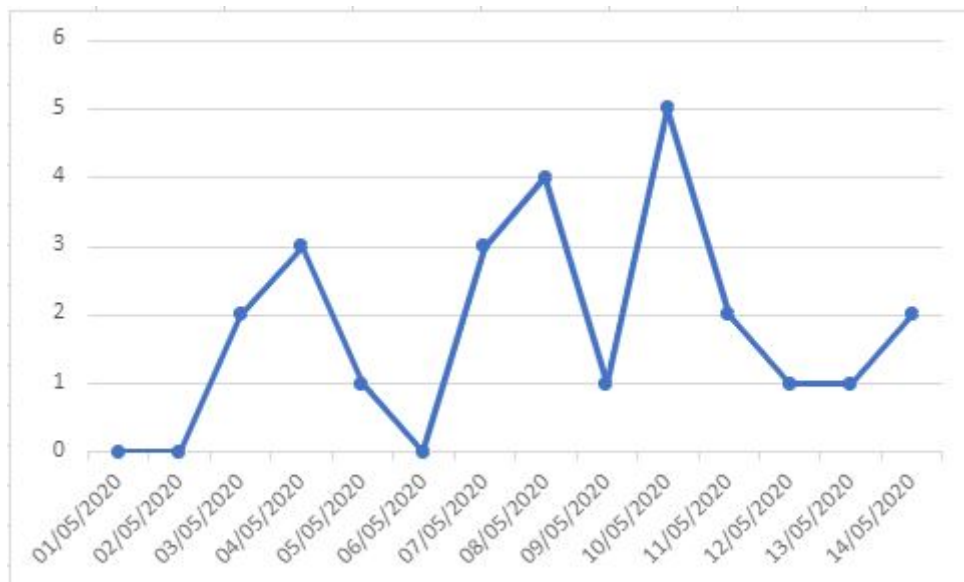


Figure 4.1: The activity logs generated in two weeks of NAPP v2.0 mobile beta test

Chapter 5

Conclusions

5.1 Conclusion

The objective of this thesis was to achieve an updated mobile application for MP-TP. The features, that were mentioned in Section 1.1 and with the feedback given after the beta tests, were all successfully implemented. Users can follow their progress with graphs, notifications engages users to use NAPP, mentees can get quick feedback about an evaluation, the activity center can be properly filtered showing the actions accordingly with applied filters, as well as being able to be aware of IST related events through the event notifications.

The first objective was to check the design of NAPP v1.0 mobile application and it was concluded that it had an unappealing aspect for a mobile application because of a non native feeling that Ionic Framework offers to users. The design is very important in an application because it is the main property that will engage the users to use it, since it makes the usage of the features easier and intuitive. With this change for React Native, the users have a native-like user experience and have a better performance in their mobile phones since it does not use a WebView to render the components as Ionic Framework does. It was very important to be able to reach a stage when the fewer possible clicks are required to make the application in a scalable way, so that more features could be implemented in the future. So this could be reached, the final design in Section 3 was implemented, fulfilling all the mentioned goals.

Changing database technologies solved an important security and data consistency issue. MongoDB offers the possibility to use transactions. With this, it can prevent system failures making all the documents in the database consistent. Also, users do not need the database password to use the offline mode on NAPP v2.0 mobile application. React Native has a offline queue library which saves HTTP requests in a queue. These are dispatched when users mobile network is available. In NAPP v1.0, with Ionic Framework and CouchDB, the user had in his mobile phone the database password, which could lead to potential security risks.

The features that were thought of at the beginning of this thesis, and with the feedback given after the beta tests, were all successfully implemented.

To ensure the next person to work in this project could make the transition as smoothly as possible,

the project code is fully documented.

5.2 Future work

For a correct NAPP framework functioning, the first step should be focused on changing the NAPP v1.0 Dashboard API, meaning that API calls will be made to MongoDB instead of CouchDB. A portion of this change from CouchDB to MongoDB is already done. It should be followed by tests to detect any flaws in the endpoints.

After these changes, the next step has be focused on modifying some aspects in the NAPP v2.0 mobile application: the login method should be replaced by FenixEdu's Central Authentication Service because is this more convenient for students; develop an interface, in NAPP Dashboard, for the AE coordinator to be able to create events taking place on IST. At this point, NAPP framework should be proceeded with beta tests. Then, new features that the AE coordinator thinks necessary could be implemented.

To finalize, NAPP framework must be properly monitored by DSI personnel since mobile operating systems are constantly being updated leading to changes that can cause instability.

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Appendix A

NAPP mobile features manual



Manual de Utilizador NAPP

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Capítulo 1. Instalação

Como instalar a aplicação?

Android < 8 (Geral):

- Definições -> Segurança -> Fontes desconhecidas: Permitir a instalação de aplicações a partir de fontes desconhecidas

Android > 8 (Geral):

- Segurança e privacidade -> Definições adicionais -> Instalar aplicações de fontes terceiras -> Dar permissão ao Google Drive ou ao Google Chrome

Android > 8 (Samsung):

- Definições -> Segurança e Biométrica -> Selecionar o Browser que vai fazer o download -> Permitir instalar aplicações ON.

