# App PT-UA: proposal of an instantiation artefact as facilitator of social learning in a tutoring program

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**Abstract:** The emerging democratisation of the use of mobile devices has challenged higher education institutions to think of innovative ways to engage their students (and teachers). Confronted with this reality and in order to improve social learning and engagement in the University of Aveiro's Tutoring Program (PT-UA), this paper describes the development of an innovative artefact – app PT-UA, based on mobile learning applications and a social network environment. The methodological approach adopted for the development of the app PT-UA is grounded in design science research (DSR). The proposed prototype is supported in an online social networking concept where all participants can publish and share ideas. It provides GPS navigation, an events calendar, real-time chat, user profiles, and a community where users can post and comment on other users' posts.

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# 1   Introduction

In 1999, the signing of the Bologna Declaration launched the process of creating a coherent and competitive European Higher Education Area through the introduction of a compatible degree structure, a common credit system, the promotion of exchange and collaboration across Europe (and beyond), and the strengthening of quality assurance (e.g., Pływaczewski and Kraśnicka, 2016). As a result of this process, higher education institutions (HEI) have changed the way teaching and learning are organised, becoming increasingly learner-centred and result-oriented. Consequently, there has been an increase in the provision of mechanisms and structures designed to support students in the transition to higher education and in the successful completion of their degree programs. These include the widespread introduction of tutoring and mentoring programs.

In line with this trend, and building on previous institutional experience, the University of Aveiro (UA) launched a university-wide Tutoring Program (PT-UA). The PT-UA put into practice a structure designed to promote the academic success and social and psychological well-being of students by focussing on the successful transition to higher education, and the encouragement of a feeling of belonging to the institution and the study program, and providing coaching in specific and general skills that can contribute to long-term success (Fernandes, 2013; Simões et al., 2016).

The structure put in place by the PT-UA involves the establishment of tutoring teams within each study program, composed of tutees (first year students), mentors (more advanced students), and tutors (teachers). The primary goal of this structure is to ease the transition to higher education by supporting students as they meet the challenges posed by this new reality and empowering them to take control of their academic paths. In this way, it contributes to the network of support provided by the university to prevent drop-out and academic failure, by installing a capacity for the personalised guidance of students and the early identification of problem situations. The PT-UA has established itself as a program which is considered advantageous by its participants and has given indications that it can also improve student well-being and academic success. It has become apparent, however, as the program has grown and expanded to more study programs and departments and the communication habits of participants have rapidly evolved, that the program's communication strategy should be revisited and updated.

In effect, the emergence of smartphones and other mobile devices has revolutionised the way we perceive the world and behave in society. In this context of major technological and social change, the use of digital media offers a promising way to facilitate dialogue among various parties, ensuring that information can arrive in a timely and appropriate manner to key stakeholders. In an educational environment, the use of digital media is also regarded as a way of engaging students (and teachers) in more dynamic ways. Currently, a considerable number of studies support the use of smartphones in formal learning settings as a complement to more traditional tools (e.g., Kadry and Roufayel, 2017; Manca and Ranieri, 2013; Pimmer et al., 2017). These authors highlight the possibility of students receiving immediate feedback and being able to express their opinions more easily, facilitating learning and collaboration inside and outside the classroom, thus enhancing interaction between students and teachers. Pimmer et al. (2017) refer to the fact that the participation rate is related to the degree of trust that students have in teachers, so when they have the opportunity to interact with a teacher personally, they tend to participate more.

In the context of a tutoring or mentoring program, contact, both face-to-face and distance, between those involved must be ongoing. Chat platforms, social networking websites, and other similar platforms present themselves as facilitators (Merritt and Havill, 2016), while the use of social media platforms and smartphones can be a successful way of engaging student populations and enhancing the establishment of relationships.

It was with this in mind, and with a view to reinforcing contact between tutors, mentors, and tutees using these digital media that we proposed the development of a mobile application to support the PT-UA. This paper, which describes the research work undertaken for this purpose, is organised according to the publication schema of design science research (DSR) methodology of Gregor and Hevner (2013), and structured as follows:

1  introduction

2  literature review about social media environments supporting tutoring programs

3  method – DSR

4  artefact description – app PT-UA

5  evaluation and artefact re-design

6      conclusions.

## 2      Social media environments supporting tutoring programs

Tutoring and mentoring programs can help HEI promote student success and well-being and combat drop-out, particularly early drop-out, but such programs require constant effort and attention in order to flourish and meet the range of cultural, institutional and structural challenges they face. In this paper, we focus on how communication between the different participants in such programs can be enhanced using mobile applications and the logic of social networking.

