NAPP: Connecting mentors and students at Técnico Lisboa

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Abstract

In the past seven years, a successful first-year mentoring programme at Técnico Lisboa's Taguspark campus promoted by Núcleo de Apoio ao Estudante - Taguspark (NAPE-TP) was brought into play. Nevertheless, the relationship between mentors (mostly second-year students) and mentees (first-year students) tends to weaken after the first academic weeks of the semester due to poorly defined communication channels. This problem can be addressed with the creation of a consistent and unique communication channel between all the parties involved in this programme. This work presents NAPP, a novel mentoring software solution for first-year mentorship programmes, that enhances the communication between mentors and mentees while providing study guidance tools for mentees. NAPP is composed of two key components, a cross-platform mobile application and a web application that is used as a high level performance analysis tool by the programme's coordinator. These components were developed using state of the art technologies like the Ionic Framework using AngularJS, and the NoSQL databases CouchDB and PouchDB. The undergone usability test to the mobile application component revealed that the developed software was simple and intuitive to use with a SUS score of 89.42 [8] (in a scale of 0 to 100), which demonstrates a high level of user experience.
Keywords: Mentoring Program; Student Support Systems; Mobile Application; NoSQL Databases

1. Introduction

Formerly known as Gabinete de Apoio ao Estudante (GAPE), Núcleo de Apoio ao Estudante (NAPE)[1] was created on the 3rd of December of 1990 from the combined efforts of Instituto Superior Técnico (IST or Técnico Lisboa)[2] and Direção-Geral do Ensino Superior (DGES)[3] to improve the academic success rates of Técnico Lisboa. This initiative was inserted in the National Programme to Combat Failure at School [6], promoted by the Portuguese Ministry of Education.

As the interface between students and the management offices of Técnico Lisboa, NAPE's mission consisted from the very start of the following actions: promotion of the relationship between students and the University, fostering of initiatives that help student's integration, reinforcement of student's activities, creation of activities to welcome first-year students and publicize the Técnico Lisboa's graduate courses offer to high school students.

NAPE's main student support service is the mentoring programme. The main focus of this programme is to welcome, integrate and assist students that are admitted for the first time in Técnico Lisboa, mainly first-year and international students, into academic life. With the help of NAPE's mentors and guides, mostly second/third year students, the newcomers get personalized assistance during their first steps in Técnico Lisboa's academic life.

The mentoring programme started in 1996 at first to support and assist students of the Electric and Computer Engineering bachelor degree. Years after, the programme was applied in 17 bachelor degrees. Starting from the academic year of 2010/2011, the Mentoring Programme had a fresh start in the Taguspark campus.

Even though the programme is well organized, there is a recognized communication problem between the three parties involved on it: NAPE-TP's coordinator, mentors and mentees. Therefore, there was a need for a software solution that supports the information flow between these parties and also integrates study guidance tools that help students throughout their academic life.

Looking at the related work on the topic of mentoring programmes, we paid special attention to

[1] https://nape.tecnico.ulisboa.pt/nape/
[2] https://tecnico.ulisboa.pt/en/
[3] http://www.dges.gov.pt/pt

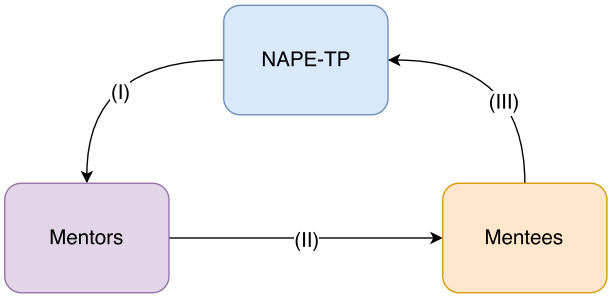
MIT Sloan School Of Management [4] the mentoring programme that is based in the relationship between students and alumni. This programme is powered by Chronus [4], a software dedicated to support mentoring. Also, between other mentoring programmes, we could identify in TU Delft [5], there are two different mentoring programmes, one for first-year students and another for master students [3].

While MIT's mentoring programme has a mentoring support software solution tailored for last-year students that are planning their career path, TU Delft's has the same focus of NAPE-TP's programme but without the technological support.