Depois destas permissões terem sido dadas, o utilizador deve instalar a aplicação pelo link que foi enviado.

Capítulo 2. Registo e Login na Aplicação

Como se registar na aplicação?

Para fazer o registo na aplicação os alunos têm de fazer parte do programa de mentorado do Taguspark. Ao abrir a aplicação aparecem 2 botões: **Login** e **Registar** (Figura 1). Ao clicar no botão **Registar** (Figura 2) vão aparecer 3 campos. **Nome**, **ISTID** e **Password**.

- Nome** - Devem colocar o primeiro e último nome.
- Curso** – Curso que frequentam de momento.
- ISTID** – O **ISTID** vai servir para fazer login na aplicação. Este deve ser no formato "istXXXXXX", onde **ist** não deve estar capitalizado.
- Password** –Esta vai servir em conjunto com o **ISTID** para fazer login na aplicação.

Depois destes dados introduzidos, devem então clicar no botão **Criar Conta**, ao fundo da página, que redirecionará para o **Menu Inicial**.

Nota: Os mentorandos apenas se podem inscrever depois dos seus mentores os inscreverem na aplicação.

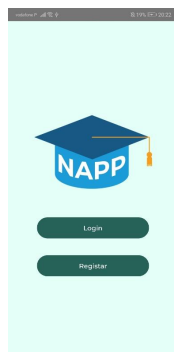


Figura 1- Menu Inicial



Figura 2- Menu de Registo

Como entrar na aplicação?

Para entrarem na aplicação têm de fazer **login** com as credenciais de registo. De notar que o ISTID tem de ser no formato sugerido. "istXXXXXX". Caso contrário o acesso será negado (Figura 3).

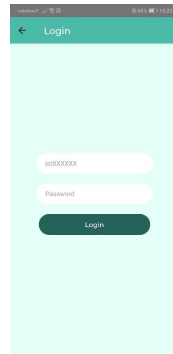


Figura 3- NAPP Login

Capítulo 4. NAPP

Na página inicial vão encontrar no topo da mesma o estado da aplicação. Também irão encontrar 4 botões abaixo com 4 funcionalidades distintas a serem explicados nos tópicos seguintes.

Menu Inicial - Estado da aplicação, o que é?

Mentor: No lado esquerdo aparecem os feedbacks que os mentores têm de realizar relativamente às avaliações que os seus mentorandos reportaram. No centro poderá ser visualizado o número de tarefas dos mentorandos, que estão para ser concluídas. Por fim é possível visualizar-se quantos eventos estão a decorrer no momento. Na (Figura 4) podemos verificar como exemplo que o mentor realizou 10 feedbacks de 11, os mentorandos concluíram 0 tarefas de 3 atribuídas e estão a decorrer 3 eventos no Taguspark.

Mentorando: No lado esquerdo aparece o número total de avaliações que foram submetidas pelo mentorando. No centro poderá ser visualizado o número de tarefas que estão por ser concluídas. Por fim é possível visualizar-se quantos eventos estão a decorrer no momento. Na (Figura 5) podemos verificar como exemplo que o

mentorando reportou 8 avaliações, concluíram 1 de 5 tarefas e nenhum evento se encontra a decorrer.

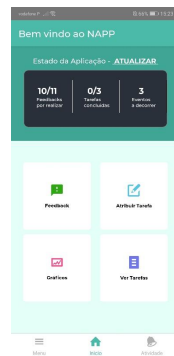


Figura 4 – Estado da aplicação mentores

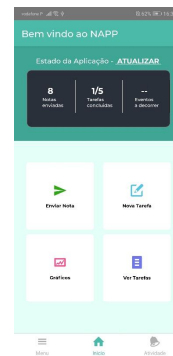


Figura 5 – Estado da aplicação mentorandos

Botões menu Inicial, quais as suas funcionalidades?

Encontram-se 4 botões no menu inicial cada um com uma funcionalidade específica. O mentorando em vez de ter o botão **Feedback** tem um botão **Enviar Nota**

Feedback: Ao clicar irá redirecionar para o menu de atividade com os filtros aplicados para serem visualizadas informações relativas às avaliações dos mentorandos. Para retirar estes filtros aplicados, é necessário clicar no botão do canto superior direito e aplicar os filtros desejados (Figura 6).

Atribuir Tarefa: Nesta funcionalidade o mentor poderá escolher a que mentorando quer atribuir uma tarefa. Este deve seleccionar o mentorando a quem atribuir e de seguida preencher o campo descrição. O campo **Descrição** não deve ser vazio. Ao clicar no botão **Criar Tarefa** (Figura 7) o mentor é redirecionado para a página **Início** e o mentorando respetivo recebe uma notificação a notificar que tem uma nova tarefa. Aplica-se o mesmo ao mentorando com excepção de seleccionar um mentorando.

Gráficos: Nesta funcionalidade o mentor poderá ver por unidade curricular o progresso do mentorando seleccionado. O mentorando poderá ver por unidade curricular o seu progresso, tendo apenas de seleccionar a unidade curricular respetiva (Figura 9).

