Visualising Data in NAPP Web Application

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October 2018

Abstract

Mentoring programmes within universities have shown to improve students’ academic performance. The Mentoring Programme at Técnico Lisboa’s Taguspark campus has had a positive impact on students. Yet, it suffers from communication problems between the parties involved. A software solution named NAPP had been created to address these communication problems. NAPP’s Web application is a component that is meant to be used as a high-level performance analysis tool by the mentoring programme’s coordinator. The previous prototype of the Web application did not present the information necessary for the proper analysis of students’ academic performance. A new Web application was created which uses data visualisations to describe students’ academic performance. Further improvements were made to the other component of NAPP: the prototype of a mobile application to be used by mentors and mentees. The first beta test of the mobile application was conducted with a small group of students for 3 months, revealing that students used the application at least once a week, except for one week. A usability test on the new Web application showed high user satisfaction (average SUS score of 95). NAPP is ready to undergo a formal test which will allow to evaluate the system’s value for the Mentoring Programme in Taguspark.

Keywords: Mentoring Programme, Student Success, Student Support Systems, Data Visualisation

1. Introduction

The Mentoring Programme is a Técnico Lisboa pioneer project first implemented in 1996. It focuses on the welcoming, integration, and assistance of students admitted for the first time to Técnico Lisboa, who are mainly first-year and international students. The new students receive personalised assistance from their peers – volunteer students who serve as mentors in the programme – during their initial contact with Técnico Lisboa and through the remainder of the first academic year. In the academic year 2011/2012 the Mentoring Programme went through a revamp in the Taguspark campus. The Mentoring Programme in Taguspark (MP-TP) uses a different strategy for accepting mentors: they are still volunteer, but they are interviewed beforehand in order to be accepted into the MP-TP. Another differentiating factor of the MP-TP is that the academic performance of first-year students is closely followed by a counsellor, who is the coordinator of the mentoring programme. Since the restructuring of the Mentoring Programme in Taguspark, the programme has had a positive impact on the academic success of first-year students at the campus. [1]

In order to achieve the intended goals of academic success and integration, the MP-TP depends on the exchange of information between three parties: the MP-TP’s coordinator, mentors, and mentees. Despite the positive impact of the programme on first-year students, there are admitted communication problems between the three parties involved. The main communication problem concerns the reporting of grades by mentees. In order to follow mentees’ academic performance, the MP-TP’s coordinator produces and analyses a spreadsheet with the grades reported by the mentees. By analysing the negative grades reported, the coordinator determines if a mentee is at risk of academic failure.

For the coordinator to receive the grades, the reporting of grades flows in a sort of “boomerang” fashion. The MP-TP’s coordinator has to message the mentors for their mentees’ grades, who will then message their mentees asking for the grades. The mentees then have to report their grades to their respective mentors, and afterwards the mentors forward their mentees’ grades back to the coordinator. This is where the communication problem lies, for two reasons: the reporting of grades is slow due to the “boomerang” flow, and the analysis of grades is also slow due to delay associated with using a very basic spreadsheet. This compromises the ability to provide timely help to at-risk mentees.
In this process, the reporting of grades relies almost completely on the exchange of emails between the three parties. Since the academic year 2017/2018, mentors began writing their mentees’ grades directly on a collaborative spreadsheet in Google Sheets, which the coordinator uses to analyse the academic performance of mentees. This change allowed for a slight reduction of the delay since the spreadsheet is now produced in a distributed manner, but the time associated with the “boomerang” flow did not decrease, nor did the time of analysing the spreadsheet.

The NAPP framework is a software solution that was developed as the Master’s degree thesis of Pedro Veiga, to try to tackle the problems of the Mentoring Programme in Taguspark. [2] Its two main components are a mobile application to be used by mentors and mentees, and a Web application to be used by the MP-TP’s coordinator. A prototype of the mobile application was made and tested for usability with a small group of students. It supports the reporting of grades by mentees, and the monitoring of mentees’ performance by mentors. It allows students to submit feedback about the MP-TP, and also includes study guidance tools to assist them in their academic life. With NAPP’s original version, mentees report their grades using the mobile application, which makes them instantly available to the mentors and MP-TP’s coordinator, thus eliminating the “boomerang” flow.