### 2.1      *Tutoring configurations and challenges*

Despite the increase in such programs in HEI, a single definition of tutoring and mentoring does not exist (Crisp and Cruz, 2009; Flores et al., 2012; Collier, 2017). The tutoring function, assigned to teaching staff, involves a range of attributes, including, principally, an advisory and counselling role, an educational and coaching role, and a mediating and support role through the establishment of a personal relationship with a tutee. For Flores et al. (2012), tutoring has emerged as an essential component of the teaching function in higher education post-Bologna as teaching has become centred on learning processes rather than on the transmission of information. The mentoring function may involve similar roles, but essentially involves the personalised support and guidance of a more experienced person (in HE, a more experienced student), in transitional settings (Crisp and Cruz, 2009; Collier, 2017). Often referred to as peer-mentoring, it amounts to a personal and reciprocal process, from which both parties benefit (Crisp and Cruz, 2009; Beltman and Schaeben, 2012). A mentor has also been described as a trustworthy person who takes care of someone in need (Dondero, 1997, as cited in Haber-Curran et al., 2017). In this reciprocal process, mentors gain self-confidence and a feeling of usefulness in serving a larger cause, and develop leadership, organisational and communication skills (Beltman and Schaeben, 2012; Harmon, 2006; Hughes et al., 2010; Gilles and Wilson, 2004).

Despite the complexity of the conceptual field, there are principles which underlie all tutoring and mentoring programs, their fundamental goal, according to Collier (2017, p.9) being "to help students stay in school and complete their degrees in a timely manner." Crisp and Cruz (2009) outline four common dimensions to the mentoring concept, which are: the provision of psychological and emotional support; guidance with setting goals and choosing a career path; support with the acquisition of academic subject knowledge; and the provision of a role model.

So, while programs involving tutors and mentors present different configurations, the literature supports the belief that such programs can help students in their transition to tertiary education and contribute to their academic success and persistence rates (Crisp and Cruz, 2009; Collier, 2017). According to Beltman and Schaeben (2012) and Harmon (2006), these programs help students develop skills necessary for success and gain a sense of belonging. Some tutoring and mentoring programs focus on students considered at risk of dropping out, such as students with disabilities, low-income students, and first-year students (Haber-Curran et al., 2017). Many cases confirm the advantages of tutoring and mentoring programs in particular contexts, with participants revealing

enhanced personal skills, such as increased self-esteem and sense of belonging to a community (Rasheem et al., 2018).

In general, studies report the advantages of tutoring and mentoring programs for academic success, highlighting the development of time management and leadership skills, among others. These programs facilitate integration and support the accomplishment of various academic tasks, translating into higher achievement (Sato et al., 2017; Etzel et al., 2018). Also, virtual tutoring programs have proven to be very useful in rural areas, allowing students to overcome geographical barriers (Keeler et al., 2018).

Almost all authors cited above point out that, in order to enhance the success of tutoring and mentoring programs, it is important to communicate adequately in the media most used by students. A program is only useful when its recipients are aware of it at the right time for them to benefit from it. Social network environments are, therefore, an ideal way to establish and maintain lasting contacts between participants in such programs. When choosing to integrate a social network environment into an existing tutoring/mentoring program, care must be taken to choose one in which both tutors, mentors and tutees feel comfortable and confident, and which is based on the profile, type of content and intended objectives (Briones and Janoske, 2013). In order to understand better how the internet and other web services have evolved and to what extent they respond to users' needs, we examined how the Internet has enabled the development of software to support users, in particular with regard to tutoring and mentoring programs.

## 2.2   *Tutoring experiences supported by mobile technologies*

Changes in student behaviour in the digital age have brought new challenges to HEI, and in this case, to existing tutoring and mentoring programs. As we have outlined above, there are advantages to integrating social network environments and new digital mobile technologies into such programs.

A mobile application, commonly known by the term APP, is software designed to run on mobile devices such as smartphones, tablets and smartwatches. APPs may be obtained and installed via official stores: App Store in the case of iOS devices and Google Play for Android devices (Tech Terms, 2012). With the emergence and development of mobile devices and the current proliferation of applications, there is a constant struggle to attract the attention and the interest of the user. Users today live surrounded by information and will access various applications during the day, although for short periods of time, making it necessary to provide relevant content, quickly. It is therefore indispensable to know the target audience and to be able to monitor how the application is used (Smilansky, 2016).

APPs exist to meet the needs of their users, particularly those needs related to information, leisure, communication and entertainment. When applications do not adequately serve these needs and do not meet the expectations of users, they will rapidly be discarded and exchanged for other similar applications. Many applications available in stores are not well-received by users, since they do not have appropriate content or score negatively on user experience (UX) (Wac et al., 2011). The UX of an application is positive when it meets the needs and expectations of the user. The attractiveness of a product is a subjective concept, which varies from user to user; however, there is the association that an attractive product offers a better UX (Hassenzahl, 2004). Therefore,

before the development or design of an application, it is important to follow some recommendations, particularly from the two big names in the mobile development industry, namely Apple and Google. Apple, for example, presents a set of recommendations on several essential aspects, such as choice of colours, typography, interface elements, appropriate animations, suitable content type, etc. These facilitate the work of designing an application and increase the likelihood of it being successful and appropriate for its audience (Apple Inc., 2017).

There are some applications on the market for the support of mentoring programs. The most relevant are: Achiiva (2016), Chronus (2018), eMentorConnect (n.d.), Graduway (2017), MentorNet (n.d.), Mentor Scout (2018), Unibly (2017), Mentored (2017) and Edmodo (2018). Based on a survey of company websites and a search of Apple and Google Stores, the analysis of the various platforms and applications, and their comparison, helped to identify some interesting features to incorporate into the app PT-UA. Despite some of these applications appearing to include relevant functionalities for the PT-UA, the development of an application from scratch is an option that allows a high degree of personalisation and a considerable reduction of costs. There is no need to pay monthly fees for the use of a platform made available by a third party. On the other hand, it is necessary to develop all the code and functionality.

