Human Computer Interaction:

Project Overview

C.U.E.

Choose your University Easily

Fazioli Mariastella, 1604197
Simionato Giada, 1822614
Tocci Luigi, 1696490
Tuninetti Chiara, 1694543

Contents

Chapter 1

Introduction

The choice of the academic career is becoming one of the most important decisions in a person's life. With the multitude of options available nowadays, finding the correct path can easily turn into a time-consuming activity that may raise confusion and abasement in those who are facing it. Going beyond the first step of such decision, i.e. choosing the course that best suits the desires of the person, the fact that the academic community is increasingly moving towards international networks, opens several possibilities to future students that could choose to study in a different country than their motherland with more ease.
Based on this reality, corroborated by our personal experience in dealing with this situation, we have decided to develop a mobile application called *C.U.E.*. This name was chosen for a double reason: it is the acronym of *Choose your University Easily*, that is the slogan of the application and the fact that *cue* also means *an indirect suggestion, hint* or even *a secondary stimulus that guides behavior, often without entering consciousness*, that is exactly what we aimed to do: offering a guide for this important choice.
This application offers a search engine for academic courses, not only limited to Italian opportunities, but also including European and international ones. In addition it provides a chatting system that allows the users to chat with students that are already pursuing an academic career, the *peers*, in order to make a more aware decision. It contains information from a manifold of points of view about how the academic world works, such as scholarships, accomodations, school cafeteria and assistance to people with disabilities. For the users that were not been able to take any decision regarding towards which course orient, the application offers a section with a local psychometric test and several links to additional free online ones. Finally the application implements a private area for the user in which s/he can modify the profile information, see the saved results and the ongoing conversations.
This report is organized as follows: in Chapter 2 we will explain all the steps that we have performed for the *Requirements Gathering* phase, in particular in Section 2.1 we will comment the competitor analysis, in Section 2.2 we will define the target user, some personas and their corresponding scenarios and in Section 2.3 we will show the results of the first data collection process. In addition in Section 2.4 we will report the Hierarchical Task Analysis and the corresponding State Transition Networks of the most relevant tasks within our project. The first mockups of the application and the implementation details will be presented in Chapter 3, while in Chapter 4 all the evaluation techniques applied to our prototype will be exhaustively discussed. Finally, in Chapter 5 conclusions will be drawn.

Chapter 2

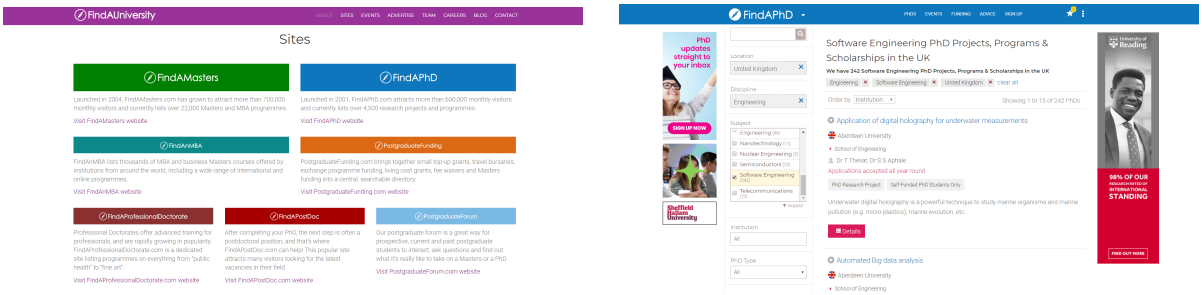
Requirements Gathering

Once having identified the problem to be tackled, a brainstorming was performed in order to determine an initial set of features that this work should have possessed and the basic architecture details on which to build the application. With this information we started a requirements gathering phase that provided an analysis of the possible competitors and a precise description of the target user, supported by the design of several personas and the corresponding scenarios. In order to both validate the target user and to meet the preferences of the possible future users over the features of the application, a questionnaire was created and the results were analysed. More on this will be reported in Section 2.3. Finally, the hierarchical task analysis over the main four tasks of the application and the design of the corresponding state transition networks were performed, ending the requirements gathering phase.

2.1 Competitors Analysis

The first step in the requirements gathering phase was to survey the market in order to find possible competitors of our application. We performed the analysis over four different websites and one mobile application. The reason why we restricted the list of competitors to only five products is that we selected the most relevant ones according three categories: *English-based*, *Italian-based* and *mobile*. The first category aimed to find the strongest website competitors, in terms of popularity and variety of services offered, that were focused on English academies. The second category, i.e. Italian-based, contained websites focused on Italian-academic opportunities, while the third one was focused on mobile applications. This analysis was performed to have a complete overview of the competitors while making possible to capture the most demanded features as well as lacks in the market.
The first website, belonging to the first category, is *FindAUniversity.com*. This is the strongest competitor since it is composed of several sub-sites each of which is specialized on a specific level of education (e.g. *FindAMaster*, *FindAPhD*, etc.). In addition it offers a 15000£ scholarship per year for one of its subscribers. The list of all the sites contained in this competitor and an example of how it displays the results are shown in Fig. 2.1(a) and (b), respectively.
Among its design strengths, stands out its highly intuitive interaction along with the high number of filtering options offered. However it suffers from the presence of some inconsistent results and, especially for some sub-sites, it is difficult to distinguish between results and advertisements.
The second competitor, belonging again to the first category, is *Ucas.com*. It is mainly focused on universities of the United Kingdom, however providing some results even for other selected countries[1]. This website has the unique feature of handling, in addition to the typical results

[1]Italy is not included. This is relevant for this work since the target user is mainly Italian: for further



(a) **(b)**

Figure 2.1. *(a)* All the sites contained in FindAUniversity.com; *(b)* An example of results display from FindAPhd.

for universities, information and results also for alternative paths to the academic career, such as gap years and internships. Another key feature that Ucas.com offers is the possibility of applying to some opportunities directly through the site. It accompanies appealing design choices to the difficulty of browsing the site due to the quantity of information contained. This drawback does not limit to a difficult information finding but also it is extended to distinguish the results and how to get them. An example of an intermediate page of this site is reported in Fig. 2.2. How it deals with such a plenty of information is therefore the major drawback of this site.

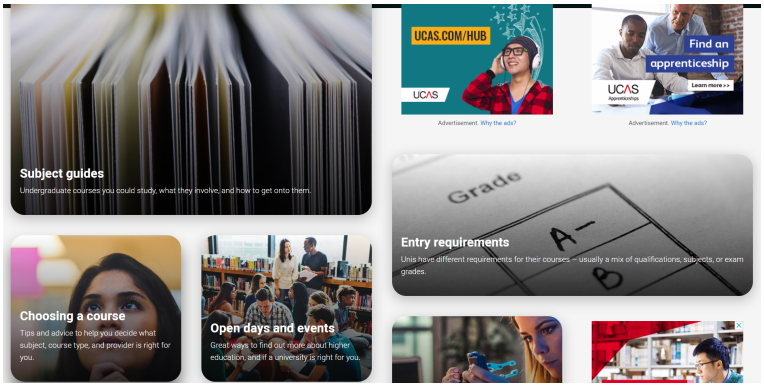


Figure 2.2. Example of an intermediate page of the UCAS.com website.

The third competitor, i.e. the first of the second category, is *Cercauniversità.cineca.it*. This website offers results uniquely for Italian universities and it is linked to the Ministry of Education but provides few results and all the information in the site are very outdated and therefore inapplicable. The cons of this website contain also the fact that it is very difficult to browse the results and to retrieve the information needed to filter such outcomes. About this latter aspect, it is worth mentioning that the filtering options are limited and no information about PhDs is present. Even if this site lacks of a good user interface it is still one of the most relevant product with an Italian-centered point of view. An example of results display is show in Fig. 2.3.

information please refer to Section 2.2.1.

Figure 2.3. Example of result display of the Cercauniversità.cineca.it website.

The fourth competitor, still in the second category is *Universitaly.it*. This is the official site promoted by the Ministry of Education and is composed by an interface that makes easy to browse the results, however the design is not highly appealing and there is a limited set of filters offered. As the last competitor, this website provides no information about neither doctorates nor results about foreign universities. Fig. 2.4 shows the typical appearance of the system when displaying the results.

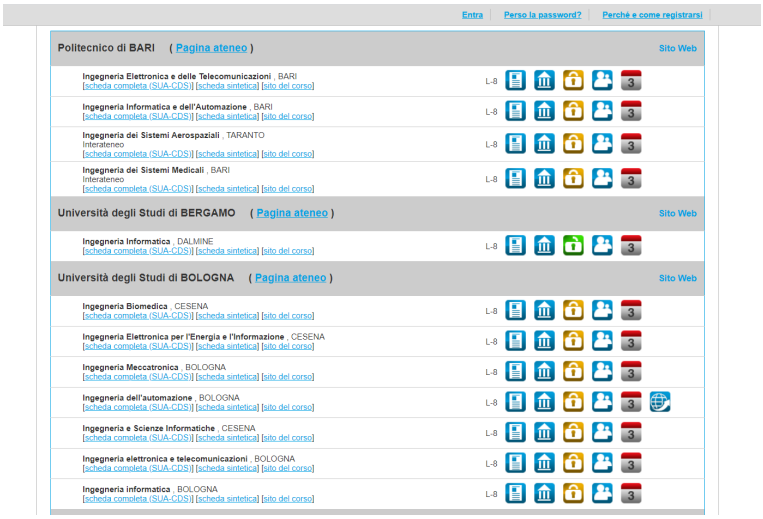
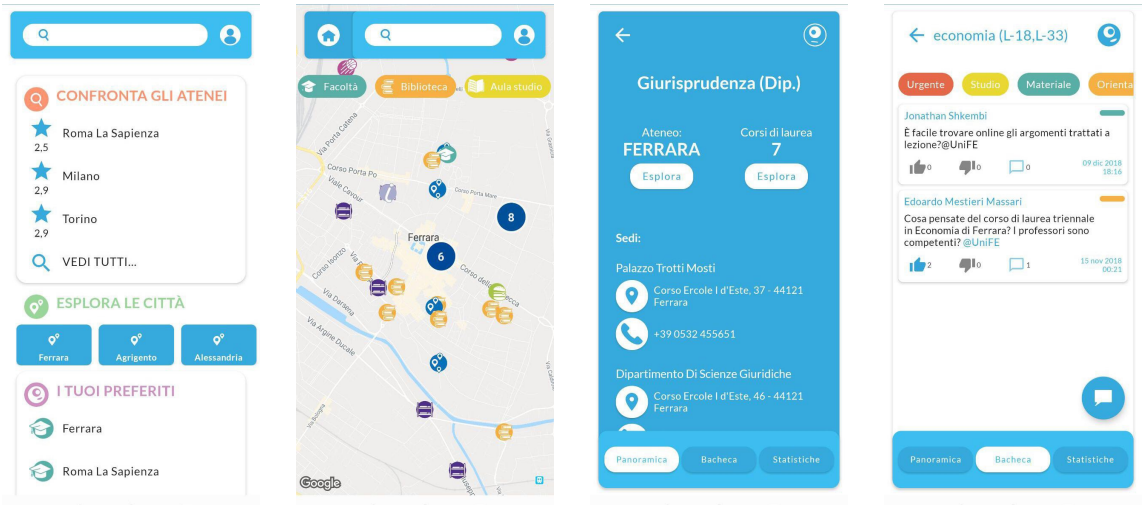


Figure 2.4. Intermediate page of the Universitaly.it website.