1.1. NAPE-TP Mentoring Process and Problem Context

NAPE-TP mentoring program depends, in what concerns the general academic integration of first-year students, on the exchange of information between the following parties (see Fig.1).

Figure 1: NAPE-TP mentoring program communication channels for academic integration



I Invite and distribute mentors to all first-year students;

II Establish a relationship of trust during the enrolment week in Taguspark campus;
Give academic support and share university-related experiences;
Suggest the attendance of study halls and groups;

III Report problems related with the mentoring program.

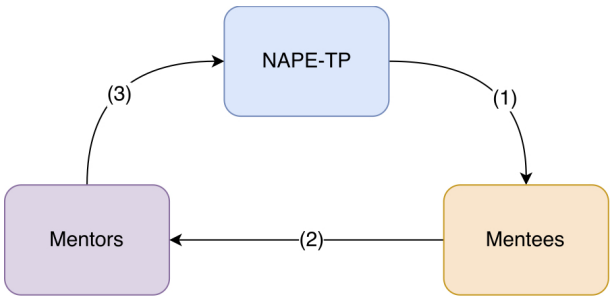
The distribution referred in (I) is a manual process in which the NAPE-TP's coordinator matches every first-year student, usually 300 at Taguspark campus, with a mentor, from a pool of around 90 students.

Analysing channel (II), it is possible to conclude that, after many editions of the NAPE-TP mentoring programme, a relationship of trust is not established during the enrolment week. After the first weeks of the semester this situation results in the end of the relationship compromising the goals of the programme.

Regarding (III), NAPE-TP has no direct feedback of the mentoring programme from mentees, only from mentor's reports.

Moreover, in what concerns the academic success of first-year students, the exchange of information is done as indicated in the next diagram (see Fig.2).

Figure 2: NAPE-TP mentoring program communication channels for academic success



1. Psychological and/or academic personalized support;
   Suggest a tailored academic plan in case of poor academic performance;

2. Report academic performance, mainly the first test grades;

3. Report mentee's grades.

If a mentor reports a case of a mentee with poor academic performance (fail in three or more evaluations), the mentee will be invited to an interview with NAPE-TP's coordinator in order to find a quick solution. This solution can be a personalised academic plan for the next semester that doesn't overload the student, or psychological support from Técnico Lisboa's Psychological Assessment and Support Services, for example.

Until now, the process of reporting grades to mentors is entirely dependent on the exchanging of e-mails between the two parties that intervene in channel (2), with the exception of the cases where there is a personal relationship. This communication process is usually very delayed, meaning that mentors have to pressure their mentees in order to get their feedback.

The delay referred in (2) cascades to (3), leading to a desynchronised communication which results in the overburden of the programme's coordinator.

1.2. Objectives and Requirements

To fulfil the need of a framework that supports the referred information flow, a software solution was

[4] http://mitsloan.mit.edu/
[5] https://www.tudelft.nl/en/

developed to support both processes (see Fig.2 and Fig.1). The following requirements were identified for this new mentoring support solution:

- A communication module between the three parties of the mentoring system: NAPE-TP's coordinator, mentors and mentees;
- A reporting module that receives as input mentee's grades. This module would firstly be used by mentors to efficiently follow their mentees academic track record evolution and, at a higher level, by NAPE-TP's coordinator to follow mentor's work and effectiveness;
- A module with study guidance tools for first-year students;
- A feedback module to obtain regular and updated suggestions related to the programme from mentors and mentees.

In this context, there was an opportunity and value in implementing an application framework to support the information flows and generate attraction to the programme by including also relevant guidance content for mentees. For the mentoring programme's coordinator, the added value provided by this application framework would be the ability to efficiently monitor the mentees' performance and the mentor activities in real time. For mentors and mentees, the application framework would provide a mentoring workflow that enables a strong optimization in information sharing as per the objectives mentioned above.

Regarding the published work, this application framework was featured in one international and one national conference. Accepted as a poster paper, this solution was published in the proceedings of the 12th European Conference on Technology Enhanced Learning, EC-TEL 2017 [12], hosted in Tallinn (Estonia). Also, this solution was presented in CNaPPES 17 [7], "4º Congresso Nacional de Práticas Pedagógicas no Ensino Superior", a portuguese conference hosted in IPS (Polytechnic Institute of Setúbal, Portugal).