## 3   Design science research

Since design science is a problem-solving process, the fundamental principle of DSR is that knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact (Carstensen and Bernhard, 2018; Gregor and Hevner, 2013; Peffers et al., 2007; Hevner et al., 2004). Based on this principle, the goal of our research project was to propose an innovative, purposeful artefact – app PT-UA – designed to enhance social learning and engagement in the PT-UA. So, following DSR guidelines:

1   an innovative purposeful artefact was created

2   for a specified problem domain

3   the utility, quality, and efficacy of the created artefact was evaluated

4   the contributions were synthetised and reported

5   then, the artefact was re-designed

6   the process by which it was created and evaluated was presented

7   as recommended, the results of the research were communicated to the senior management team at Aveiro University, so that the application of the artefact to the UA tutoring community could be assessed.

The purpose of the app PT-UA is to enhance social learning and engagement among all PT-UA participants through the provision of convenient access via a smartphone. Thus, the mobile application includes features which enable:

1    access to a map screen with GPS navigation allowing the location of the user to be identified and a dropdown where a place of interest can be chosen

2    access to all information about relevant events taking place at the university, such as training sessions, workshops, social events

3    chat between members

4    the addition of content to the community discussion forum with questions, doubts and pertinent information.

## 3.1   Development of an innovative purposeful artefact

For the creation of an innovative purposeful artefact in response to a specified problem domain – communication flows between participants – the state of the art was surveyed, and a careful analysis made of other cases of mobile applications applied to tutoring (or similar) programs, the best ways of developing mobile applications and the care to be taken in their design were identified. Next, the layouts and main features of the application were elaborated. It was decided not to carry out a needs assessment with tutors, mentors and tutees but instead to undertake a benchmarking exercise in order to identify the most commonly used features in applications similar to the one we intended to develop. The design of the layouts corresponded to the creation of the artefact, and was done using code, following the recommendations outlined in the state of the art so as to ensure an agreeable and appropriate user interface (UI). The development principles presented were also essential for the code we developed to be reusable, simplified and easy to maintain in the future.

For the development of the app PT-UA, React Native was used in conjunction with Redux (React Native and Redux are tools to ease the development of JavaScript (JS) applications). An application has several states, which change, either when a user clicks a button, or when the data changes. The more complex an application is, the more complicated it is to manage states efficiently and to assign responsibilities. Redux has dealt with these problems by keeping all data in a single store. In Redux, actions are activated when a status change request occurs, such as the click of a button. The action registers the action type and can also record the values stored in the input boxes. The main function of actions is to send the type and payload to reducers. The reducers are pure functions, that is, they give the same output for the same input. When an action occurs, it is sent to all the reducers, and modification only occurs when one of the reducers has planned a type of action for that action type. When a reducer has not predicted an action type for the action, it returns only the state. The reducer receives the action payload and creates a new state with the changes. When the change is made, the store informs the react of the change and it changes the data in the application, and new content is presented to users. This type of architecture allows for the assigning of responsibilities and the separation of concerns, making it easy to know who was responsible for changing the state, facilitating debugging. Figure 1 shows the communication flow between React Native and Redux with the server.

To implement the chat, Pusher was used, and communication established between Laravel backend and Pusher, making it possible to write messages in the database. A connection was also established between React Native and Pusher so that react could receive the changes in real-time. For this to work, communication was implemented

through sockets, and in the Laravel backend part, Laravel event broadcasting was configured to create channels.

To implement the application's GPS navigation mode, a react-native-maps package was installed to facilitate the incorporation of GPS and maps, and to develop the specific methods and add the coordinates of each point of interest. Clicking the find me button allows access to the user's location.

**Figure 1**   Communication flow between React Native and Redux with the server
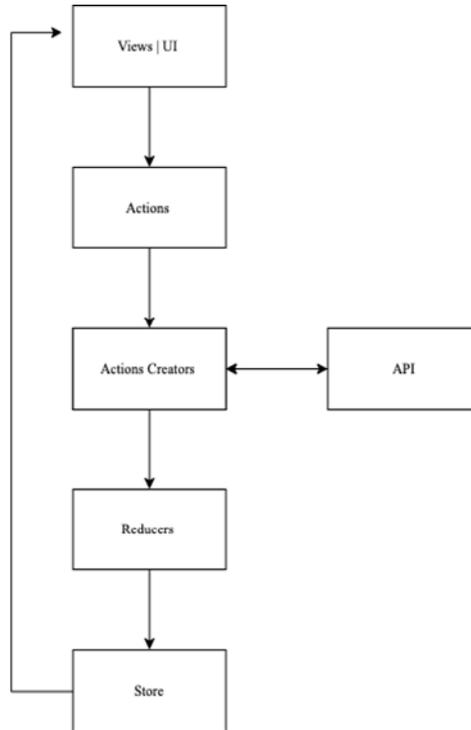


In the graphic part of the application, the native base feature was introduced, providing a set of UI components compatible with Android and iOS. Native base was used for buttons, input boxes, bottom and side menus, as well as all icons. Features such as giving a 'like' generate a request to the database that requires a joint action of three different tables.