The last competitor taken into consideration, i.e. *WhiriWhiri*, is the only one belonging to the third category. The reason why only one mobile application was considered is due to the fact that no other applications were found that resemble, at least at a reasonable level, the idea of this work. In addition other products, more similar to our application, ended the support, and therefore the availability, prior to 2013. Its uniqueness relies in the fact that it contains statistics, made by users, about the courses offered by Italian universities. In addition it provides the possibility of exploring maps, such as the ones normally powered by Google, where are highlighted all the places of interest of the specific university that was searched. Examples of functioning of different features are shown in Fig. 2.5.
WhiriWhiri has an user interface that makes easy to browse the several functionalities, however



(a) **(b)** **(c)** **(d)**

Figure 2.5. Examples of WhiriWhiri functioning: *(a)* Homepage from which assessing to its functionalities; *(b)* An example of the geographical navigation feature; *(c)* Example of information and statistics of a course; *(d)* Example of the public dashboard for asking/answering questions.

it shows some drawbacks. First of all the registration process is difficult to perform[2], aggravated from the fact that is mandatory, then some titles and information are truncated making impossible to see them completely and there is no filtering nor sorting options, available. Finally the academic information are only about these aforementioned statistics made by users and, again, there is no space for doctorates in the concept of this application.
The coarse-grained analysis of these competitors was then refined to include both how they connect to the users and keep them engaged, and to check whether they possessed a set of core features. As regards the former, we've taken into account three factors: the *size of the customer base*, the *social media platforms used* and whether there was a *sign-in option*. The result of this fine-grained analysis is reported in Fig. 2.6. As it's possible to see the size of the customer base was not available for all competitors, however the strongest one, i.e. FindAUniversity.com, has shown to have a wide community of monthly users while WhiriWhiri is not very popular, since it has only slightly more than a hundred of downloads and the reviews are not relevant. The other parameter for the evaluation was which social media platforms they used for keeping the connection with the customers. As is possible to notice from Fig. 2.6, almost all the competitors used at least three social media platforms, that allow different way of spreading contents. The last check was whether they provided a sign-in option. All the English-based and mobile competitors allow to register for either accessing to a private area or to subscribing to a newsletter.

[2]For example, it requires the date of birth but it allows to select it only from a monthly calendar starting from the current date (this implies to scroll back until the birth date: a very time-consuming operation).

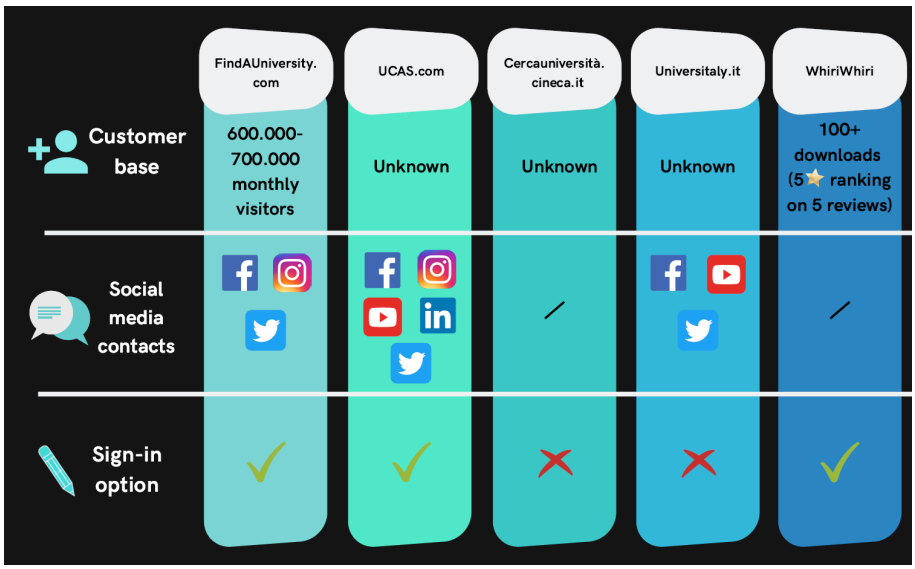


Figure 2.6. Results of the connection-with-customers focused analysis.

As above-mentioned, the last point of the analysis was to check if a set of features was implemented in the competitors. This list of functionalities was drawn according to the fact that we wanted to insert them in the first version of our application and we desired to check if and how they had been realized in the market. This was useful since allowed us to see how users reacted to these functionalities and how to differentiate our product maintaining the effectiveness of the interaction, as well as identify lack of features in the competitors. These *core* features are collected in Fig. 2.7.

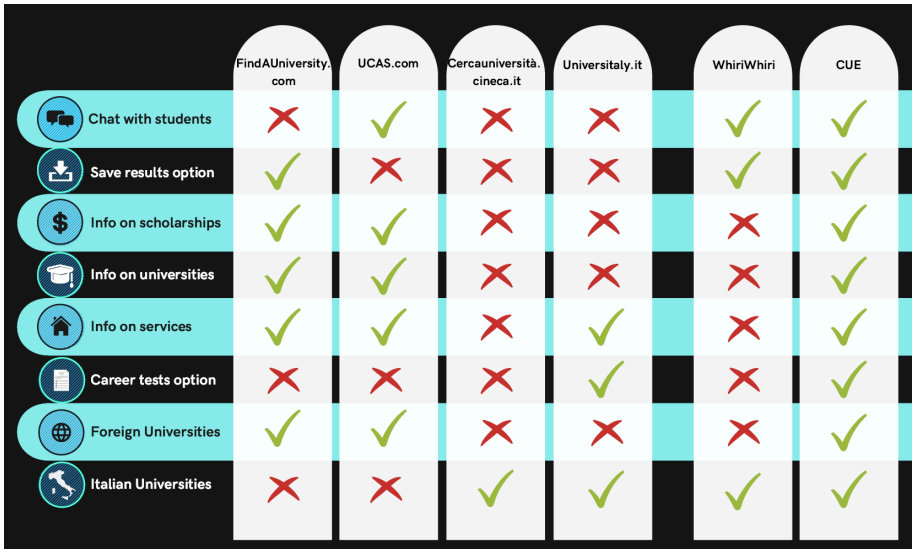


Figure 2.7. Set of core features along with the result of the check with respect to all the competitors. Note that the last column shows that our application possesses all of them.

The first core feature, i.e. *chat with students*, is the most important one in this work: it allows the connection with students that are already pursuing a specific course in a specific university for asking questions and collecting information prior to make a decision. While UCAS implement it through a private chat system, WhiriWhiri has only public dashboards for asking only general questions. The second feature allows to save the results of the searches, e.g. particular courses. Other features are the presence of information about scholarships, e.g. how they are awarded and eligibility criteria, about how the university is structured and

about the services that this latter provides, such as disability services, school cafeterias and accomodations. As it is possible to see in Fig. 2.7, the rarest feature among the competitors is the presence of psychometric tests for helping younger students to choose the future career. Finally we checked whether the competitors provided results for Italian and/or foreign universities. As it is possible to notice all the competitors have only one of the two options, but our application aims to have both. The last column of the table in Fig. 2.7 highlights that this work possesses all the core features.
In conclusion we have analysed the competitors in order to find the most valuable features to insert in the application and to focus on covering the lacks in the market as to provide an original and useful product.

2.2 User

The ultimate purpose of an application is to be used by users, therefore defining which is the user base is crucial. In order to tailor our product for a precise class of customers we defined the target user and, in order to settle its definition, some examples of personification of this user, i.e. the *personas*, were designed. In addition, for each persona, a *scenario* was described. More details on these steps will be revealed in the following sections.

2.2.1 Target User

The *target user* is described by the collection of characteristics that represents the average user of the application. The parameters, and their values, taken into consideration are collected in Fig. 2.8. Since the application is referring to students both of the last years of the high school and of the university, the target user should have an *age* ranging from 17 to 30, according to a distribution whose mean is 23 years old. We did not make a prior assumption about any *gender* inequality, hence we expect that our users will be both male and female in equal portion. The *location* of the target user is the whole Italy, however the results in the application are not restricted to it, in fact also foreign opportunities are considered. Straightforward was identifying the *job title*, i.e. students and researchers, and from this it was possible to draw other characteristics to refine the description of the target user, namely the *working hours*, counting 25 hours weekly of lectures plus individual study and the *education* level, hence from high school to doctorate. Another aspect is the level of the *knowledge of technology* in which we assume different levels of expertise: from beginners to expert. However, we consider at least minimum requirements. Finally it's been considered the aspects of *disabilities*, where no specific limitations were highlighted and the *family* context, namely that the target user is either single or married, but predominantly the former, as can be seen in Fig. 2.8.

Figure 2.8. Characteristics and values constituting the target user.

2.2.2 Personas

In order to validate the target user defined in Section 2.2.1, three *personas* were defined. Each *persona*, representing a personification of the target user, was tackled by several points of view. In order to have different perspectives and examples of users we've designed one person for each level of study within our target user. The first one, currently at the last year of a linguistic high school, is completely disclosed in Fig. 2.9.

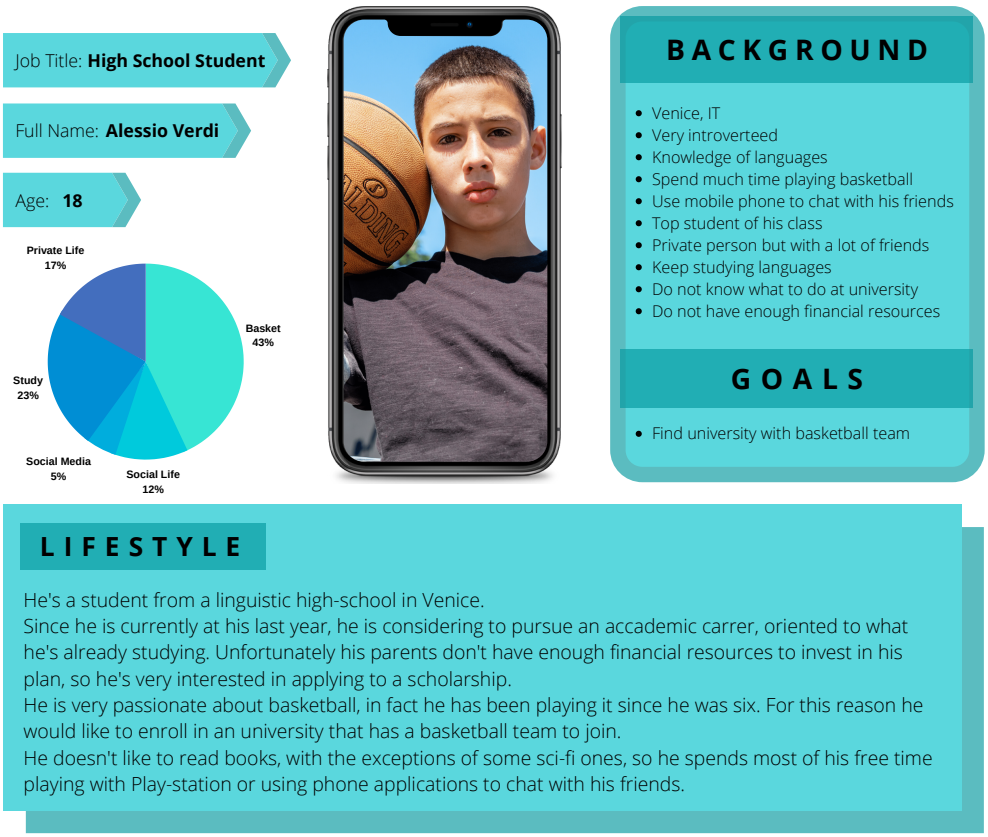


Figure 2.9. Complete description of the first persona, i.e. the high school student.

As it is possible to notice this person was described by means of personal data as well as his background, goals and an example of his lifestyle. We repeated the same pattern for the other two persons, namely the bachelor's student Martina, shown in Fig. 2.10 and the master's student Isabella, in Fig. 2.11.