2. Mentoring Software Solution

2.1. Approach

As it was described in section 1.1, the main problem faced by NAPE-TP's mentoring programme is an undefined and inefficient communication channel used in both processes (see Fig.2 and Fig.1). Although there was an attempt that the exchange of information was done through emails, the programme coordinator always resorted to other methods to reach mentors and mentees to avoid the inefficiency of emails. There was some not very successful efforts to overcome this situation using Facebook and Slack, but after some time the students failed to regularly use these platforms.

The proposed solution is subdivided in two components. The first is a mobile application, for mentors and mentees, that is developed to increase their engagement in NAPE-TP's mentoring programme. This app provides mentors with academic performance tracking reports of their mentees and key study guidance tools. The second component is a web application, developed for NAPE-TP's coordinator, that enables a high level view of the mentees' academic performance evolution and the mentoring activities carried out by mentors.

The communication, study guidance and feedback modules, referred in section 1.2, are exclusively supported by the mobile application. The part of the reporting module, also described in this section, related to the mentees' academic track record analysis is implemented on the mobile application. The part referring to NAPE-TP's coordinator high level monitoring is the key functionality of the web application.

The chosen name for this mobile application was NAPP, which is the result of the word binding between NAPE (Núcleo de Apoio ao Estudante) and App (Mobile Application). As can be viewed in Figure 3, the final version of the logo of NAPP was created using vector graphics. The objective was to reflect the main target audience of the app, students, while using Técnico Lisboa's official color palette [1].

Figure 3: NAPP's logo first version

2.2. Architecture

NAPP's architecture is based mainly on three technologies: Ionic Framework, PouchDB and CouchDB (see Fig.4).

On the client side (mentor's and mentee's side), the multiple NAPP mobile applications are able to keep their local PouchDB database up-to-date even when the users are offline. On the server side (NAPE-TP's side), NAPP web application provides access to the information on the CouchDB server that is synchronized with all PouchDB instances.

The Ionic Framework leaves app bundling to Cordova. Apache Cordova is a platform for web-based hybrid apps and its high level architecture is schematically shown in Figure 5.

Figure 4: NAPP's architecture

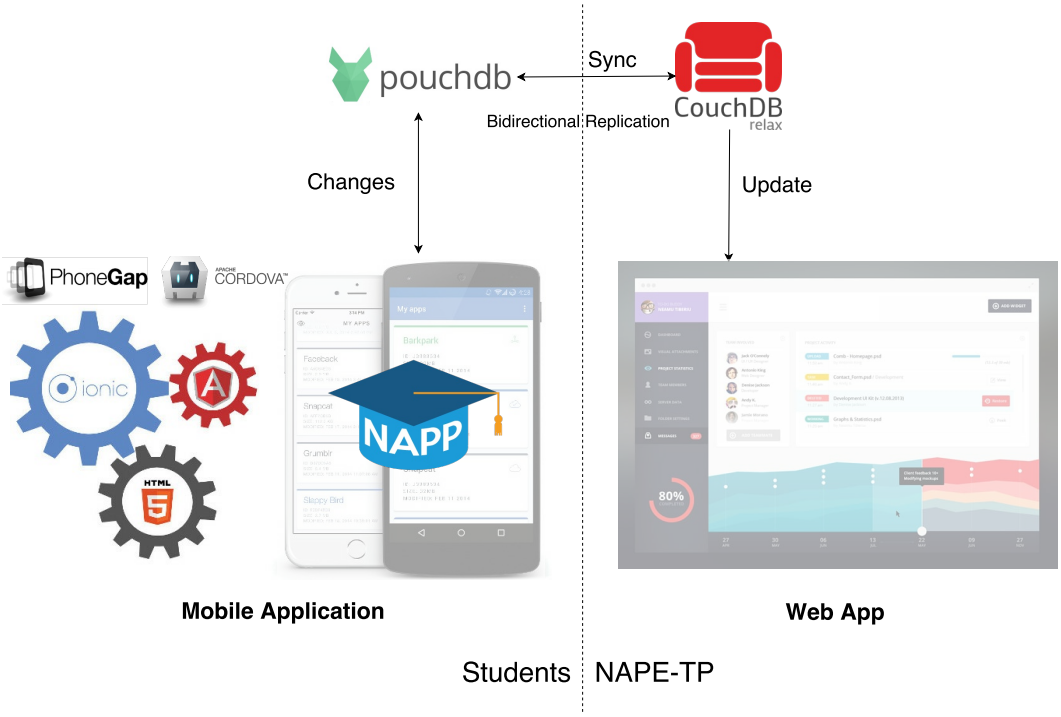
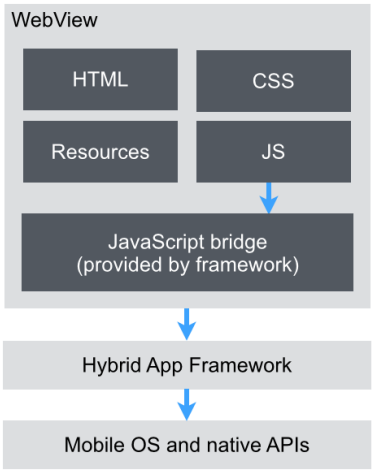