Since it was not possible to purchase the Apple iOS and Google developer licenses for the development stage, EXPO XDE was used to test the code on mobile phones. EXPO XDE allows code to be written once and later converted to iOS and Android.

### 3.2   Evaluation and re-design of the artefact

The evaluation of the created artefact is a crucial component of the research process, so the evaluation of the IT artefact – app PT-UA – required the definition of appropriate metrics and the gathering and analysis of appropriate data (Hevner et al., 2004). Because the design is inherently an iterative and incremental activity, the evaluation phase

provides essential feedback on the quality of the product being developed. Given that the artefact in question was a mobile application based on design evaluation methods presented in the work of Hevner et al. (2004), we decided on the experimental method as the most appropriate. This method consists of the study of the artefact in a controlled environment, testing its qualities (e.g., usability) and including simulation with artificial data.

Usability tests allow the UX to be assessed and the degree of satisfaction and experience provided by the app to be measured (Finstad, 2010). The UX is the experience of a user with an application regarding its ease of use. It responds, therefore, to the way people interact with, perceive and feel about the use of a product or artefact. To achieve a good UX, the real needs of users must be effectively met (Norman and Nielsen, 2018). An interface must be designed with its end users in mind, with the focus on making it as simple, intuitive and as appropriate as possible to the needs of its users. According to Nielsen (2012), usability can be evaluated as the ease with which users use an application; the time they take to perform a task after learning; the memory capacity of an experienced user when they cease to use the application over a long period of time and the time they take to retrieve proficiency; the number of errors users commit; whether the user can recover from the error; and the degree of user satisfaction. Usability tests can be done in a laboratory or in a small room; the important thing is to simulate the actual conditions of use of the application, recreating an environment as close as possible to its actual use. Collecting users' emotions during the tests is a challenge given that these are subjective and may change, if, for example, problems occur. Pictograms may be used to facilitate this collection and the description of the users' emotions, and instruments such as the self-assessment manikim (SAM) or emocards can be used (Isomursu et al., 2007). Emocards allow users to express their emotions without the need to use words, requiring only that they choose the cartoon that best reflects their state of mind (Zenk et al., 2009).

For the evaluation of the app PT-UA prototype, an exploratory testing approach was followed. After a brief oral presentation, the potential users were asked to perform a set of tasks contained in a script. The degree of satisfaction with the app PT-UA was then assessed by means of a questionnaire (delivered by hand) using emocards, a Likert scale and open questions. Questionnaires are considered suitable for studies in which the objective is to assess the needs of users and their points of view about an experiment (Williamson, 2018). In the opinion of this author, questionnaires allow researchers to identify the types of use and the degree of satisfaction that users have with the experiment. In addition, if they are delivered by hand, there will be a higher response rate than if the questionnaire is conducted by mail or online.

The questions included in the questionnaire were designed to be as simple and direct as possible in order to avoid misinterpretation. Closed questions were used, mostly opinion questions, and a Likert scale was employed. Likert scales are used in questionnaires because they are easy to build, and they allow questioners to know the opinion of respondents on, sometimes, complex issues (Llauradó, 2015; Lantz, 2013). In addition, some open questions were used to provide users with the opportunity to express their opinions. Questions using emocards were related to the various features of the application and whether these features were useful for users. The Likert scale was used to assess the degree of difficulty with each of the screens, and the open questions were designed to identify which functionalities users considered to be most important, as well as those they liked less. Respondents were also asked for suggestions for improvement.

The combination of these methods provided a general idea of the degree of user satisfaction and the main difficulties encountered.

Following the script, the participants were asked to perform a set of tasks. These were:

1   register a new user account

2   log on

3   access the profile screen, add a profile photo and a brief description

4   visit the community screen

5   like a news item of your choice and write a comment

6   create a new item of news

7   access the events calendar

8   add a new event on the calendar

9   access the chat and start a conversation

10  browse the map, find your location and get directions to one of the university departments

11  log out.

After completing the tasks, participants were asked to answer some questions relating to their opinion about the different screens and the general feel of the app, and how easy it was to navigate between the different screens. For the 'feel' type of questions, emocards were used, with a scale from zero to ten, where zero corresponded to very happy, and ten corresponded to very unhappy.

A sample composed of participants in the PT-UA (tutors, mentors and tutees) was selected by invitation. The usability testing involved one-to-one interaction between researcher and user with the application. The researcher analysed how well the users performed the particular tasks and their feeling of the whole experience. All tests took place in a small room in the UA.

A laptop with EXPO was used to compile the code and render it on a smartphone, making it possible to do the tests. EXPO is a free software developed by a community of developers, many of them former officials and developers of React. It allows React Native code to be compiled to the native languages of smartphones and rendered to the app, without these being in the App Store or Google. It is very useful in the development and test phases, because it contains a set of features that reduce the complexity of the code that is required to communicate with components of smartphones, such as geolocation and the image library devices. After all, the code being developed allows all code to be compiled in an optimised way, facilitating the process of launching the App Store or Google.