A prototype of the Web application was also made, but it did not undergo any kind of testing. NAPP’s Web application is intended to serve as a performance analysis tool for the MP-TP’s coordinator. Yet, the first prototype did not satisfy the coordinator’s needs for analysing each student’s academic performance.

The first version of NAPP had other problems besides the prototype of the Web application. NAPP was not integrated with the evaluation methods of Técnico Lisboa’s courses: the grades reported by mentees were associated only with a course, and not with a specific evaluation of the course (e.g. tests, projects, etc.) This association is critical to the correct analysis of the mentees’ academic performance by the coordinator.

1.1. Key Contributions
This work presents the various enhancements made to NAPP’s original version. The data model was redesigned for improved scalability; the mobile application was subject to significant modifications; and the inadequate first Web application was discarded and a new one was created according to the requirements of the MP-TP’s coordinator. Moreover, three tests were conducted including: a short duration beta test on the mobile application, a long duration beta test on the mobile application, also with a small number of students; a usability test of the Web application.

1.2. Document Outline
This document is divided into five sections. Section 2 presents the related work, including two mentoring software solutions and the case of a successful use of academic data for the benefit of students. It also introduces the NAPP framework, as it was originally developed. Section 3 explains all the work that was done to enhance NAPP and the various phases of evaluation. Section 4 presents the results and discussion. Lastly, Section 5 explains the conclusions of this work and outlines the future work.

2. Background
Organisations around the world are progressively choosing to use specialised mentoring software to enrich the experience of participants taking part in mentoring programmes.

These mentoring software solutions concentrate on the interactions between mentors and mentees, and, even when they offer variants that target mentoring programmes in higher education, they do not include any capabilities for directly analysing students’ academic progress. Since this is one of the fundamental aspects of the MP-TP, there was a need to investigate another topic which relates deeper with students’ academic success: learning analytics. In recent years, higher education organisations have started to take advantage of the large amounts of data generated by their Learning Management Systems to provide insights on how to improve learning. [3] Georgia State University is a recognised successful case of the use of learning analytics to improve student success.

The two following subsections present two prominent software solutions for mentoring programmes, as well as the successful case of Georgia State University with learning analytics. A third subsection introduces the NAPP framework, explaining its original state.

2.1. Mentoring software
Chronus and MentorCore are two mentoring software solutions that can be applied to mentoring programmes within universities.

Both Chronus and MentorCore provide matching capabilities, which use mentor and mentee information to suggest suitable matches. Matching criteria are customisable, and can be defined by mentoring programme administrators. This technology is the best option when dealing with large numbers of mentors and mentees. However, it isn’t particularly useful in the context of the Mentoring Pro-
gramme in Taguspark, because the number of participants is too small (approximately 250 mentees and 80 mentors). Thus, the matching has been randomised since the beginning of the programme, with the only constraint being that the mentor and the mentee must belong to the same academic degree. It is assumed that this randomisation has had no meaningful impacts on the results of the programme.

Within Chronus, mentors and mentees can engage in the programme through a Web application and native mobile applications for smartphones and tablets. These applications offer not only direct communication tools between mentors and mentees, but also mentoring resources for new mentors, as well as a forum where participants can submit questions and answers. Unlike Chronus and NAPP, MentorCore does not provide a mobile application to programme participants. Instead, a Web application allows mentors and mentees to apply to the mentoring programme, find suitable matches, and engage in the programme.

Among the two, these mentoring software solutions offer monitoring and management features to be used by mentoring programme administrators, including:

- A dashboard which contains real-time status reports regarding the mentoring programme,
- Workflow management, which enables mentoring programme administrators to define tasks and milestones for mentors and mentees,
- Simple visualisations of programme data, which allow to analyse programme outcomes and objectives,
- Creating customisable reports, which can be exported into Microsoft Excel,
- Creating surveys to be answered by mentors and mentees,
- Uploading resources and documents for mentors.