Figure 5: Apache Cordova architecture [11]

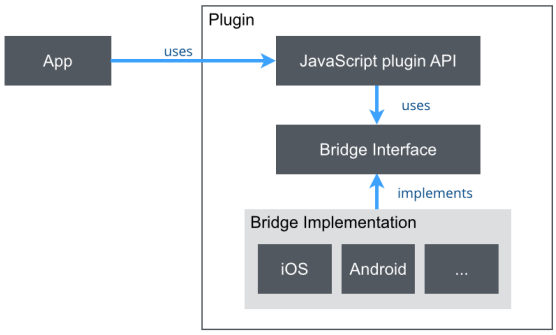


Cordova supports and interacts with many different device-specific APIs and combines all the APIs from a native environment in one JavaScript API that is accessible by the hybrid app. These apps run inside a WebView under the control of Cordova Framework.

Aside from this, Cordova communicates through an encapsulated channel with native device APIs with the usage of plugins. These plugins obtain basic device information and device's geolocation, for example.

Cordova's plugins are subdivided in two parts. The first part runs in JavaScript within the WebView in order to provide an API to the hybrid app. The second part is written in the device's platform native code with the purpose of controlling the native APIs. Figure 6 schematically describes the high level plugin architecture.

Figure 6: Apache Cordova plugin architecture [11]



CouchDB has two unique features: HTTP and Sync. Its primary means of communication is HTTP, therefore there is no need for a intermediary layer that converts database queries into RESTful HTTP calls. Being CouchDB based only on REST and HTTP, it is possible to communicate with it using only a web browser. CouchDB was built from origin to be capable of supporting synchronization. It is possible to establish two-way replication between CouchDB server instances. This means that users can speak with different CouchDB servers across the globe without being concerned about latency in their client-side applications.

PouchDB concept is to have the database inside the browser. Inside the Node.js enviromment, PouchDB uses LevelDB and other backends via the LevelUP ecosystem [6].

2.3. Sources of Information

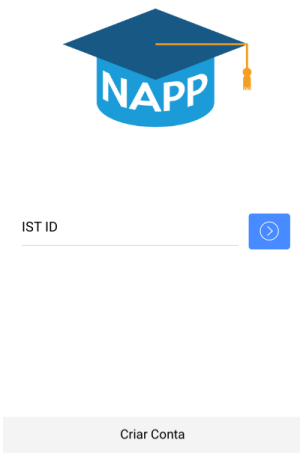
Regarding the sources of information needed to develop the app, instead of the use of FenixEdu Open API [5], mentors and mentees have to create an account using the NAPP mobile application describing their personal information (name and course, for example).

Also, as expected, mentees have to manually input their grades through the mobile application. Any missing or relevant data can be inserted in the NAPP web application by NAPE-TP's coordinator.

2.4. NAPP mobile app

The first page of the NAPP mobile app is a login screen (see Fig. 7). In order to login, the user has first to create an account. The alert that can be seen in Fig. 8, states that if the user of the app is a mentee, he needs to be added by his mentor to his mentees list through the app. Only then the account creation panel will be prompted with the corresponding mentee's IST ID after he tries to login.