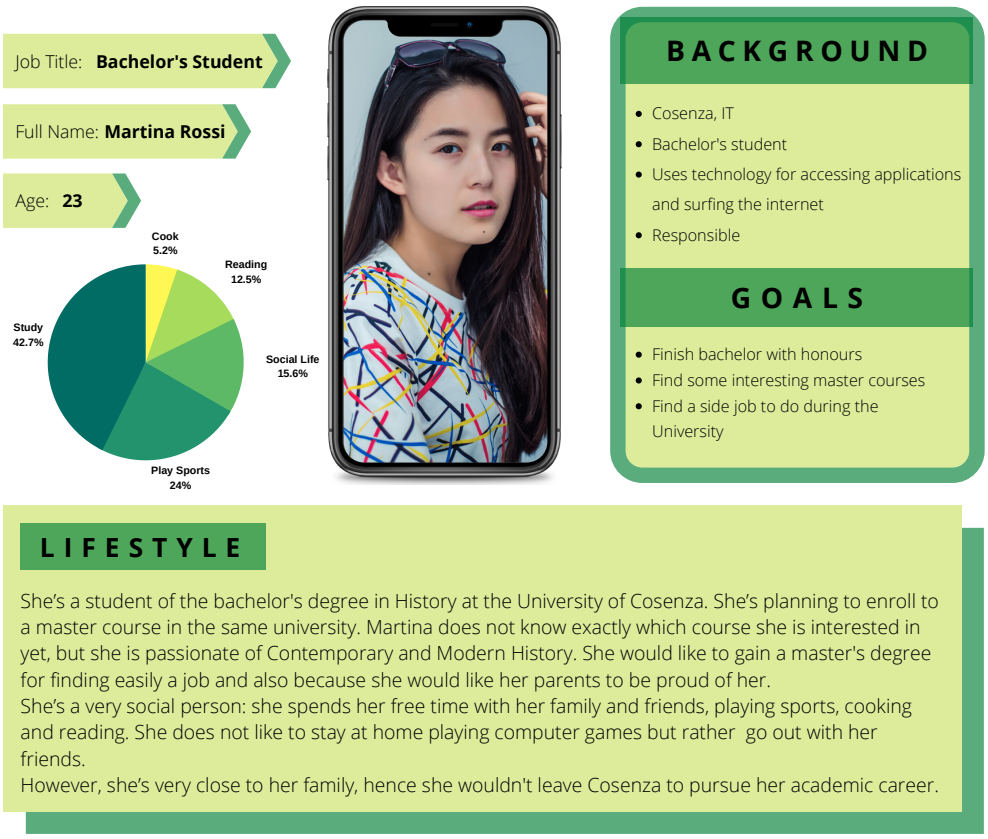


Figure 2.10. Complete description of the second persona, i.e. the bachelor's student.

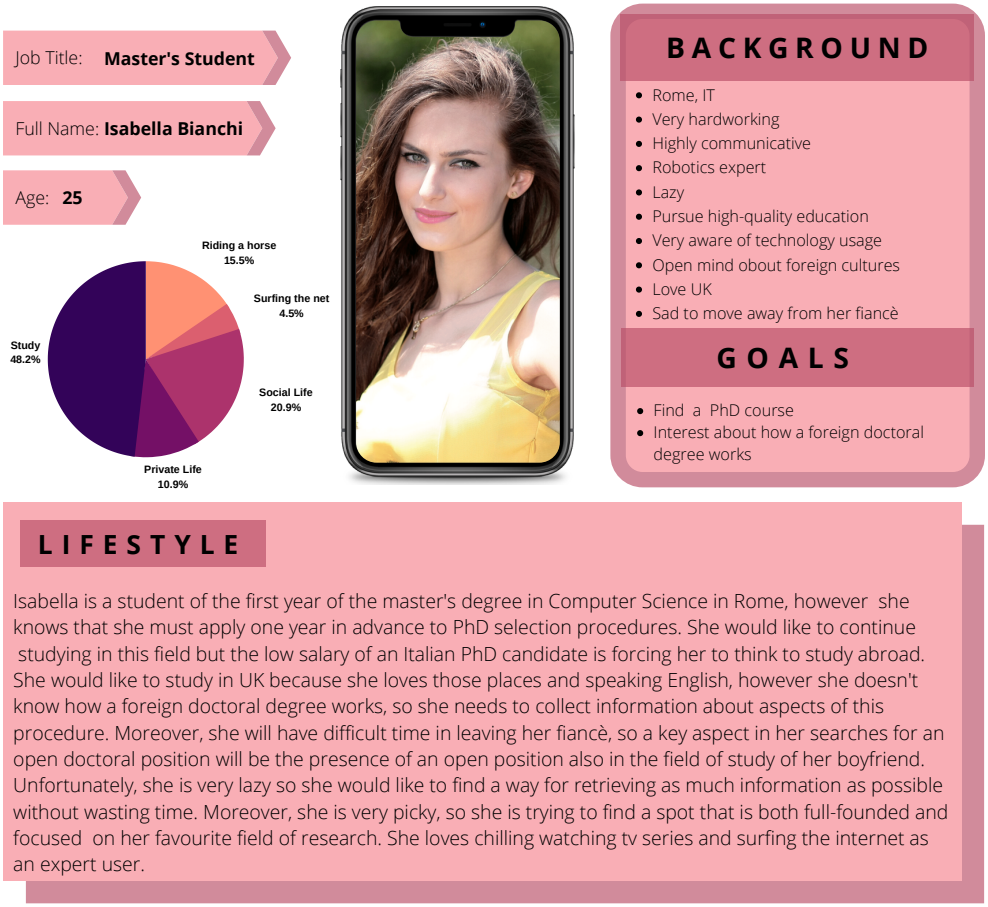


Figure 2.11. Complete description of the third persona, i.e. the master's student.

2.2.3 Scenarios

To finalize the analysis of the user base, we combined each person in Section 2.2.2 with a fictional scenario aiming to emulate a situation in everyday life, in which the user faces the problem that we wanted to address in this work. In this way it was possible to study examples in which the users could have used our application to fulfill his/her goals.
As regards the first persona, described in Fig. 2.9, the corresponding scenario is:

> *It is January and Alessio is attending the last year at a linguistic high school in Venice. He would like to continue studying but he is very confused about which kind of degree is the most suitable for him. From one side he would like to deepen the languages that he is currently studying, on the other he is thinking to change the field of study. Moreover, his family cannot afford to fund a bachelor's degree, so he is very interested in understanding how to deal with scholarships.*
> *With the same mobile phone that use for chatting with his friends, he starts searching over internet some information about the courses offered in the nearby universities that also offer founding opportunities.*
> *Finally, he loves playing basketball so he will prefer to choose an university that have a basketball team.*

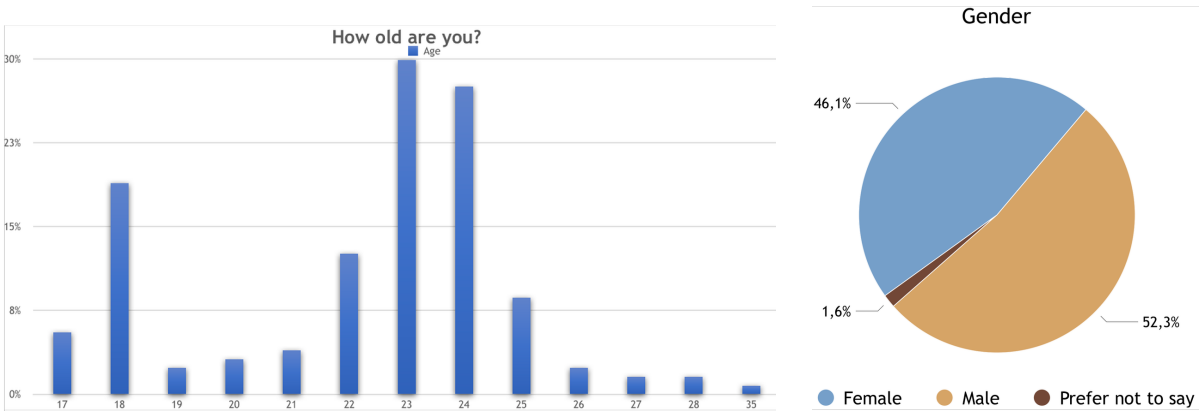
As regards the second persona instead, in Fig. 2.10, the scenario is:

> *Someday, during Martina's last year at the bachelor's, a friend of her starts talking about his future and which specific master degree he's planning to begin. Once at home she's very confused by what her friend said and she starts thinking about her future too, because she is really bewildered about the multitude of options.*
> *So, she starts surfing the internet to gather more information about the courses offered by Italian universities.*
> *Eventually she decides to pin the websites she found, because she's late for an appointment with her friends but at the same time she would like to spend more time on reading carefully these new information.*

Finally, the third persona, i.e. the one in Fig. 2.11, corresponds to the following scenario:

> *Isabella is a brilliant student from the first year of the master's degree in Engineering in Computer Science. She would like to apply to a doctoral program, so she knows that she has to submit her application an year in advance. She desires an high-quality education and she would like to go to study abroad. However, she is not aware of how foreign programs are composed so she is searching information about these aspects. She will prefer to study in the United Kingdom so therefore she is also informing on the language certificates that are needed.*
> *She has a long relationship with her fiance, also a student, so she is searching an university that may offer a position for both of them.*
> *In addition, the field in which she is willing to focus is very specific, so she needs to carefully examine the proposals from the universities. Moreover, she would like to start to receive a salary high enough to become autonomous.*

As it is possible to notice, all the scenarios were based on the background of the specific person to which they are referring to, in this way the examples of use are as much as possible realistic and useful.



(a) (b)

Figure 2.12. *(a)* Age distribution of the respondents; *(b)* Gender distribution of the respondents.

2.3 First Data Collection and Evaluation

The next step in the requirements gathering phase was to design a questionnaire to submit to students. The reasons why we drafted this questionnaire were manifold, here the main ones are reported:

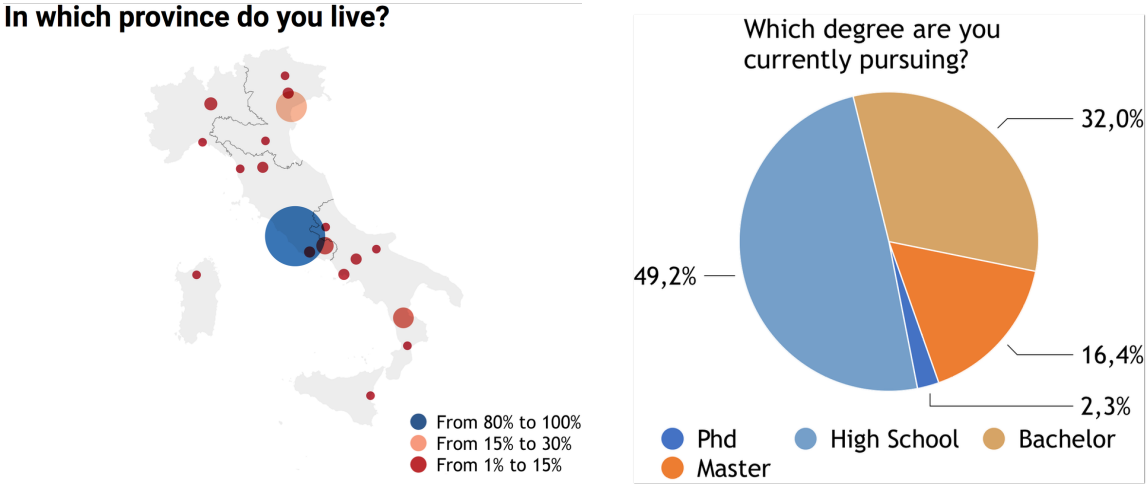
1. *Validate target user*: since our user base is composed of students, we forwarded the questionnaire to some of them in order to collect their personal information for statistical purposes. This was done to compare the results of the obtained distributions with the ones in the target user definition.