Like these two systems, NAPP is intended to be a technological solution that promotes the communication between all the parties involved in a mentoring programme. However, what sets NAPP apart from Chronus and MentorCore is the special attention to the students’ academic success. None of these other systems provide modules that have the explicit focus set on following the academic track record of participants – not even Chronus, which has been applied in academic contexts several times before.

2.2. Learning Analytics at Georgia State University

In the years leading up to 2012, academic advisement at Georgia State University (GSU) was showing signs of decay. The university supported six advising offices which had developed independently across multiple colleges, and thus had little coordination, no sharing of records, and no common training. This separation resulted in an inefficient and ineffective academic advisement system which often failed to provide assistance to GSU’s large number of at-risk students. [4]

To try to solve this problem, a Web-based advising platform was built in collaboration with the Education Advisory Board (EAB). The platform consists of an early-warning system, named Graduation and Progression Success (GPS, or GPS Advising), which tracks GSU’s 30,000 students on a daily basis, and applies ten years of historical data (2.5 million student grades) to create alerts and predictive analytics. [5] These alerts and analytics are delivered to adviser dashboards every morning, prompting student meetings with advisers, as well as providing guidance during those meetings. The platform keeps track of meetings with advisers and allows them to write notes on a permanent record available to all advisers in the university.

Georgia State University and EAB began developing the GPS Advising system in January 2012. The system went live in August 2012, and EAB provided common training to the university’s advisers. [4] By 2017, the university-wide graduation rate has increased 22 percentage points, standing at 54%, and achievement gaps were eliminated for at-risk students.

Georgia State University is a very successful case that highlights how data can be used to benefit students. The GPS Advising system shares some aspects with NAPP, such as the idea of delivering relevant alerts to the adviser’s dashboard, or the visualisation of each student’s progress in that same dashboard. Yet, the success of the GPS Advising initiative depends on the students’ willingness to actively interact with their assigned adviser. When students enter the higher education system, they can often feel overwhelmed and lost. Peer Mentoring in higher education helps new students feel welcome and integrated, which often translates into their academic success. The core goal of NAPP is to join technology, Peer Mentoring and academic data to ultimately contribute to students’ academic success.

2.3. The NAPP framework

The NAPP framework is designed from the beginning to consist of three elements: the mobile ap-
plication, the Web application, and a server which hosts the database that keeps all the data generated by the applications.

The mobile application was built using the Ionic Framework, which provides tools to develop cross-platform mobile applications using Web technologies like CSS, HTML5, and JavaScript. The mobile application is divided into two views: the mentee view and the mentor view. It allows mentees to report their grades—though this feature was not integrated with the evaluation methods of Técnico Lisboa’s courses—and mentors to follow their mentees’ academic evolution. It also includes study guidance tools for mentees, such as a list of tasks integrated with a Pomodoro timer. Mentors can also add tasks to their mentees’ task lists through their view in the mobile application. The mobile application also has a feedback feature which mentees can use to submit their suggestions for improving the MP-TP.

The Web application uses a front-end dashboard template, ng2-admin, which provides tools to create charts and tables. The Web application consists of two pages. The first page displays a small amount of aggregated data, and the second page contains a table that displays the student information, each row corresponding to a student.

The server hosts an Apache CouchDB database. CouchDB is a database software that has a document-oriented NoSQL database architecture. The CouchDB database hosted on the server stores all the data related with the NAPP framework. Local data storage on the mobile application and on the Web application is done through PouchDB. PouchDB is open-source JavaScript database software which was created to facilitate the development of offline applications. It also has a document-oriented NoSQL database architecture. PouchDB stores data locally on the device, and then syncs those data to the server-side CouchDB database when an Internet connection is available. The system architecture, as described above, is presented in Figure 1.