Figure 7: Login Screen



NAPP's mobile application component was developed to be used by two different groups of students, mentors and mentees. The mentor's application viewpoint is composed of the following functionalities (see Fig. 9 and 10): Mentor Dashboard ("Dashboard") and List of mentee's academic performance analysis panels (one for each mentee). With the Mentor's Dashboard each mentor is able to see their mentees ranked by their academic average performance and an activity feed with their last updates. For example, this activity feed will inform mentors about their mentees last reported grades. The mentor's component of the reporting module described in section 1.2 can be accessed through each of their mentees panels.

Figure 8: Create Account Panel Alert

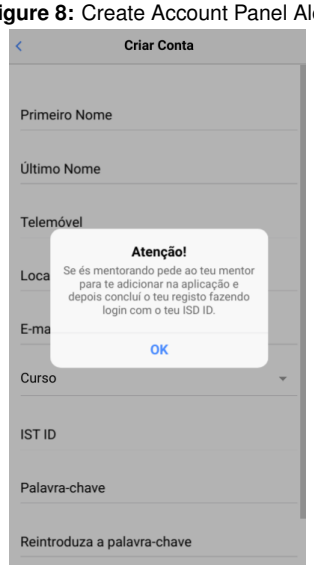
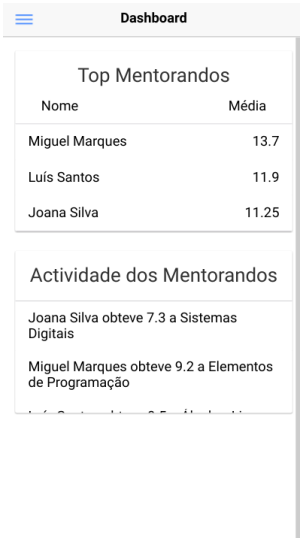


Figure 9: Mentor's Dashboard



[6] https://github.com/Level/levelup/wiki/Modules

Figure 10: Mentor's Menu

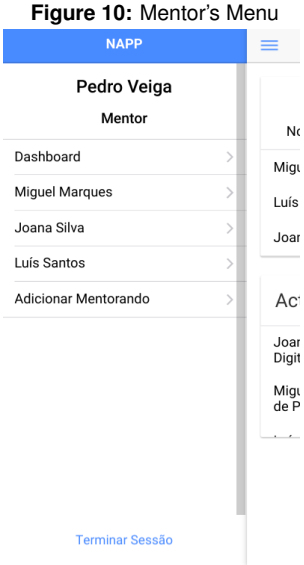
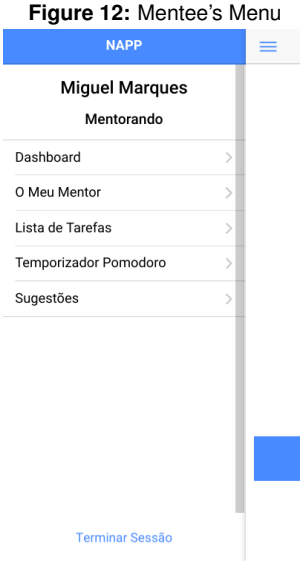


Figure 12: Mentee's Menu



The mentee's application viewpoint is composed of the following functionalities (see Fig. 11 and 12): Mentee Dashboard ("Dashboard"), My Mentor ("O Meu Mentor"), To-do List ("Lista de Tarefas"), Pomodoro Timer ("Temporizador Pomodoro") and Mentoring Program Feedback ("Sugestões").

The Mentee Dashboard shows the overall average of a certain mentee along with the number of his/her passing and failing grades. Here the mentee can report a grade directly to his mentor through the button Report Grade to Mentor ("Reportar Nota a Mentor"). The general information about the mentee's mentor is described in the My Mentor functionality. The To-do List and the Pomodoro Timer functionalities are the study guidance tools referred in 1.1 section (see Fig. 13 and 14). The feedback module is implemented in the Mentoring Program Feedback functionality.

Figure 11: Mentee's Dashboard

Figure 13: Mentee's To-do List

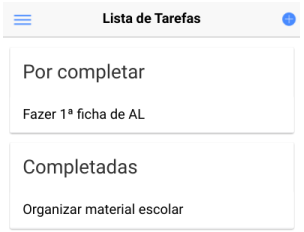


Figure 14: Mentee's Pomodoro Timer

2.5. NAPP web app

The NAPP web app was developed to be used by NAPE-TP's coordinator. This web has two modules: a dashboard, with the most relevant information about the mentoring activity; a smart table, which enables a profound and detailed analysis of the student's data (mentors and mentees).