2. *Get hints about importance of features*: in order to collect information about how much important the users consider the given features and to know towards which ones to focus.

3. *Get hints about the modalities of implementation*: for collecting information about which modalities of implementation of some given features are preferred by the users.

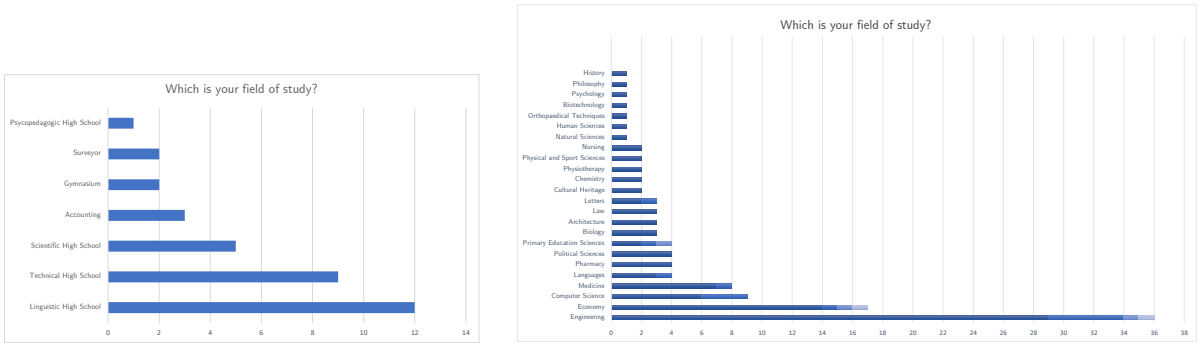
The questionnaire was drafted and forwarded using *Google Forms* and was composed by two sections: the first one was devoted to collect personal information about who was answering it, such as personal data and use-of-devices habits. The second one was, instead, focused on surveying the possible features of the application and the ways in which they could have been implemented. The complete text of the two sections is reported in Appendix A: Fig. A.1 and A.2, respectively. Overall we received 151 responses. A complete analysis of how questions were posed, of the results obtained and how these affected this work will follow.
As regards the first section, in order to have non-biased responses we remembered that the questionnaire was anonymous yet the personal data would have been collected but only for statistical purposes. For who answered the questionnaire, from now on denoted as the *respondent*, was asked his/her age and gender. Please note that we added a third option, i.e. *Prefer not to say*, to the canonical *Male* and *Female* ones, to not force people to identify in one of the two genders. Results of these two questions are shown in Fig. 2.12(a) and (b), respectively.
As it is possible to notice from Fig. 2.12(a), the age distribution of the respondents mirrored the range described in the target user in Section 2.2.1, however the average doesn't seem to correspond to the one in Fig. 2.8. This happened because we relied on two flows of submissions: initially we forwarded the questionnaire to some students without constraints and we received 124 responses. The encountered age distribution, strengthen the description of the target user, both for the range and for the average[3]. However since the range, i.e. 17 to 30 y.o., usually

[3]We obtained a perfect average of 23 years old.



(a) **(b)**

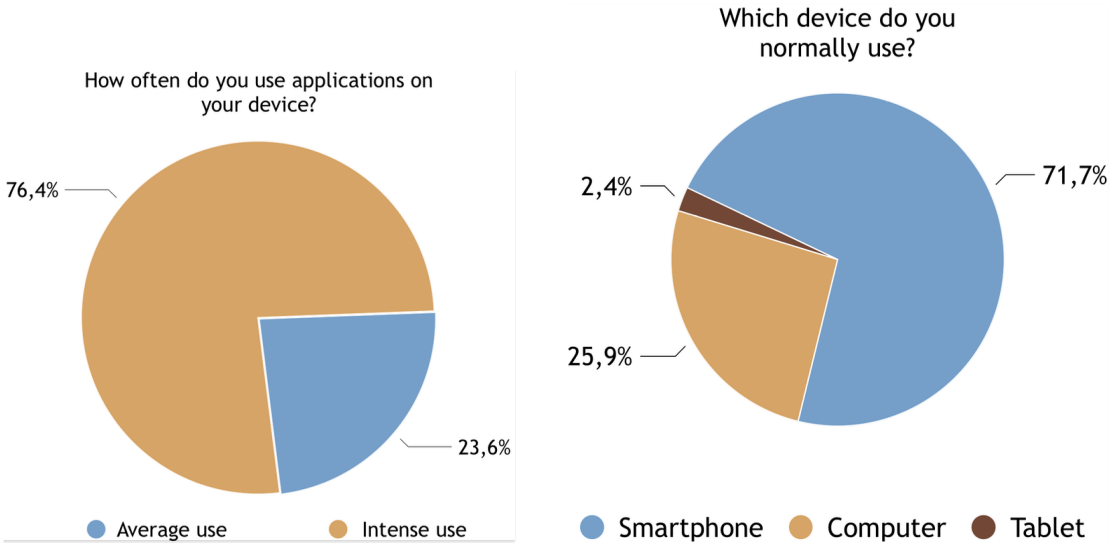
Figure 2.13. *(a)* Geographical distribution of the respondents; *(b)* Level of education of the respondents.



(a) **(b)**

Figure 2.14. Fields of study of the *(a)* high school and *(b)* university populations.

implies great variety in needs, habits and behaviours of the users, it raised the necessity of performing a differential analysis of the results, hence to study in an individual and separate fashion the two categories: high school students and university students. In order to perform such a refinement, and since only the 4% of the responses were made by high school students, we forwarded again the questionnaire to a high-school targeted population, as to obtain a pool of responses sufficiently wide enough to be statistically-significant and possible to be used as the basis of the differential analysis. This explains the two picks in the plot in Fig. 2.12(a).
The differential analysis, however, lead to pretty the same distributions for both categories in almost all the questions, with the exception of a couple of them: for this reason, if not directly specified, unique results will be shown based on cumulative data.
In order to locate the respondents and to validate the geographical assumption of the target user 2.2.1, we asked in which province they lived. Results are shown in Fig. 2.13(a).
The questionnaire also included questions about the career of the respondents in order to get information about their level of education and which was their field of study. Please note that the former question was posed with four options, able to cover all the possibilities while guaranteeing an easier filling: results are reported in Fig. 2.13(b).
As regards the latter, hence the field of study, we made a separate analysis for both the categories: results are shown in Fig. 2.14(a) for high-school students and (b) for university ones. As it's possible to see in this figure, it was obtained a huge variety in the results making the analysis not-biased with respect to the course attended.

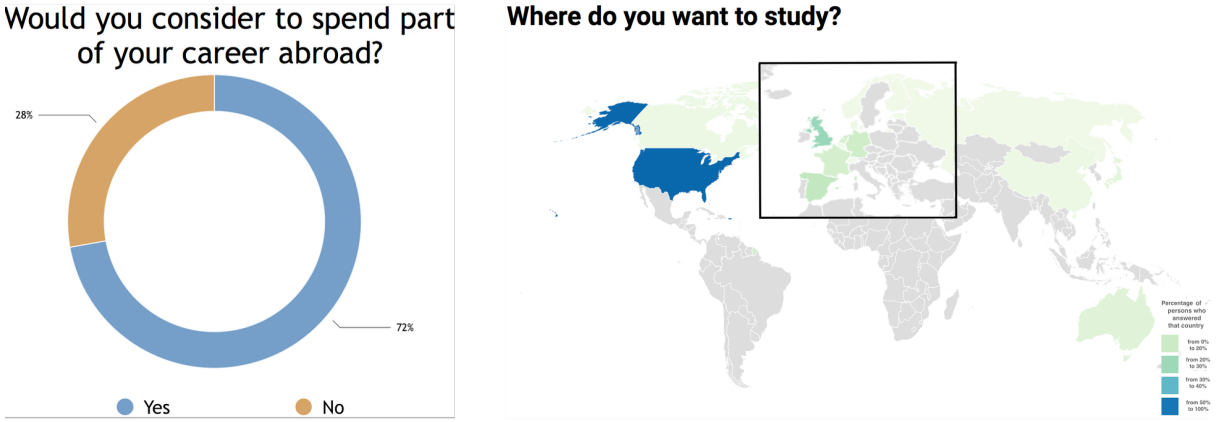


(a) (b)

Figure 2.15. Device-habits of the respondents: *(a)* how often they use applications one their favourite device; *(b)* which device they prefer.

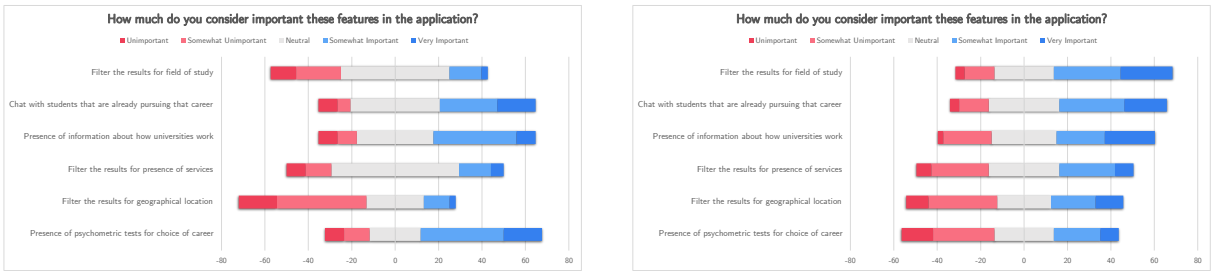
The next questions aimed to understand the habits of the respondents about the use of devices, such as how often they use applications on their favourite device[4] or which is the one that they normally use among $\{smartphone, tablet, computer, other\}$. Results of the two questions were similar for both the categories and are reported in Fig. 2.15(a) and (b), respectively.
The data collected through these questions was fundamental since allowed us to understand that nowadays users in the age range of the target user are very used to technology and have therefore a strong background and knowledge about how applications work. This highlighted the need of our application to be consistent with the ones already in the market for not providing confusion to the users. Another key point derived from Fig. 2.15(b) is that we've decided to implement the application for smartphones instead of a desktop one, to get along to the respondents preferences and habits. This also was compliant with the lack of this kind of application in the market, as emerged in the competitors analysis in Section 2.1.
Finally, the first section asked whether the respondents would be interested in spending part of their academic career abroad and, if yes, in which states. This question was inserted to understand towards which parts of the world to focus in showing the results in the first version of our application. The percentages of the answers are shown in Fig.2.16 (a) and the hot map of the preferred states in Fig.2.16 (b).
In the second section of the questionnaire we've briefly introduced the aim of our project in order to give a context to which the questionnaire would have referred. The first question asked to rate the importance of a set of features that we were considering to implement in the application, on a scale of 1 to 5, where the former was the least important value, labelled *unimportant*, while the latter the most important one, i.e. *very important*[5]. The categories were the possibility to chat with possible future colleagues, to filter the results by geographical location, by field of study or by the presence of particular services. In addition there were the presence of information about how universities work and the presence of psychometric tests for helping students to choose their career. The results gathered from the two flows of submissions, hence university and high school, were found to differ from what such populations thought was most significant. The differential results, reported in Fig. 2.17 (a) for high school students and (b) for university ones, showed that, even if both populations considered important to have the

[4]We suggested three different options and an *other* one to allow answers not included in the question.
[5]The other values were: 2=*somewhat unimportant*, 3=*neutral* and 4=*somewhat important*.



(a) (b)

Figure 2.16. *(a)* With which distribution the respondents would like to spend part of their academic career abroad; *(b)* where they would like to spend it.