## 4   Artefact description: app PT-UA

In order to promote greater acceptance and involvement of students and teachers, the app PT-UA was designed to include features and functionalities usually available on social

networking websites. In particular, the app provides a user profile page where it is possible to modify personal data and profile image, join communities and groups, chat with other users, create posts and express opinions, create and disseminate events, training sessions, etc.

The implementation of layouts in code offered each user GPS navigation capability to facilitate navigation within the campus, to access main events and to add new events. They are also able to 'like' or comment on a particular post and create new posts, and to engage in real-time chat and edit their profile page. For the implementation of layouts, React Native was chosen for the app's graphical component (UI), and Redux selected for the management of the app's state. For the backend, we chose to use Laravel, and the Pusher for the real-time chat communication. The GPS navigation mode uses an external module in conjunction with React Native, which allows access to the user's location and presents routes, depending on the choice of a destination point. For the backend/server-side part, PHP programming language was selected and MySQL for the database system. PHP was chosen because it is easy to develop, and there are many frameworks and much documentation available. Regarding the implementation of the mobile application, one of the JS frameworks was used and once developed, the code was compiled into native Android or iOS code. This option supported the development of a single time, without the obligatory code in Java in the case of Android and Swift in the case of iOS. These JS frameworks for mobile development allow access to various modules in smartphones, such as access to GPS navigation. To implement the chat and make the notification systems in real-time, the use of socket communications was selected.

In developing the app PT-UA, the principles of object oriented programming (OOP) and good software design, in particular scalability, were followed. The decision was made to apply good programming practices such as not repeating code, making the separation of concerns, and commenting on the code so that it can be easily understood by other developers.

The app PT-UA contains seven main screens. Figure 2 shows the user flow and the screens. The screens are:

- landing screen, where the user can choose whether to enter or to register

- registration screen

- login screen

- profile screen

- community screen

- events screen

- map screen with GPS navigation

- chat screen.

The landing screen, when the user has not yet logged in, requires a choice between registering a new account or logging into an existing account (Figure 3a). In Figure 4, the login screen is presented with some visual feedback; the UI shows a red cross when the input fields are not correctly completed and shows a green check mark when everything

is correct. The profile screen is designed to enable users to access their profile and view and edit their data, such as name, e-mail address and profile photo.

**Figure 2**    The user flow for the use of the app PT-UA (see online version for colours)
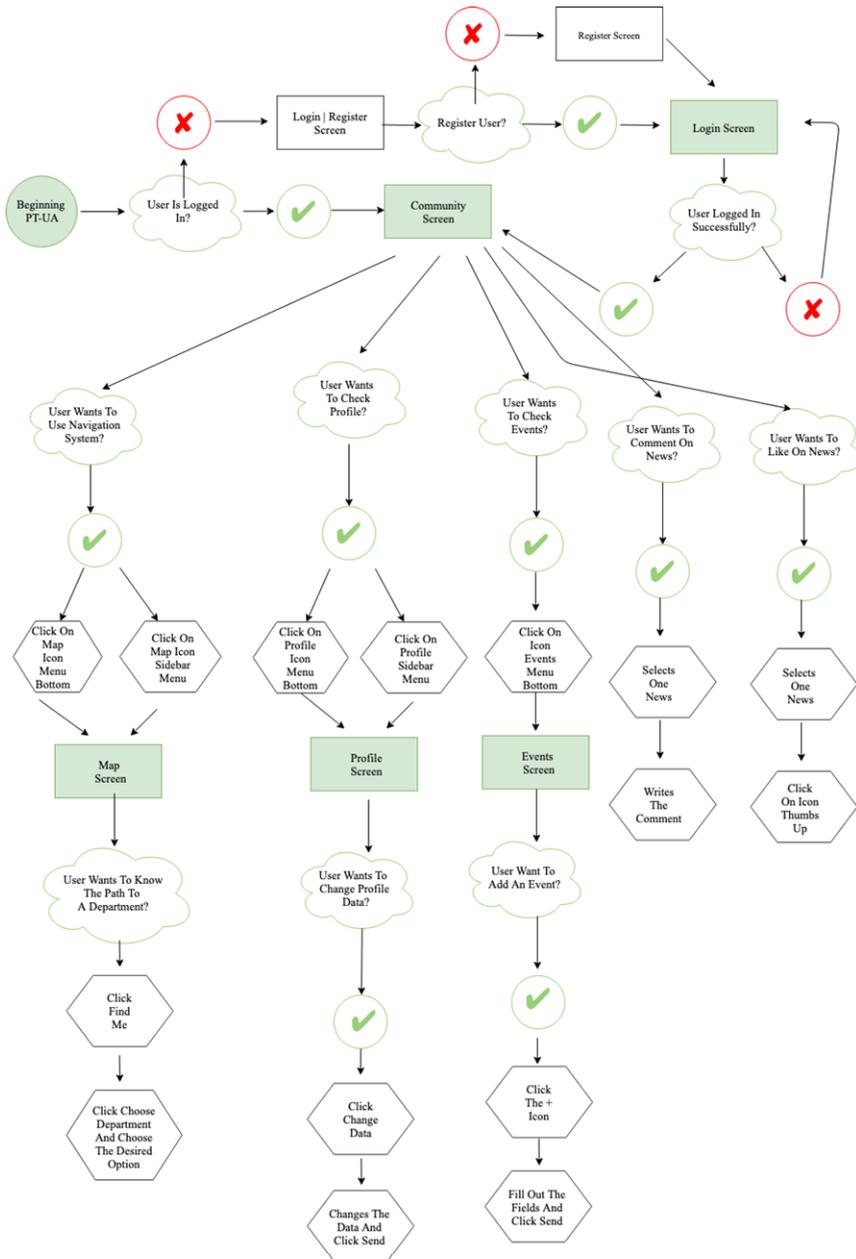