The dashboard (see Fig. 15) has: the number of mentors ("Mentores") and mentees ("Mentorandos") in the mentoring program, the number of passing ("Notas Positivas") and failing ("Notas Negativas") grades, the number of reported mentee's grades ("Notas Reportadas"), the number of completed tasks by mentees ("Tarefas Completadas"), the number of tasks that mentors assigned to their mentees ("Tarefas Atribuídas") and the number of full pomodoro cycles done by mentees ("Pomodoros Completados").

The smart table, or "Tabela Dinâmica" (see Fig. 16), is a tool to manipulate the student's data and sorting it by a certain field. Through this table it is possible to analyse, for example, the mentees of a certain mentor by sorting the "mentor" field. Also, here the mentoring program coordinator can change directly the student's data if, for example, the student wrongly inserted some information. The changed information in this table is reflected on the single CouchDB server referred in section 2.2 and consequently on the multiple NAPP mobile applications.

3. First Results

3.1. Evaluation Plan

NAPP was tested according to usability. For all types of different software, usability tests consider the following aspects [10]:

- More efficient to use (Effectiveness) - takes less time to complete a particular task;
- Easier to learn (Efficiency) - operations can be learned and completed consuming low resources;
- More user satisfaction (Satisfaction) - meets user expectations.

The existent types of evaluation methodologies [10] that are usually used to evaluate mobile usability are:

- Laboratory experiments - human participants are required to perform specific tasks using a mobile app in a controlled setting;
- Field studies - users are provided with mobile apps and asked about their experience;
- Hands-on measurements - defined aspects of mobile apps are measured directly.

In the case of the developed mobile application, the main part of NAPP framework, the field study methodology was the most appropriate methodology to evaluate the app because, not only it could be applied as very useful approach early in product development, but also allowed to gather direct user feedback. In general, during field studies, data is collected about task flows, inefficiencies (errors during tasks), and the organizational and physical environments of users.

3.2. Usability Test Results

A controlled group of 30 students (including mentors and mentees) undergone a usability test using NAPP in a test environment (web browser) as soon as the prototype was created. The objective of this first test was to evaluate mobile device-based gestures, content, interfaces, and the general user experience [9].

The test was subdivided into two sets of tasks. The first set of tasks was with the mentor viewpoint and the second was with the mentee viewpoint of the prototype app.

The mentor tasks were:

- Check a certain grade of a mentee in a specific course;
- Assign a task to a mentee;
- Order mentees according to a certain criteria (best grade).

And the mentee tasks were:

- Report a grade to the mentor;
- Add a task to the to-do list;
- Start a Pomodoro cycle;
- Send feedback of the mentoring program to NAPE-TP.

During each task, the test process was: assign the test task to the students, record the time that was necessary to conclude the task, record the number of clicks that were necessary to finish it and consequently the number of errors while doing it.

Measuring the effectiveness (referred in section 3.1) of the prototype app, the obtained results can be seen in Figure 17

With a mean of 9.41 seconds all tasks were rapidly completed.

The efficiency of the prototype app (referred in section 3.1) was measured based on the number of errors while performing each task. The obtained error rate (at least one error during the task) can be seen in Figure 18.