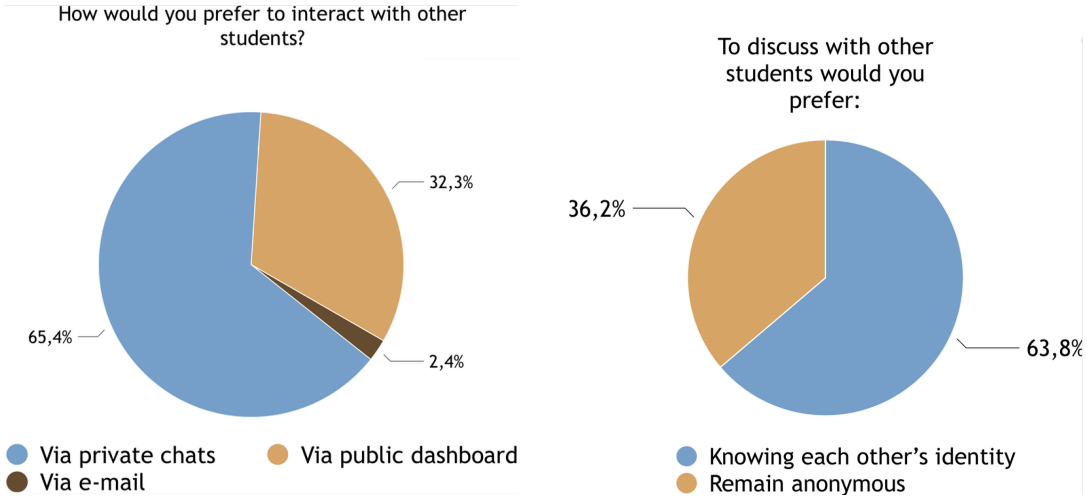
(a) (b)

Figure 2.17. *(a)* Ratings of the features of the application according to high school students; *(b)* ratings of the features of the application according to university students.

possibility of chatting with possible future colleagues and the presence of information about the university, the former were less interested in filtering the results according to the field of study with respect to their academic counterpart, however they showed a strong interest towards the presence of psychometric tests, feature that appears to be the most neglected one by the latter. Since the network of students was our most important feature, that was then validated by results in Fig. 2.17, we added a couple of questions regarding the possible ways of implementing such connection: how the respondents would prefer to interact with the other students, hence choosing among private chats, a public dashboard or via emails, and whether they would have preferred to know each-other's identity or remain anonymous. Results are shown in Fig. 2.18(a) and (b), respectively.

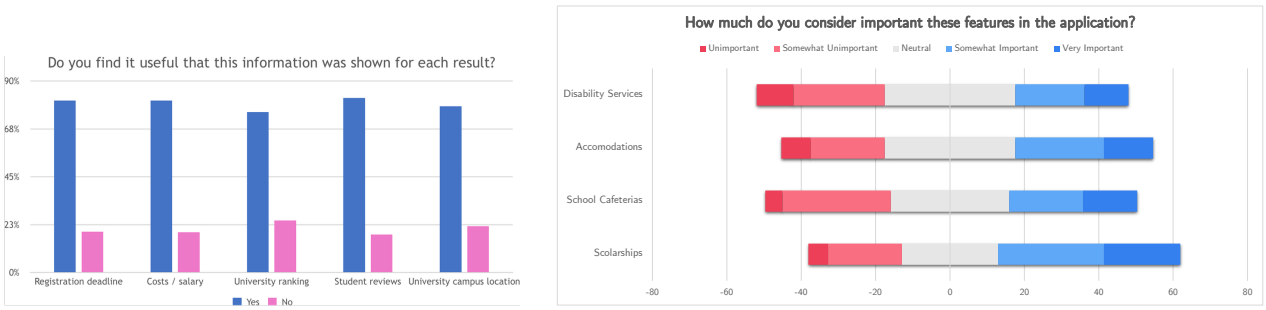
The results in Fig. 2.18 pushed us to implement the chat option through a system of private chats with a mutual knowledge of the identity.

A key point in any application similar to ours, is how to show the results and with which information fill such results. Since at the time of this first questionnaire the work was still in the preliminary stage, design issues were not considered. However for the second problem we listed several kind of information that in our opinion would have been useful during a research about academic opportunities, namely: the deadline of the course registration; the tuition fees (or the salary for the PhDs); the ranking of the university and its location, and finally the reviews of students already enrolled and we've asked the respondents whether they would have found them useful too. The results are collected in Fig. 2.19(a). As it is possible to see all the options scored very high, however the presence of the registration deadline and the students' reviews were the most requested while the university ranking the least, making it the most expendable information if design issues will require some cuts.



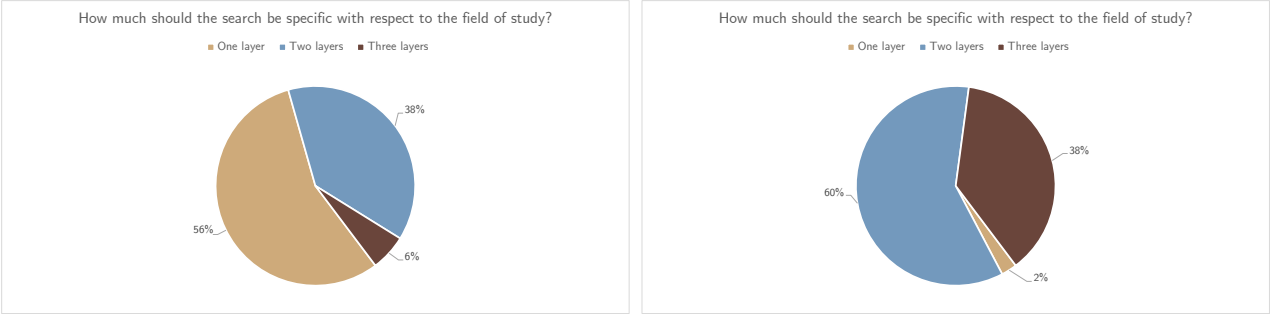
(a) (b)

Figure 2.18. *(a)* Results about the preferred way to chat with possible future colleagues; *(b)* results about the preferred privacy setting in the chat option.



(a) (b)

Figure 2.19. *(a)* Results of whether the respondents found useful to display the information in the *x-axis* for each result; *(b)* results (in percentage) of the ratings of the importance for each service.



(a) **(b)**

Figure 2.20. Results of how much the search should be specific for *(a)* high school students ; *(b)* university students.

From results display to services: the next step in the questionnaire was again a rating question, with the same scale used before, aimed at understanding which service was the most important for possible future users and which the least, among: {*scholarships*, *accomodations*, *disability services* and *school cafeterias*}. Results are collected in Fig. 2.19 (b). As it is possible to notice the most rated services are the presence of information about the scholarships and accomodations, while the least rated ones are the presence of information about school cafeterias and which disability services are offered.
Another source of discrepancy between the high school and the university populations raised when it was asked how much the search should have been specific with respect to the field of study. We gave three levels as options, as to cover all those courses that from the root of the discipline (the first level), e.g. *engineering, psychology* or *history*, expand and specialize one (the second level, e.g. *engineering* *engineering in computer science*) or two times (e.g. *engineering* *engineering in ICT* *curriculum telecommunications*). The high school students, as shown in Fig. 2.20(a), seemed strongly prefer the most shallow option, followed from the second level, while the university ones, Fig. 2.20 (b), preferred this second level followed by the third.
These results, together with the ones in Fig. 2.17, seem to strengthen the hypothesis that the high school students usually do not have a clear idea of which academic path to take[6], therefore they would like to be guided in this choice, through some tests, listening to other opinions and offering a wider pool of results that demanded fewer knowledge in the filtering options. For this reason we've decided to implement two ways for filtering the results: one for the macro-disciplines and one that enables, within the first macro level, a micro one with all the second-level options for that category.
The last question was asked in order to understand whether to require a mandatory registration to the application. This doubt raised from the fact that we wanted to implement the possibility of saving the favourite results reached during one's search and to provide the private chatting option, however this would have required such mandatory registration: a solution not always well accepted. Conversely not providing this possibility at all would have limited the features of the application and implementing both solutions was beyond the scope of this work. For this reason we explained such problem to the respondents, letting them to choose on our behalf. The results, in Fig. 2.21, showed a strong tendency to accept a mandatory registration if these extra features would have been provided: for this reason we've decided to implement the private area requiring mandatory log in to access to the contents of the application.

[6]This is in contrast with the university students whose already are aware of the main academic possibilities and therefore wishes some more advanced options.

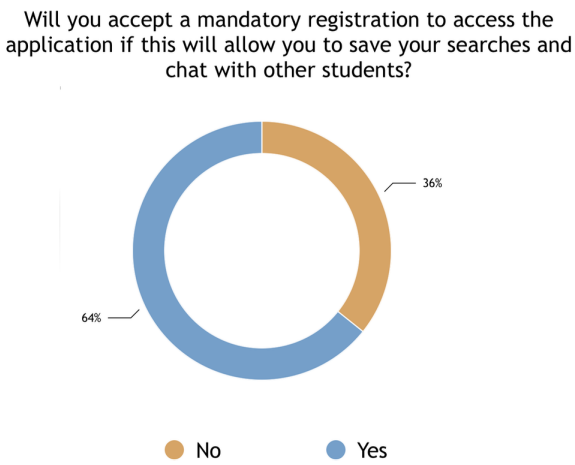


Figure 2.21. Preferences about the mandatory registration required.

Finally we provided an empty box for collecting suggestions. Among those that we've received, one is worth to mention: a respondent suggested us to perform a check of the profiles with which it is possible to chat within the application, for avoiding fake or dangerous profiles. This was an interesting opinion that blended well with the decision of a mandatory identification along with the possibility of selecting the profile with which to start an interaction.
Since the differences about the needs and preferences between high school and university students were limited, we've decided to implement a unique version of our application, oriented to better handle the shared wishes but providing also the most important features considered by both groups. In this way each student, no matter his/her background situation, could find in our application an useful tool to make informed choices and be aware of interesting opportunities.

2.4 Task Analysis

The requirements gathering phase was completed by the detection of the four most relevant tasks of the application, as follows:

- *Select a course* is the task of searching a course, surveying the results and finally selecting the desired one;
- *Ask a question to a student* is the task of posing a question to a peer, done by searching among all the profiles the one of the student which the user is interested to chat with and opening the corresponding chat;
- *Do the test for the career* is the task of completing the local test for finding an hint about the user's future career;
- *Get information about a service* is the task of retrieving information about a specific service of the academic world.

All these tasks were decomposed through the *Hierarchical Task Analyses* (HTAs), as will be shown in the next section, and the corresponding *State Transition Networks* (STNs) were finally designed in Section 2.4.2.

2.4.1 Hierarchical Task Analysis

The first task that was analysed, i.e. *Select a Course*, is the core action of our application. Through this task the user can search the academic opportunity that most suits him/her, by customizing the level of education along with various parameters of the search, such as the state, the faculty and the department, and the presence of additional services offered. The results matching these criteria are then presented as a list that can be scrolled to find the desired one, eventually selected. The complete HTA can be found in Fig. 2.22.