3. Methodology

From the beginning, it was known that the evaluation of this work was highly dependent on whether there would be real data to analyse how valuable NAPP will be to the MP-TP. For this reason, the first objective was to get the mobile application to a state where it was ready to be used by mentors and mentees. Since the mobile application was initially developed as a prototype, it had only been tested for usability; and NAPP as a whole had only been run on a local computer environment.

At that time, a considerable flaw of NAPP was related to the reporting of grades: the grades reported by students were not linked to an evaluation, which would make it very difficult for the MP-TP’s coordinator to follow the students’ progress accurately. The approach chosen was to model the courses’ information, including the evaluation methods, and store it in a database, named the Courses database. NAPP’s mobile application was then modified to retrieve courses’ information from the Courses database, allowing students to choose both a course and one of its evaluations when reporting a grade.

3.1. Structured test

With these changes, NAPP was ready for a first round of beta testing. The system was tested with a small group of students for three days, from the 1st to the 3rd of March, 2018. CouchDB was set up on a desktop computer, and the mobile application was built for Android and installed on the students’ mobile devices. The students were given a small guide which had a set of chores to complete on given days, along with the expected results of each chore. The goal was to make sure that the system behaved as expected. Because of the very methodical nature of this test, it was named the “structured test”.

During the structured test some critical problems were found that needed to be fixed. The most severe of these problems had to do with NAPP’s data model. The test guide was carefully planned to test the offline behaviour of the mobile application, and the data model proved to be unfit to handle the mobile application’s requirements. At that point, all the data generated by users were stored in a single database, named “napp_data”. This approach of centralising all the users-related data in a single collection of documents (one for each user) does not scale well: firstly, it makes queries to the database unnecessarily complex and slow; secondly, it is very prone to creating replication conflicts. A replication conflict happens
when CouchDB is trying to sync a remote database with the local databases on the users’ devices, but the data being synced are incompatible, so one of the versions is discarded. This often happens due to concurrent offline writes, which were induced by some of the guide’s chores. Since NAPP did not implement any conflict resolution mechanisms, the data in the conflicting versions were lost. These problems prompted an extensive redesign of the data model. The problematic approach of storing all the user data in a single database document was abandoned, and instead, user-related data is now stored in three different databases. The Users database has a document for each user which stores the user’s personal information and, if the user is a mentee, their grades. The Tasks database stores a new document for each task that is created (previously, the tasks of a mentee were stored in the user document, which would cause replication conflicts when the mentee created a task and the mentor assigned a task to the mentee while one of them was offline). The Feedback database stores all the feedback submitted by the users, which facilitates accessing and querying all the suggestions (as opposed to the old data model, where the feedback was stored in the user document). An additional database, named Log database, keeps a record of relevant actions performed by users, which will allow to analyse the impact of NAPP on the MP-TP in the future.

Other problems were found during the structured test, for example, one problem had to do with the interaction flow of the authentication process in the mobile application. The original authentication process confused mentees who took part in the test – some of them ended up accidentally signing up for mentor accounts because the process was not clear. The interaction flow was then modified, which included redesigning the authentication screens on the mobile application. Additionally, the concept of authorisation was introduced into the authentication process. Previously, anyone could sign up to use NAPP’s mobile application, making it vulnerable to malicious exploits. An authorisation stage was added to the authentication process, which ensures that only mentors and mentees who were previously enrolled can sign up to use the mobile application.

3.2. Unstructured test

With these problems fixed, the next objective was to test the mobile application in an actual environment for nearly an entire semester, to be able to collect the data needed to evaluate the value of NAPP to the MP-TP. The ideal course of action was to test the mobile application on both Android and iOS devices, to collect data from as many users as possible. At that point, the acquisition of the licences for publishing the application on “app stores” had not yet been authorised by Técnico Lisboa’s administrative services, so it was necessary to turn to an alternative course of action: distribute the application, to the users who would participate in the test, outside of official channels.