When the user has logged in, the landing screen becomes the community screen, where the user may consult other publications, 'like', comment on and create his/her own publications (Figure 5).

**Figure 3**   (a) Landing screen and (b) registration screen (see online version for colours)
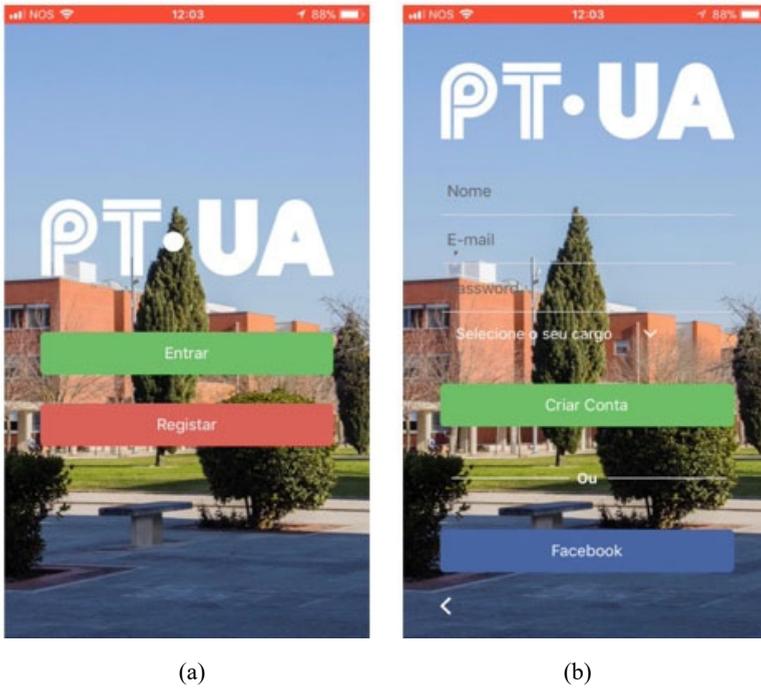


(a)                                                                (b)

**Figure 4**   Login screens with visual feedback (see online version for colours)



(a)                                                                (b)

**Figure 5**    Community screens (see online version for colours)
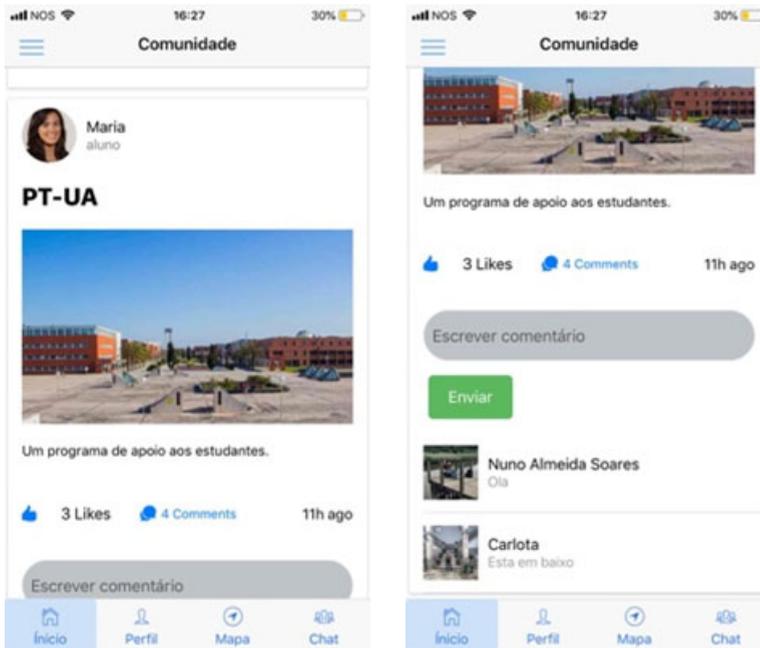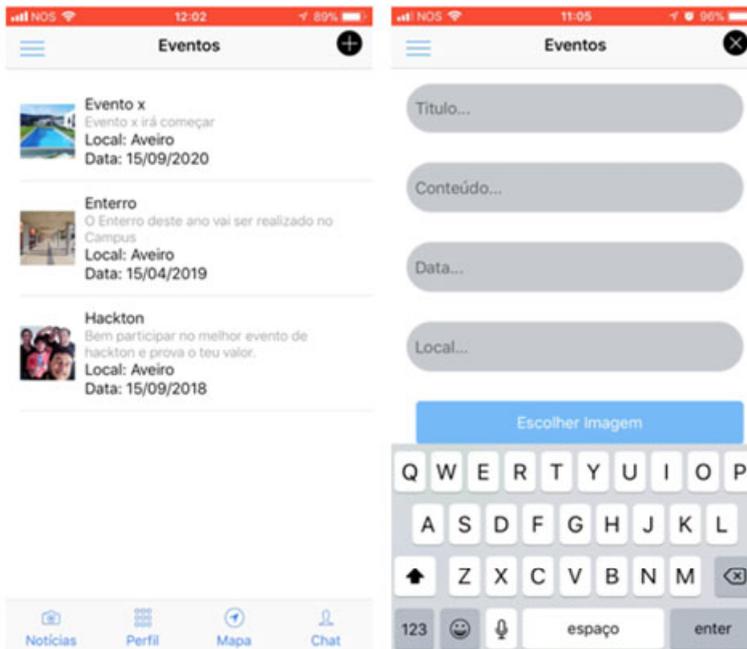