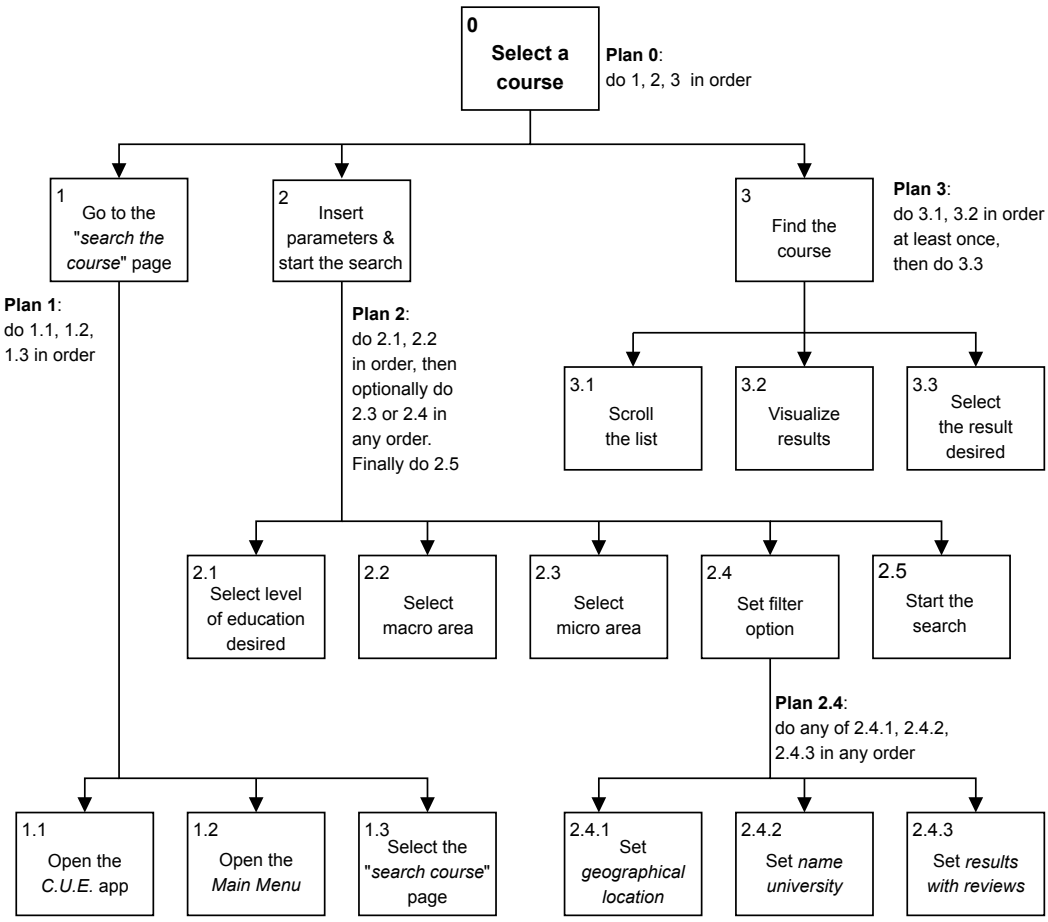


Figure 2.22. Hierarchical Task Analysis of the task of searching and selecting a course.

The first layer of the HTA is divided into three sub-tasks, aimed to bring the system to the correct section, setup the search and actively perform this search, respectively. It is worth to mention that one of the sub-tasks of the part for inserting the parameters of the search and starting it, implies an third layer in the HTA, in fact `set filter option` describes the opportunity of setting zero or more filters for the search. Please note that in Fig. 2.22 only a subset of the available filtering options were reported for brevity.
The second task for which the HTA was performed was *Ask a question to a student*. This decomposition, reported in Fig. 2.23, was again divided into three layers: the first, made by three sub-tasks, has the objective of bringing the system to the correct page, choosing the student to contact and asking the question. The third layer is introduced by the sub-task *choose the student*, since this complex activity can be further decomposed.

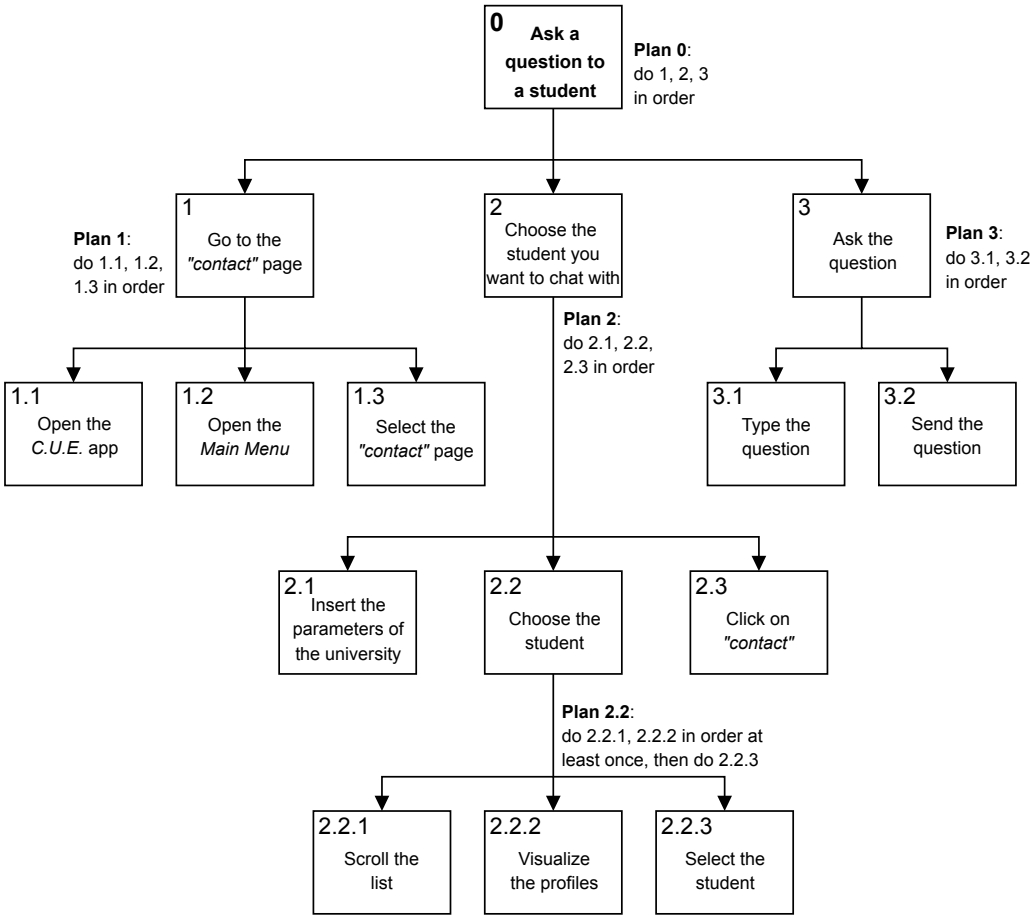


Figure 2.23. Hierarchical Task Analysis of the task of asking a question to a selected peer.

The *Do test career* task represents the sequence of actions that the user must perform in order to complete the local psychometric test for finding the future career, i.e. the one directly encoded in our application. Fig. 2.24 shows the HTA for this task. As it is possible to see this task is easier to accomplish with respect to the previous two ones, since the main action, answer the questions, is repetitive, allowing us to compactly represent most of the procedure. Finally note that the `plan 0` reported in Fig. 2.24 contains also an discretionary step, i.e. the task number `3`, that completes the plan.

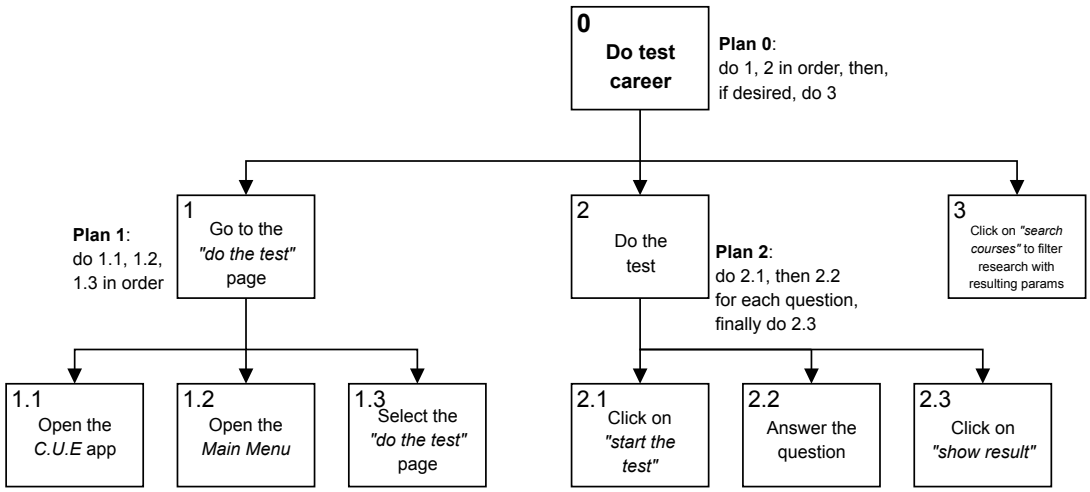


Figure 2.24. Hierarchical Task Analysis of the task of performing the local test for the choice of the career.

Finally, the last HTA performed was done for the *Get information about a service* task. The simplicity of this task is mirrored by the structure of its HTA, in Fig. 2.25, yet without compromising the effectiveness and variety of the information provided by the application, where this procedure can be largely applied.

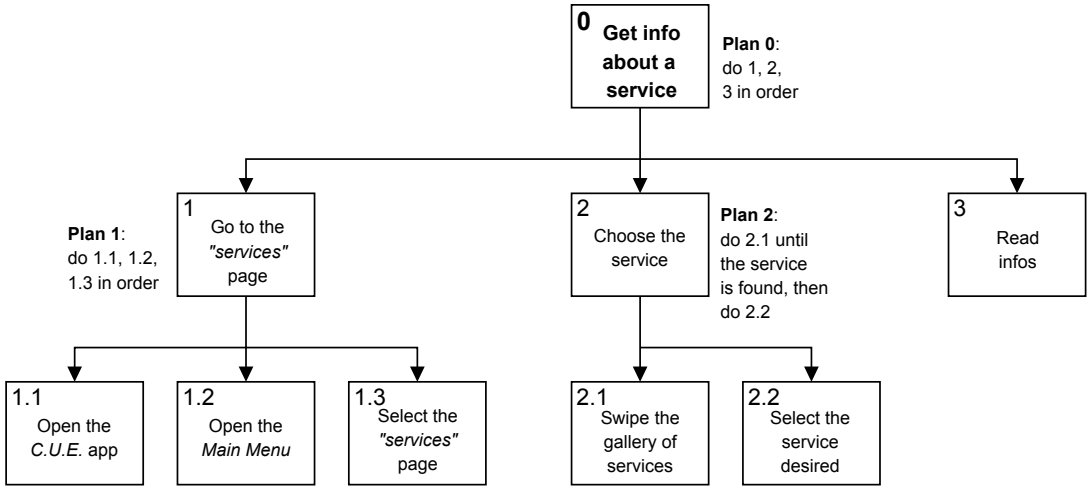


Figure 2.25. Hierarchical Task Analysis of the task of retrieving information about a particular service.

2.4.2 State Transition Networks

To conclude the first phase of this work, we have designed the STNs corresponding to the HTAs of the previous section. It is worth to mention that the mockups that will be presented in Section 3.1, are based on these state transition networks, however, for the sake of usability we have also endowed them with additional ways to accomplish the same task. Therefore the following STNs represent only one way, the canonical one, to perform it. As the construction requires, every arc in the STNs has an upper label denoting the action performed by the user,

that ideally follows the plan computed from the HTA decomposition, and a lower one for the feedback that the implemented system provides to the user as a response of his/her action.
As regards the task *Select a course*, the STN is reported in Fig. 2.26. It begins with the opening of the application and ends when a course is selected. As encountered in the HTA of Fig. 2.22, the filtering options listed in the annotation are an example of the ones that will be actually implemented in the mockups and, later, in the concrete application: they are meant to give just an insight of how the search procedure will be experienced by the user. This is also the reason why the filtering options are in a separate arc with respect to the *micro* and *macro* areas selection, since these cannot be either neglected nor modified.