Regarding iOS devices, the only way to install an unpublished application to the devices is to start a an official beta test, which still requires a licence. On Android, on the other hand, one only needs to build the mobile application into an Android package, which can be installed on any Android device, without the need for a license for distribution through Google Play. Therefore, while the licences were not acquired, it was only possible to test NAPP’s mobile application on Android devices.

Two short presentations were given to try to gather students to participate in the test. During these presentations, most of the mentees who showed interest happened to have iOS devices. In the end, 5 mentors and 11 mentees participated in the test. During three months of the second semester of the academic year 2017/2018, the mobile application was used by these students. The students were presented the features of the mobile application but were not given any guide to follow, they were free to use the mobile application as they pleased. Because of the more informal nature of this test, it was named the “unstructured test”.

3.3. The new Web application

While the tests took place, another core part of this work was being developed. NAPP’s Web application is a fundamental component of NAPP because it is the element that aims to help the MP-TP’s coordinator to analyse the students’ grades more efficiently. The problem was that the existing Web application did not suit the needs of the coordinator. In the original Web application, all the user information was displayed in a table, but this table did not resemble the spreadsheet already used by the coordinator and could not be manipulated like that spreadsheet. The previous Web application was developed using a front-end dashboard template, named ng2-admin, and this template was sufficient for the very few features of the application. However, due to its high complexity and poor documentation, the template was not suitable for the continued improvement that NAPP requires. For these reasons, the existing Web application was discarded and a new one was built according to the coordinator’s requirements.

The new Web application was developed with Angular, without the use of any template. The Web application employs charts to facilitate the visualisation of information, and the Chart.js library is
used to draw them. Chart.js is a charting library for JavaScript that has support for various types of charts and interactivity. The Web application is divided into five features.

### 3.3.1. The Courses feature

The Courses feature gives the MP-TP’s coordinator the ability to manage courses’ information, and to visualise and analyse the results of each course’s evaluation. The Courses feature is comprised of three pages: the list of courses, the course page, and the page to add a new course.

The list of courses displays a list of cards, each representing a course. Each card has a hyperlink to the course’s page, and also shows basic information about the course.

The course page is the most important page in the Courses feature. The main goal of this page is to facilitate the analysis of students’ results for each evaluation of the course. The page provides a way to quickly identify the students who had negative grades in an evaluation, and automatically calculates basic statistics of each evaluation (average grade, number and percentage of negatives and positives). The distribution of students’ grades is plotted in a bar chart which adapts to the grade intervals of each evaluation (some evaluations do not fit the usual 0-20 scale). Figure 2 shows the distribution of grades for first test of the “Algebra Linear” course, whose grade interval ranges from 0 to 5.

![Figure 2: The course page of the Web application](image)

There is a table below the distribution of grades which shows the list of students and their grades. When a bar in the chart is clicked, the table will be filtered to only show the students who obtained the grade relating to the selected bar. On the right-hand side of the page, a circular chart shows how the students are partitioned in terms of number of positive, negative, and not reported grades. Additionally, the same statistics are presented in text format below the chart, along with the average grade for the evaluation.

The last page of the Courses feature is the page to create a new course, by filling in the necessary information. The page contains a form that is divided into two parts: first the user inserts the basic information about the course, then the user adds the evaluation method. There are field validation rules in place, and error messages are shown to the user if any field does not follow the rules.

### 3.3.2. The Students feature

The Students feature allows the MP-TP coordinator to view and manage information related to the students who take part in the mentoring programme. Most importantly, the coordinator is able to follow each student’s academic progress. The Students feature is comprised of four pages: the students list, the student page, the page to enrol mentors, and the page to view unregistered students (students enrolled in the programme who have not yet signed up on the mobile application).

The students list displays the registered students who take part in the MP-TP. The students’ pages can be accessed through this list or by means of a search bar at the top of the page.

The goal of the student page is to allow the MP-TP's coordinator to follow a specific student's progress. In the case of mentees, this refers to the academic progress; in the case of mentors, it concerns the progress within the mentoring programme. The student page has two possible views, depending on the role of the student: the mentee view and the mentor view.