**Figure 6**    Event screens with the (a) list of all events and (b) event creation (see online version for colours)



(a)                                    (b)

The event screen allows users to search for events on campus or to add/edit events (if users have the necessary permission) (Figure 6).

The map screen (Figure 7) allows users to obtain their location on the map, select a location they want to go to, and be presented with a route to the desired location. This has the function of helping new students (but also all participants) in their early days on campus.

**Figure 7** (a) Map screens showing user location and (b) showing the path to the point of interest selected (see online version for colours)



(a)                                                                    (b)
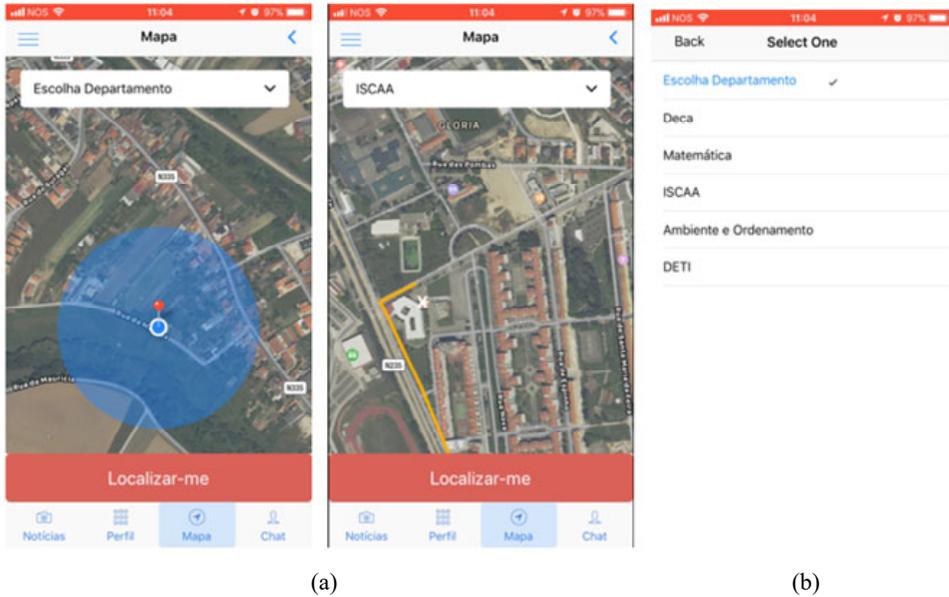
The chat screen (Figure 8) aims to assist users in real-time communication, and in the development of stronger relational ties. This screen must present the image and name of the user on each text insertion in the chat, in order to facilitate the recognition of the author.

Of the three types of users (tutor, mentor and tutees) of the app PT-UA, only the tutor has administrative privileges for validating mentors' requests to join. Adherence as a tutee gives direct access to the application after confirmation of the e-mail. When tutors and mentors register an account, they have to confirm their e-mail and wait for the account to be validated. Only tutors and mentors can post events and delete other users' posts.

In chat mode, it is possible to have a public conversation with all the users of the app. When someone sends a text message in the chat, an event is sent to Laravel event broadcasting, which sends the message to the Pusher, thus informing all the users that are connected in the chat, automatically updating new messages in real-time.

Regarding the login process through the mobile application, this is done through an HTTP request made by React Native to the Laravel API. Laravel receives this POST request, compares the data with the data in the database and returns a response to React Native. The response can be 'data mismatch', if the user is not authenticated, or it can

respond with 'login successful', giving access to the remaining screens of the application. Without authentication, users can only access the login and user registration screens.