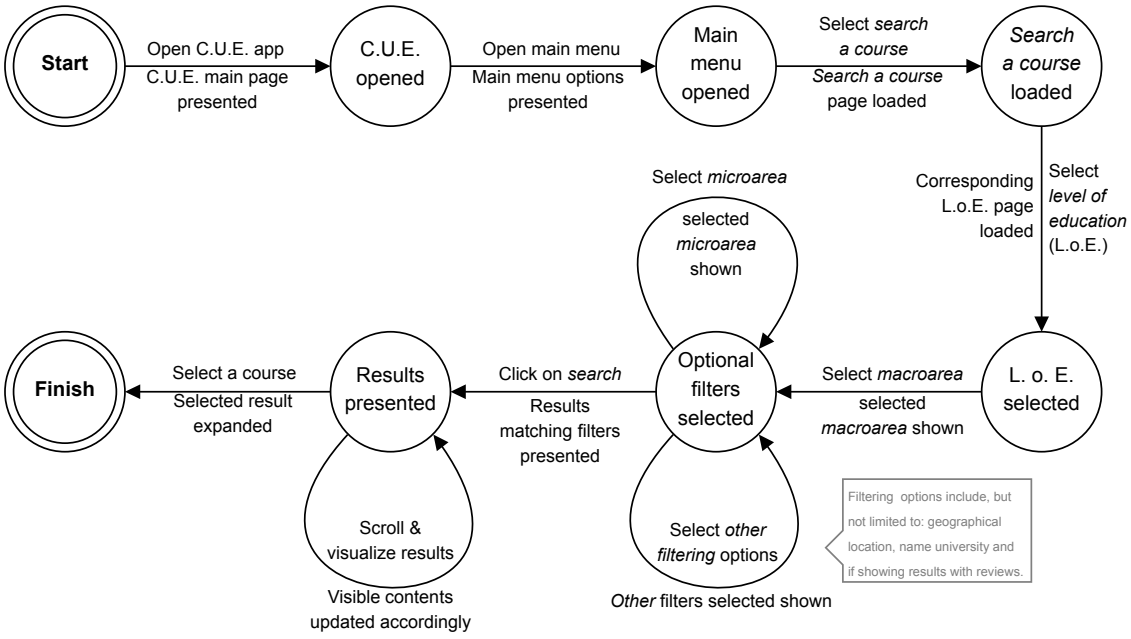


Figure 2.26. State Transition Network of the task of searching and selecting a course.

The STN for the *Ask a question to a student* task is shown in Fig. 2.23. As corroborated from the annotation in this figure, it is possible that the search for peers with a particular combination of input parameters ends up in a zero-result page. In this case, instead of simply throwing an error to the user, we offers the possibility of becoming the first peer with those criteria[7], mitigating in this way any negative feelings towards our application that may arise. This behaviour is, however, out of the scope of the task under consideration, therefore was not included in this STN.

[7]If eligibility criteria apply.

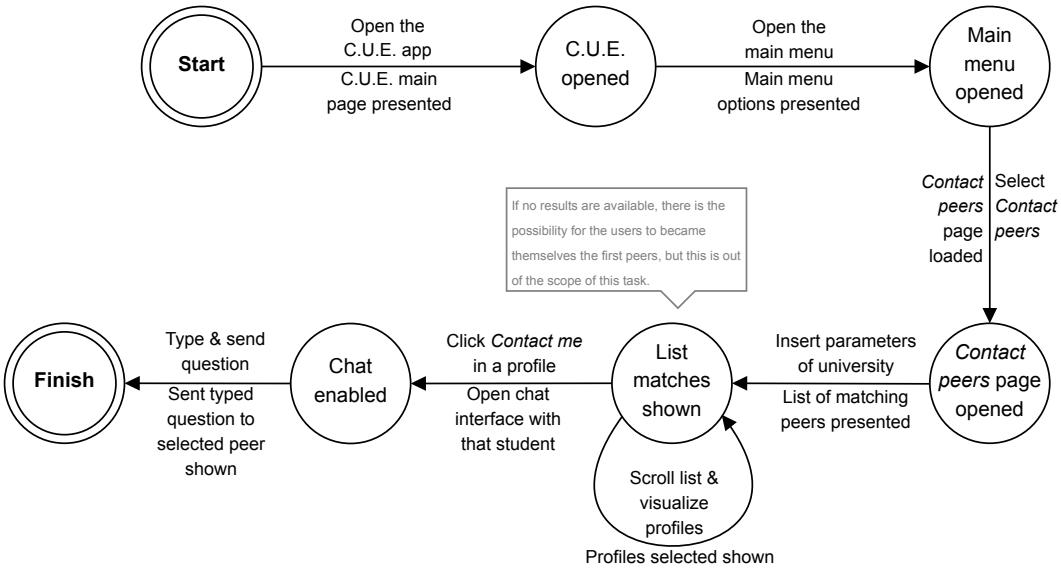


Figure 2.27. State Transition Network of the task of asking a question to a selected peer.

The third task, i.e. *Do test career*, has its own STN in Fig. 2.28. This schema introduced the idea of allowing the user to change the previous answer given and also to start the test from scratch, as represented by the loop and backward arcs, respectively. In order to make the STN an accurate representation of the user-system relationship over this task, we had to make the assumption that the user must provide an answer for each question before clicking on next, to avoid encountering errors. Later, during the mockups design, this assumption was handled choosing to allow the display of the next question only after the selection of one answer, thus preventing error messages.

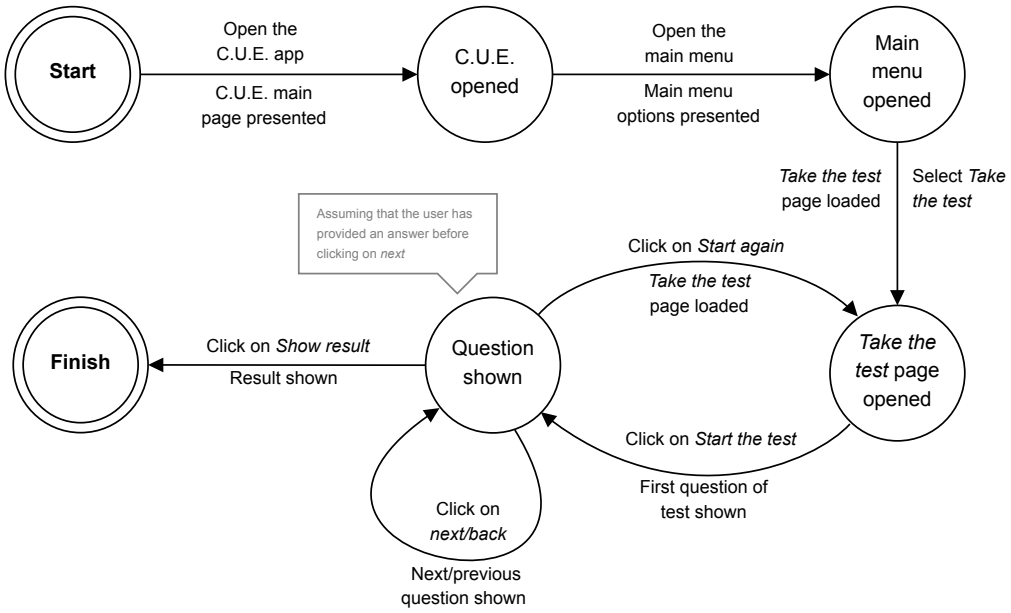


Figure 2.28. State Transition Network of the task of performing the local test for the choice of the career.

Finally the STN of the last task, that is *Get information about a service* starts at the opening

of the application and ends when the user has read the information that was looking for. As mentioned above, the simplicity of this task it is also its biggest strength, since this kind of procedure was highly employed in our work. More details on how the system reacts to the user performing this task can be found in Fig. 2.29.

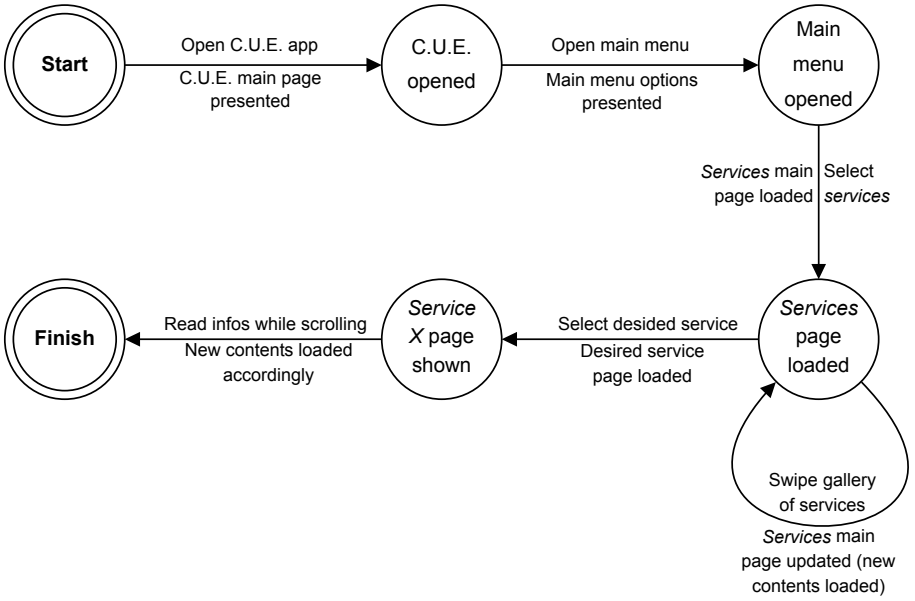


Figure 2.29. State Transition Network of the task of retrieving information about a particular service.

In the next chapter it is going to be described how we have used these Hierarchical Task Analyses and the State Transition Networks as foundations for designing the first set of mockups of the application.

Chapter 3

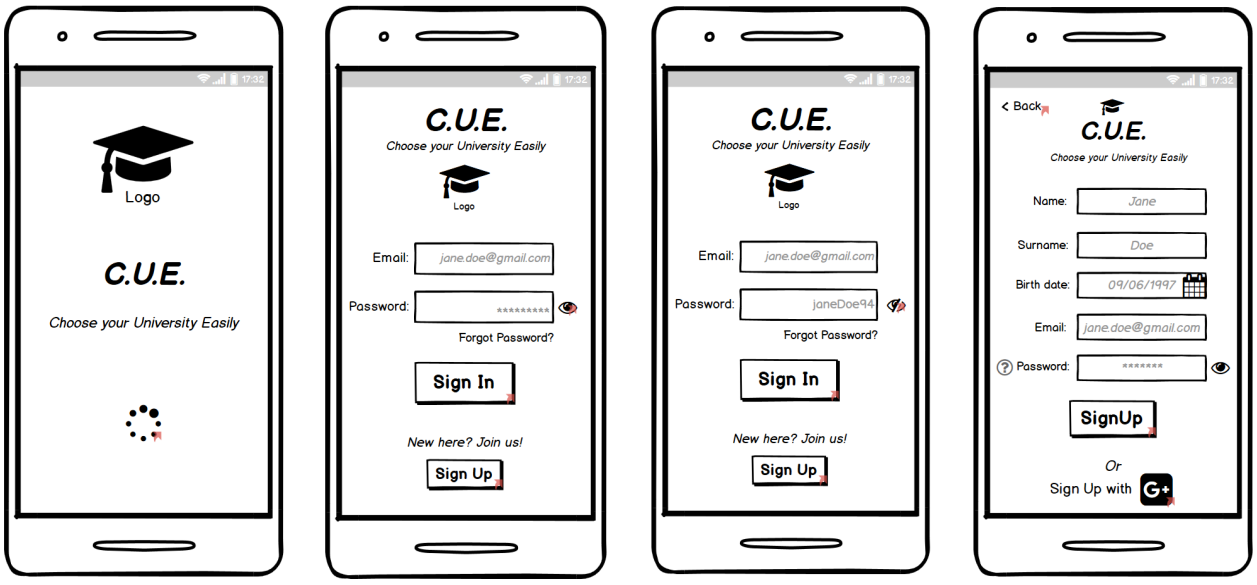
First Prototype

The next phase in the deployment of the *C.U.E.* application was the actual implementation of the first prototype. Starting from the information contained in the Hierarchical Task Analyses and in the corresponding State Transition Networks, we have designed a set of *mockups* to set up the underlying structure of the application, which information the pages should have contained and how these elements should have interconnected. Concurrently to the design of the mockups, we have started to implement the application: more details about these two steps will be revealed in the following sections.