Figure 15: Web Application Dashboard

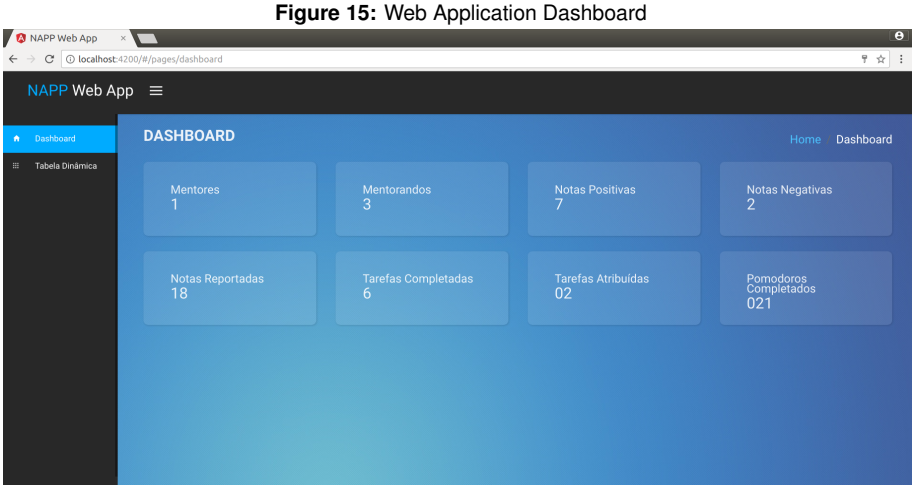


Figure 16: Web Application Smart Table

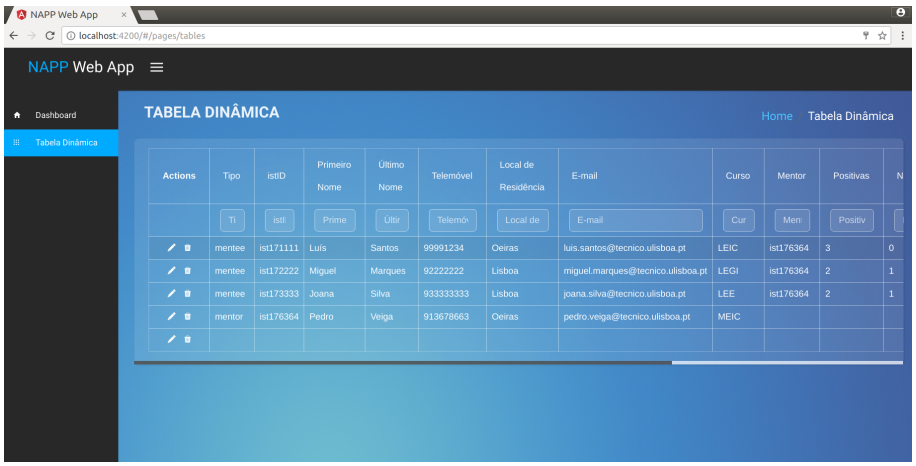
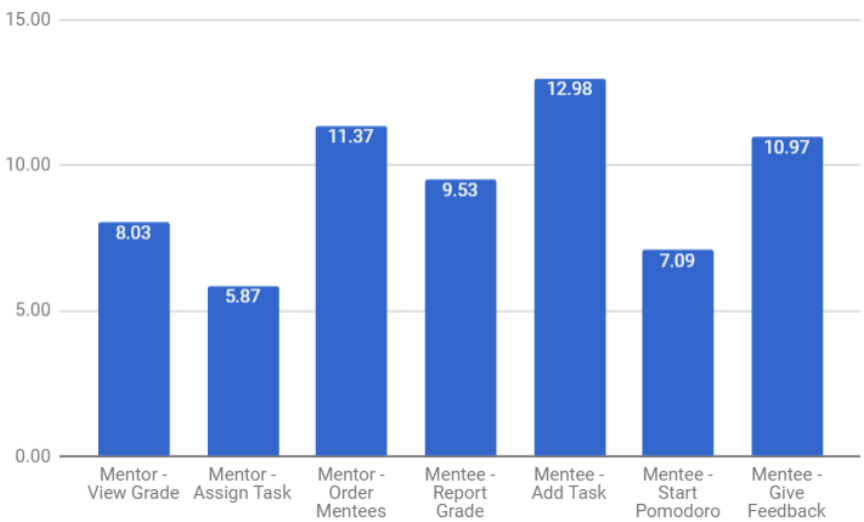


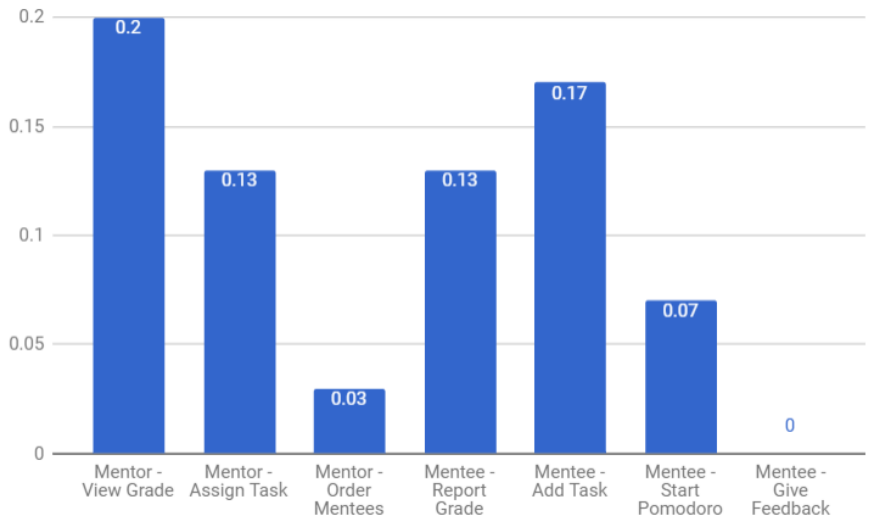
Figure 17: Usability Test Results - Time to conclude each task