**Figure 8**   Chat screen (see online version for colours)
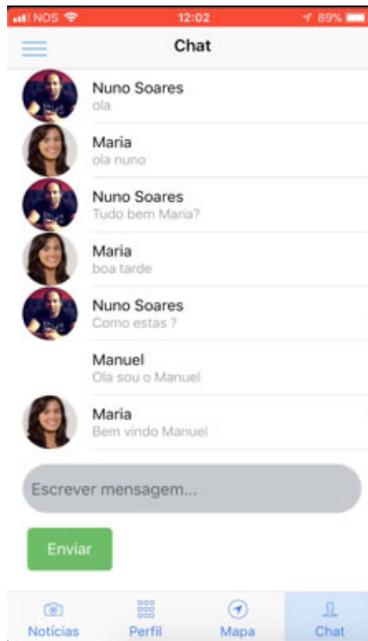


In the user registration process, an HTTP request is made by React Native to the Laravel API. Laravel receives this POST request, and inserts the data into the database, returning a response to React Native. The response may be 'user successfully created' or an error message may be returned.

The user profile and profile data can be viewed on the profile screen and edited by clicking on the edit profile button. The user account can be deleted by clicking the delete account button. When the edit profile button is activated, an HTTP request is made to the Laravel API, processing the change of data in the database, or the upload of the profile image. When the screen changes successfully, it updates automatically, displaying the changes made. With the edit profile function, it is not necessary to change all the data; it is sufficient to modify only the information that needs changing.

On the community screen, simply clicking on the create publication button creates a publication – the title and description must be entered, and an image can be included, if desired. When the submit button is clicked, a React Native HTTP request is made to the Laravel API, which deals with uploading the image, if any, and inserting the remaining data into the database.

Events can be viewed on the events screen, and new events can be added by clicking on the '+' button in the upper right corner. The user fills in the data, such as location, event date, name, description and may add an image. When uploading, an HTTP request is made from React Native to the Laravel API, which uploads the image, if any, and inserts the remaining data into the database. To access the image library and upload images or the user's location, a set of authorisations is required. These changes are

handled by the EXPO, and once they have been accepted, the user is no longer confronted with this authorisation request.

All code is hosted on Github, one of the most widely used repositories in the world. It allows the creation of a control version, as well as access to an entire community, in the case of public repositories, and access to private repositories when approval of the administrators has been obtained. In our project, two private repositories on Github are used, one for the API and the other for the app.

## 5    Evaluation and re-design

The usability tests took place in a study room in a UA department. The group of participants was made up of one tutor, four mentors and one tutee, aged between 19 and 53. They came from different departments and study programs.

The results revealed that participants were in general happy with the overall feel of the app PT-UA and in using the different screens. They considered it easy to navigate and to complete the different tasks. Nevertheless, they suggested a number of additional features to enhance their experience, namely: the option of a calendar to facilitate the creation of events, the possibility of reminders to notify the users when events are about to take place, the ability to conduct private chats, the ability to limit event creation to tutors and mentors, and the creation of a mini-cloud for file sharing. On the tutors' profile page, information such as time and availability, as well as the tutor's academic area could be included. A search field was also suggested to make it easier for users to search for data, as well as the possibility of 'liking' a post without having to click the like button, by double tapping on the post. Users reacted positively to the possibility of being able to remove 'likes', as well as visual feedback of loadings. The suggestions for improvement made by the participants are summarised in the following list:

- implement an e-mail server to be able to send e-mail for account confirmation

- develop the logic in the application for each type of user

- allow the possibility for tutors and mentors to validate new accounts with tutor or mentor user types

- allow tutors and mentors to delete content and moderate publications

- implement private chat, file sharing and video calling

- include indication of user status (online, away, offline) on chat screen

- implement a search engine to filter and find information more quickly

- include a calendar on the event creation screen to enable the selection of dates for events

- include a map on the event creation screen to enable the selection of a location

- implement a system of notifications to inform users when new events or private messages are posted

- permit users to share posts on their Facebook profiles

- enable the identification of users in the comments

- permit access to the profile of other users, and include tutors' areas of expertise and availability in their profiles

- implement the double-tap on a post to give a 'like'

- permit mentors to add new points of interest on the map screen

- create an event detail screen.

After analysing the data resulting from the usability tests, some of the suggestions for improvement were carried out and some bugs corrected, like the register/login through Facebook function, which was not working at the time of the performance of the tests. Among the improvements implemented were the event detail screen, the loading indicators and the register and login using Facebook.

The usability tests allowed us to assess the UX of the app PT-UA, to detect some flaws and find new features.

## 6    Conclusions and future research

Tutoring and mentoring programs can be very important for integrating new students and combating early drop-out. The development of the app PT-UA was a big challenge but has the potential to enhance and ease contact between all participants in the PT-UA, from the very start, as well as allowing fast access to information essential for their well-being and academic success. The social networking aspect of the application takes advantage of the fact that social networks are in vogue and is a way of encouraging all stakeholders to feel that they belong to a community and have an important contribution to make. Social networking platforms and the use of smartphones are expected to remain in the coming years, constituting an opportunity for tutoring and mentoring programs to take advantage of technological developments to reach their central goals. The usability tests allowed flaws to be identified and solved, usability to be improved and new features included.

The results of the research project were communicated to the UA's senior management team in January 2019, for them to study the artefact and decide if it could be applied to the community of the PT-UA. If this materialises, some other resources should be applied, namely private chat, file sharing and video calling, user status indication in the chat screen, a search engine to filter and find information more quickly. A system of notifications would also be a positive addition to inform users about the creation of new events or private messages, and the ability to identify users in the comments.

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