Ver Tarefas: Ao clicar irá redirecionar para o menu de atividade com os filtros aplicados para serem visualizadas informações relativas às tarefas que foram atribuídas. Para retirar estes filtros aplicados, é necessário clicar no botão do canto superior direito e aplicar os filtros desejados (Figura 8).



Figura 6- Filtros aplicados nos Feedbacks

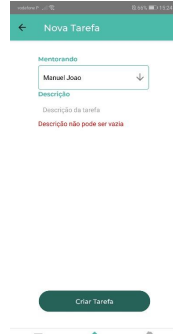


Figura 7- Atribuir Tarefa



Figura 8- Filtros aplicados nas Tarefas



Figura 9-Gráfico relativo a Mecânica e Ondas

O que contém a página Menu?

No canto inferior esquerdo, encontra-se a página **Menu**. Nesta secção são disponibilizadas todas as funcionalidades existentes da aplicação (Figura 10).



Figura 10- Funcionalidades na página Menu

Como posso adicionar os meus mentorandos ao NAPP?

Para os mentores, na página **Menu** deve clicar no botão **Adicionar mentorando**. Ao clicar na página poderá inserir o seu mentorando colocando o seu ISTID neste formato "istXXXXXX".

Ao clicar no botão "+" este irá aparecer numa lista por baixo. No momento em que adiciona pode remover ao clicar no botão "-". Para adicionar os terá de clicar no botão **Adicionar Mentorandos**. Depois de inseridos, estes não podem ser removidos. Caso tenha inserido algum mentorando de forma incorreta e que não faça parte de nenhum dos outros mentores, não irá haver problema. Caso contrário, é contactar o responsável para fazer a alteração o mais rápido possível (Figura 11).



Figura 11- Adicionar novas mentorandos

Quais as outras funcionalidades presentes na página Menu?

Atribuir Tarefas, Feedback, Tarefas e Gráficos: A explicação destas funcionalidades encontra-se na secção **Botões menu Inicial, quais as suas funcionalidades?**

Eventos: Ao clicar será redirecionado para o menu **Atividade** onde o filtro de visualizar os eventos é aplicado. Para se inscreverem num dado evento é contactarem o e-mail que se apresenta na informação **Contacto** (Figura 12).

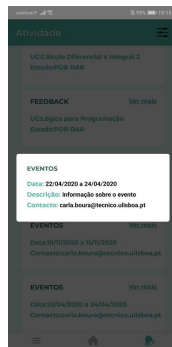


Figura 12 – Informação Evento

Atividade: Ao clicar será redirecionado para o menu **Atividade** onde podem ser visualizadas todas as **Tarefas e Feedbacks**. Neste caso, nenhum filtro é aplicado podendo ser escolhidos ao pressionar o botão no canto superior direito. (Figura 13). Podem ser escolhidos os filtros, clicando sobre os itens disponíveis. Ao clicar no botão **Filtrar** este é redirecionado para a página **Atividade** com os filtros aplicados(Figura 14).

Logout: Ao clicar no botão, o utilizador terá de confirmar a saída da aplicação. Ao clicar **Sim** será redirecionado para a página da (Figura 1). Ao clicar **Não** este continuará na aplicação.



Figura 13- Menu Atividade

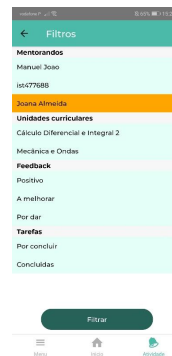


Figura 14- Filtro de um mentorado aplicado

O que contém o Menu Atividade?

No menu atividade é possível verificar todas as notificações relativas a **Feedback, Tarefas e Eventos**. Ao clicar no botão **Ver Mais**, um janela em formato **Pop-up** aparecerá com diversas informações (Figura 15) .



Figura 15- Dados de uma tarefa

Mentorando: O mentorando nesta secção consegue ainda **Concluir** as tarefas que tem pendentes. Ao clicar no botão **Ver Mais** e se esta estiver pendente, ao clicar **Concluir** dá-se por concluída e o seu mentor é notificado da conclusão (Figura 16).



Figura 16- Tarefa por concluir

Mentor: O mentor, nas notificações com título **Feedback**, conseguem dar o feedback **Positivo** ou **A melhorar** em relação à avaliação que visualizam no ecrã. O mentorando irá ser notificado sobre essa mesma avaliação (Figura 17).



Figura 17- Enviar Feedback

Sendo mentorando, como posso enviar a nota de uma avaliação?

Na página **Inicial** ou na página **Menu**, existe um botão **Enviar Nota**. Ao clicar neste botão o mentorando será redirecionado para a página respetiva.

O aluno terá de selecionar a **Unidade Curricular**, o tipo de **Avaliação**, a **Data que ocorreu a avaliação** onde esta é importante ser a correta para um correto funcionamento da funcionalidade de ver os **Gráficos**, a respetiva **Nota** e podem adicionar opcionalmente um **comentário** em relação a essa nota.

Nota adicional: Caso o método de **Avaliação** selecionado seja **Outra**, será necessário especificar qual foi o outro método utilizado pelo docente (Figura 18).



Figura 18- Enviar uma nota