The mentor view has very little functionality at the moment. It only shows the mentor’s personal information and the list of mentees (both registered and unregistered).

The mentee view shows the mentee’s personal information, grades, use of the study tools on the mobile application, and allows to switch the mentee’s mentor in the current academic year. For each semester, user grades can be visualised in a line chart (Figure 3). The chart allows for easier visualisation of the evolution of the student’s grades over time. The horizontal axis represents dates within the selected semester. The vertical axis represents the grades obtained by the student, normalised to the 0-100% range (normalisation was needed because grade intervals vary among the evaluations). Below the chart, the page also displays tables, where it is possible to view the student’s grades in every evaluation of each course.

Another page in the Students feature allows the
coordinator to enrol new mentors. The enrolment of new mentors relates to the new authorisation mechanisms introduced before the unstructured test: mentors must be enrolled beforehand in order to be able to sign-up using the mobile application. To enrol new mentors, the coordinator must insert an academic year and the IST IDs of the mentors. For convenience, instead of having to type out the IST IDs of the students, the coordinator should submit an Excel file. There are instructions on screen on how to correctly create the Excel file.

3.3.3. The Alerts feature
The objective of the Alerts feature is to deliver alerts about relevant events within NAPP to the Web application. At this point, the only event that was identified as being valuable is when a student reports a negative grade. Thus, the Alerts feature serves the purpose of helping the MP-TP’s coordinator to identify at-risk students. The Alerts feature was designed with extensibility in mind, so that, in the future, it can support different types of alerts, and not only alerts relating to the report of negative grades. The goal is to give the coordinator the ability to customise, within a set of predefined parameters, what types of alerts they would like to receive. For this purpose, it was necessary to create and model an entity that can describe the preferences of the coordinator. The coordinator’s preferences are kept in a document in the Users database – the coordinator’s document. The Alerts feature uses Firebase Cloud Messaging (FCM) to deliver the alert as a push notification, which appears in the coordinator’s device even if they are not using the Web application at that time. The coordinator has to allow the Web application to show push notifications to activate this functionality, and they can opt out at any time – the alerts will still be delivered inside the Web application even if the coordinator has opted out of push notifications.

The Alerts feature is a programme that runs continually on the server. The program syncs with the Log database and listens to changes, so that every time a new document is written to the database, it will trigger the execution of some procedure associated with the Alerts feature. This procedure determines whether the event associated with the new log document should cause an alert to be delivered to the MP-TP’s coordinator, and it also handles the delivery of the alert (both to the Web application and through FCM). In the Web application, the list of alerts is shown in a panel that can be opened by clicking a “bell” button on the top-right corner of the screen, which will show the panel overlaying the current page.

3.3.4. The Dashboard feature
The goal of the Dashboard is to allow the coordinator to view relevant, up-to-date information about the MP-TP without the need to browse through the other pages of the Web application. This information is conveniently aggregated and presented in the form of “cards” in the Dashboard page (Figure 4).

The information presented in the Dashboard page includes:

- A table with statistics about evaluations that took place within the last month. For every recent evaluation, the card shows how many grades have been reported, how many of those are negative grades, and the average grade,
- A table with the dates of evaluations that will happen within the next two weeks,
- A list of at-risk students, featuring those who have reported at least one negative grade,
• The number of enrolled versus unregistered mentors and mentees. This is particularly relevant at the start of the academic year, so that the coordinator can keep track of how many students have not yet created an account in the mobile application.

• A visualisation of the activity logs generated by the students using the mobile application, in the past week and month.

As this is a Dashboard, it is important that the information is up-to-date, so the page is configured to refresh every five minutes.

3.3.5. The Feedback feature
The Feedback feature is made up of a single page where the MP-TP's coordinator can view the suggestions submitted by mentees. The suggestions are sorted by date, showing newest suggestions first. Above the list there is a search box that can be used to search for words within the text of the suggestions.