The maximum number of errors per task was 1 and the mean error rate was 10.4%.

With the above results it is possible to conclude that the app was successfully designed to be effective and efficient because the test tasks were completed in an very short period of time and almost

Figure 18: Usability Test Results - Error rate of each task



no error was made.

After the tasks were concluded, the students had to fill in a short 10 question survey, based on Likert scales [7], which was done according to the System Usability Scale (SUS) [8].

SUS is one of the most efficient and cost-friendly way of gathering statistically valid data and giving a certain system, in this case an app, a precise usability score.

The 10 asked questions were:

- I think that I would like to use this system frequently.
- I found the system unnecessarily complex.
- I thought the system was easy to use.
- I think that I would need the support of a technical person to be able to use this system.
- I found the various functions in this system were well integrated.
- I thought there was too much inconsistency in this system.
- I would imagine that most people would learn to use this system very quickly.
- I found the system very cumbersome to use.
- I felt very confident using the system.
- I needed to learn a lot of things before I could get going with this system.

[7] https://www.en.wikipedia.org/wiki/Likert_scale

Each of the questions had to be ranked from 1 to 5 based on how the tester student agreed with the statement that they read. 1 means they strongly disagree and 5 mean they strongly agree.

To calculate the SUS score of each of the students the following mathematical operations were made: For each of the odd numbered questions, it was subtracted 1 from the score; For each of the even numbered questions, it was subtracted their value from 5; These new values added up are the total score; The final score was obtained by multiplying the total score by 2.5 [2].

The mean SUS score of the tester students was 89.42, which is a very positive result that proves the satisfaction (referred in section 3.1) level of the users while using NAPP's prototype app.

4. Conclusion

Even though NAPE-TP mentoring programme can be considered a successful initiative from the pedagogic point of view, its communication channels, as described in section 1.1, are undefined and inefficient resulting in a desynchronized information flow. The developed mentoring framework, NAPP, aims to solve this problem with an app developed thinking of first-year students that supports all the required exchange of information, as referred in section 1.2, while providing study guidance tools. Besides, the mentoring programme coordinator has access to a web application, integrated within NAPP framework, with the relevant academic performance information of all the mentees.

Therefore, this framework is ready to modernize the mentoring programme, reducing the number of manual processes that are still part of it, while increasing its impact and fostering the engagement

of first-years students through a mobile approach.

4.1. Future Work

NAPP next development phases should focus on the publishing process of the application in mobile application markets (iOS and Android). After the publishing process is complete, a performance test in real devices should be carried out to check first, if the defined solution architecture can support the necessary exchange of information, and second, if the communication between the parties referred in chapter 1 (NAPE-TP's coordinator, mentors and mentees) was improved. To measure the performance increase in all the involved communication processes the following key performance indicators (KPIs) and metrics can be used: satisfaction of mentees with the feedback/support from mentors through the mobile application (>60%), percentage of mentees that recognize the mentoring process was helpful (>80%), satisfaction level of mentees with study guidance tools (>60%) and satisfaction level of mentors and mentees with the feedback module (>60%).

During the usability test, several suggestions were made by mentors and mentees which shall be taken into account in future implementations. The most demanded features were: access to a full record of the achieved grades, while in the mentee's perspective; possibility to create hypothetical grade scenarios that lead to a certain final grade in a course, also in the mentee's perspective; and finally, the integration of NAPP in the Técnico Lisboa's FenixEdu [8] software ecosystem, which would allow the use of its Centralized Authentication System (CAS) [9] and its API [10] with all the student's information.

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