3.3.6. Usability testing
In order to be able to detect flaws in its design, the Web application needed to undergo usability testing. In a usability test, the users are asked to perform a set of tasks using the system. These tasks should represent a realistic scenario of usage. In this test, the Courses and Students features were tested individually, but the Dashboard and Feedback features were tested as a group. The decision of grouping these two features was based solely on the small number of tasks for them. The Alerts feature was not tested because of the lack of meaningful tasks concerning this feature.

It is important to note that the purpose of these tests was to evaluate the Web application's features from a qualitative viewpoint: the goal was to gain insight into common errors, to be able to correct them. The purpose of this test was not to do a quantitative usability study by analysing metrics such as user efficiency, number of user errors or subjective satisfaction. As advocated by Nielsen, when running a usability test that is not meant for a quantitative usability study, testing five users almost always reaches the maximum benefit-cost ratio of user testing. [6, 7] For these reasons, the Courses feature was tested with seven users and the remaining features were tested with five users.

To gain a general idea of how the users felt about the system, they answered the System Usability Scale (SUS) survey after testing each feature. The SUS is a means of assessing the usability of a system by means of a survey answered by the users taking part in the test. The survey consists of 10 items which the users must answer on a scale of 1 to 5 (1 corresponding to “strongly disagree”, and 5 to “strongly agree”). The answers are then converted into a score which ranges between 0 and 100. [8] The users answered a version of the SUS survey translated into European Portuguese. [9]

3.4. The REST API
Besides the two main components, a REST API was also created, mainly to fulfil some requests that would put a heavy load on the client machine if they were computed by the Web application. After the authentication process of NAPP was migrated to use FenixEdu (Section 3.5), another category of endpoints was added. The endpoints provided by the REST API can be divided into four categories:

• Authentication: endpoints relating to the FenixEdu authentication process
• Academic: endpoints to retrieve information related to school, such as evaluations or student grades
• Analytics: endpoints to retrieve statistical information about the usage of NAPP
• Mentoring: endpoints to retrieve or update information about the MP-TP

3.5. FenixEdu Authentication
After the end of the structured and unstructured tests, another important improvement was made to the mobile application. The authentication process became integrated with the Central Authentication Service provided by FenixEdu, the academic information platform created by and used at Técnico Lisboa. This allows students to use NAPP with their academic credentials. Not only is this more convenient for students, who will not have to memorise a new set of credentials to use NAPP, but it will allow to further integrate NAPP with the FenixEdu API in the future. After the student is authenticated via FenixEdu in the mobile application, the authorisation phase begins. A request is made to the REST API which will verify if the authenticated user corresponds to a new mentor in the current academic year (who would have been previously enrolled by the MP-TP's coordinator on the Web application), or to a new mentee (who would have been added by the student's mentor using the mobile application).

3.6. System architecture and deployment
In the current system architecture (Figure 5), the server no longer runs only CouchDB. The REST API also runs on the server, and it answers requests from the Web and mobile applications. The REST API was developed in Node.js, and it uses PouchDB to communicate with CouchDB for database access and sync.
The Alerts feature of the Web application requires that a worker runs on the server. This worker was developed in Node.js and it also uses PouchDB to connect to CouchDB for database access and sync. The Alerts worker communicates with Firebase Cloud Messaging for delivering push notifications to the coordinator’s device. Firebase Cloud Messaging is a cross-platform cloud solution for messaging provided by Firebase, a subsidiary of Google.

The Web application has database access through PouchDB – it keeps local replicas of most databases, which sync with the remote server databases. As for the mobile application, each client device running the application will have its local replicas of the databases, and PouchDB will take care of keeping them in sync with the remote server databases.

The Server pictured in the system architecture will actually be deployed as two separate servers. These servers are hosted by Técnico Lisboa’s virtualisation platform, powered by OpenStack software. The first virtual server runs CouchDB exclusively, thus becoming the dedicated database server. The second virtual server runs the REST API, the Alerts worker, and also Apache Web Server software which serves the Web application. Each virtual server has a public IP address, making it accessible from outside of Técnico Lisboa’s campi. Both servers have been configured with HTTPS for secure communications, with SSL certificates provided by Técnico Lisboa.

As of October 2018, the licences to publish NAPP’s mobile application on Google Play (Android) and iOS App Store (iOS) have been acquired.

4. Results and discussion

As mentioned before, the Web application underwent a usability test made up of three parts, where each part tested a different feature (the last part tested the Feedback and Dashboard features as a whole). An acceptable average score on the System Usability Scale ranges between 65 and 70. [10] Table 1 shows the average scores obtained by the features that were tested, which fall above the range of acceptable average scores. While there is no intention to use these scores as a means to quantitatively evaluate the Web application and to make a definite statement about its usability, one can say that the average SUS score shows high user satisfaction.

In general, users were fairly successful in completing the tasks that were presented. However, there was one particular task in the Feedback and Dashboard features that all five users failed – the task consisted of looking up information in the dashboard, and answering a question; users were not informed during the test if their answer was correct. As such, it is interesting to note that the Feedback and Dashboard features have the highest SUS score among the three tests. This could be explained by the fact that the SUS survey is answered immediately after the users finish the test, before any feedback is given about the results.

As for the mobile application, 5 mentors and 11 mentees participated in the unstructured test. Because this was a very small number of students, it was not possible to do any meaningful statistical analysis about the use of NAPP’s mobile application. Given these circumstances, it was decided that the objective of this test was no longer to collect data to evaluate the value of NAPP to the MP-TP, but rather to get a first impression of how much the students would use the mobile application over an extended period of time.

Over the course of nearly three months (between April 10th and June 26th, 2018), the students generated 132 activity logs. Figure 6 shows the distribution of activity logs over time. It is possible to see that there was higher activity during the first week and that later it slowed down. During the remaining time, students mostly reported grades and used the task list tool. As can be seen in the distribution, although there peaks in activity, students used the mobile application at least once a week (except for

<table>
<thead>
<tr>
<th>Feature</th>
<th>Average SUS Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses</td>
<td>95</td>
</tr>
<tr>
<td>Students</td>
<td>93</td>
</tr>
<tr>
<td>Feedback and Dashboard</td>
<td>97</td>
</tr>
<tr>
<td>Average of all tests</td>
<td>95</td>
</tr>
</tbody>
</table>

Table 1: Average SUS scores obtained by the Web application

As of October 2018, the licences to publish NAPP’s mobile application on Google Play (Android) and iOS App Store (iOS) have been acquired.
the week between May 29th and June 5th). In a feedback session after the test ended, students reported that what they struggled the most with was knowing when the mentor interacted with them, or when the mentee reported a grade or completed a task – this difficulty to remain engaged with the mobile application explains the peaks in activity seen in the distribution.

5. Conclusions and Future Work

The unstructured beta test conducted with a small group of students over a long period revealed that students engaged with the mobile application at least once a week, except for one week. The usability test carried out on the new Web application allowed to diagnose some usability problems, but users were generally very satisfied with the application.

These tests allowed to get NAPP into a state where it is ready to undergo a bigger and more formal test, in a real environment. The goal of this test will be to evaluate whether NAPP contributes positively to the MP-TP by evaluating a key metric: “How many days have passed since a professor published an evaluation’s grades until the coordinator received them”. For this test, the students will be divided into two groups. An experimental group will use NAPP’s mobile application and, to be able to make a comparison with the traditional method of the MP-TP, a control group of roughly the same size will not use the mobile application. This test will include approximately 150 mentees and their mentors. This test will take place from late-October 2018 until January 2019 (end of the first semester).

Moreover, further enhancements should be made to NAPP, including the implementation of push notifications in the mobile application to increase user engagement, as well as the implementation of a score system of mentors’ activities by the MP-TP’s coordinator.

References