3.1 Mockups

The mockups were created using the open-source *Balsamiq Wireframes* tool: with its varied library of elements, Balsamiq made it possible to design the skeleton of the application page by page and set up the links among its elements, thus simulating the interaction that a real user may experience.
We started this design phase with the block of mockups for the *Sign In* and *Sign Up* options. As explained in Section 2.3, due to the results of the first questionnaire, we have decided to request a mandatory registration in order to use the application, therefore the first step that a user has to do when s/he opens it, is to login or register if new. The wireframes involved in this process are shown in Fig. 3.1. As shown in Fig. 3.1(a), we have decided to insert the logo, the name and the slogan of our application as first thing to appear after the launch: it automatically redirects the user to the Sign In page (Fig. 3.1(b)) after a couple of seconds, as suggested by the loading symbol at the bottom of the page. We have borrowed the idea from some of the most famous apps already in the market. The Sign In page allows the users to insert only their Emails and passwords to enter, while providing the possibility of making the password visible by clicking on the well-known eye symbol: option represented by the wireframe in Fig. 3.1(c). We have also provided the possibility of retrieving the password, whenever forgotten, via clicking on `Forgot Password?`. Finally the page contains also the chance of signing up if the user is new: with a easy-to-detect button, the user is redirected to the wireframe in Fig. 3.1(d). This page contains the possibility of going back to the Sign In page in case of errors, to not force the user to register again. We have chosen to require few information to avoid making heavy this process to the user, in addition we have provided again the opportunity to see the password typed so far and to learn which characteristics the password has to possess using the question mark symbol. In order to additionally help the users in this process, we have added the possibility of signing using Google[1].

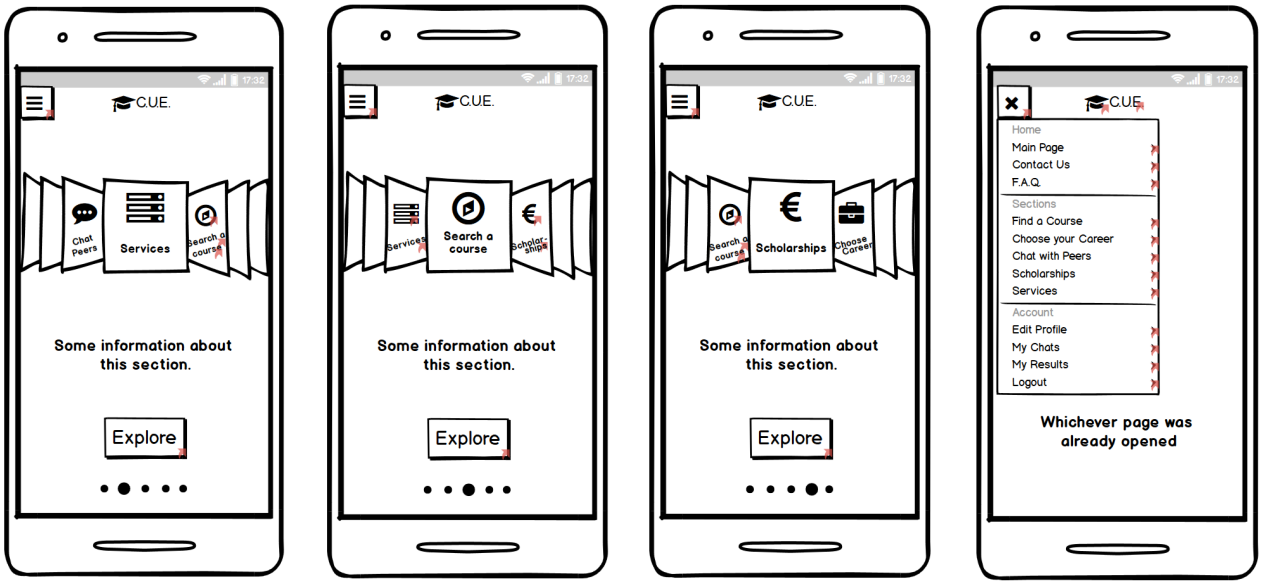
[1]This service is standard and not editable by us, therefore it was not shown in this report.



(a) **(b)** **(c)** **(d)**

Figure 3.1. Set of mockups for the *registration* process: *(a)* opening page; *(b)* Sign In page; *(c)* Sign In page with visible password; *(d)* Sign Up page.

Once either the registration or the sign in processes have been completed, the user is redirected to the main page of the application. This is composed by a scrollable gallery containing all the functionalities offered by this app, as shown in Fig. 3.2. The *Search a course* option is the leading element of the gallery, as depicted in Fig. 3.2(b), since it is the most relevant feature that we offer, but, scrolling the gallery, all the others can be presented and accessed though the text and button below, respectively. The gesture of scrolling is suggested straightforwardly by the shape of this element and also by the presence of the well-adopted sequence of dots at the bottom of the page. An example of this approach can be seen in Fig. 3.2(a), (b) and (c), where it is clear that the primary navigation is driven by sections. In each page of the application, and therefore in every wireframe of the mockups, we have decided to put a small version of the logo and of the name of the application, used to redirect the users back to the main page after further navigation in the application. In addition we have chosen to use an *overlay side drawer* for the main menu, since we have found that the majority of the apps in the market have this type of menu rather that an inlay one, therefore we expect that the users are more suited to this functioning. The main menu, reported in Fig. 3.2(d), is divided into sections to allow the users to find the right content with less cognitive load. In particular it is divided into three main categories: the `Home`, aimed at containing the links to the home page, to the contacts and to the F.A.Q.s and the `Sections`, containing all the features of the application, e.g. `Find a Course`, `Choose your Career` or `Chat with Peers`. The last category contains all the options related to the private account of the user. The menu appears over every page in which it was invoked by pressing onto the usual symbol of the three horizontal bars that, once the menu is expanded, becomes a cross with the power of compressing again the menu, saving space for the important contents of the app. It is worth to mention that the functioning and the appearance of the menu was studied to make it the most similar to the one used as default nowadays.



(a) **(b)** **(c)** **(d)**

Figure 3.2. Set of mockups for the *Main Page and Main Menu*: *(a)* One scroll to the left of the gallery from the home page; *(b)* home page; *(c)* one scroll to the right of the gallery from the home page; *(d)* main menu aspect: under it, the page that was already opened, remains open.

The `Home` section of the main menu, as well as containing a link to the home page, contains the links to two pages aimed at providing additional information on the authors of the application and on the F.A.Q.s about it, to troubleshoot any issue that may arise and to act as a guide to the new users. The first one, i.e. `Contacts` can be seen in Fig. 3.3(a). It contains our pictures and names and reports the links to the social media channels to engage the users in following any further update and news. We have collected a list of questions that may arise by the users, in particular we have inserted specific questions that act to a tutorial on the usage of the application to prevent the user to be annoyed by a comprehensive tour of the application and to circumscribe the answers to prevent the user from wasting time in learning what s/he already knows. The list of the F.A.Q.s can be scrolled to find the desired one as reported in Fig. 3.3(b) and (c). Due to the fact that only the questions are present, whenever the user wants to see an answer, s/he can click on the plus symbol to reveal it, or vice-versa on the same symbol, now minus, to hide it again to save space.

(a) **(b)** **(c)**

Figure 3.3. Set of mockups for the `Home` section of the main menu: *(a)* contact page; *(b)* main page for the F.A.Q.s; *(c)* an expanded question for the F.A.Q.s page.

The most important feature offered by our application is the searching process for finding an academic course. This is also the most crucial part, since it is difficult to decide which filters to provide by performing a trade-off between the number of such filters and the customization level of the search. Moreover the display of the obtained results is of fundamental importance since, as seen during the competitor analysis in Section 2.1, may easily become a source of confusion and mistakes. To cope with this potential issue we firstly redirect the user to a page presenting the same gallery of the home page, to support consistency, but with new contents to choose the desired level of education (l.o.E.), as it is possible to see in Fig. 3.4(a). Once the L.o.E. is chosen by pressing on the `Select` button, the user can setup also others parameters of the search, namely:

- *State*: the state in which the user wants to check the available courses;
- *Faculty*: the macro-area of the discipline towards which s/he is oriented;
- *Department*: area to additionally filter the results based on the available departments according to the selected faculty. This filter is optional as to provide also one-level researches as highlighted by the results of the first questionnaire in Section 2.3;
- *Filtering options*: a set of possible filters that can be added to the search parameters through checkboxes. They represent either the availability of particular services, e.g. disability dedicated services, or whether the course satisfies particular criteria, such as belonging to a top-ranking university.

This second set of filtering options can be see in Fig. 3.4(b): it is worth to mention that we provided a button to go back to the previous L.o.E. selection to help the user solving eventual mistakes. The search can then be started using the `Search` button, displaying the results as in

Fig. 3.4(c) and (d). As it is possible to see at the top of the results page there is a button that allows the user to modify the parameters of the search, by redirecting s/he to Fig. 3.4(b). The results are displayed using a list that can be scrolled whenever the number of results exceeds the limit imposed by the layout page. This scrolling gesture is at the base of most system nowadays, hence we expect that the newly users won't face any difficulties in seeing all the results. Each course has the same structure and it is summarized to avoid confusion and to target the focus of the users to each results without annoying them. The summary includes:

- *name course* respecting the filtering criteria, highlighted as to be the first thing that captures the attention of the user;
- *name university* to easily understand to which university the course belongs;
- *set of flags* to provide information about the satisfaction of predefined criteria and additional information, such as the city in which the university, and therefore the course, is located;
- *star button* allows the users to save a particular course that can be retrieved easier from their private areas, as in Fig. 3.9(c). Once tapped the result will be marked as saved;
- *plus button* allows to expand the result selected, without affecting the scrolling property of the main list. It shows the complete description about this course and all the links to the official sites for additional information, as in Fig. 3.4(d). The symbol, now becomes minus, allows to hide the description and return to the compressed view[2].

(a) (b) (c) (d)

Figure 3.4. Set of mockups for the `Find a course` section: *(a)* First parameter of the search, i.e. L.o.E. selection; *(b)* parameters of the search; *(c)* results display; *(d)* expanded result display.

The second most important feature offered by our application is the possibility to chat with students, named *peers*, that have already done their academic choice and are therefore available to answer to any doubt that the user may have. The main page of the `Chat with Peers` section is composed by a set of filters with which it is possible to filter the search of peers, as in Fig.

[2]This is consistent also with the F.A.Q.s part.

3.5(a). Once the setting of such filters is completed the user may click on the `Search peers` button to be redirected to the results of the search that takes the form of Fig. 3.5(b). From this view is is possible to scroll, as suggested from the sequence of dots at the bottom of the page, the profiles of the peers, reported as cards completed by all the information about them, to choose the one that complies most the user's expectations. In fact, one of the future development might be the addition of a star-based rating system to highlight *pro-respondents* and to collect negative feedback about certain peers. The selection of the peer happens whenever the user presses the corresponding `Contact Me!` button. This opens the corresponding chat environment and enable the chatting option, as in Fig. 3.5(c), directly on the page or opening a new page and redirecting it the user[3]. It is worth to notice that in the results page there is a button, i.e. `Edit Search`, that allows the editing of the search parameters whenever required. Since recruiting volunteer peers is not straightforward, sparsity in the searches may arise. To avoid showing errors to the user or presenting an empty page, we decided to add the possibility to become the first peer, if the correct criteria match (Fig. 3.5(d)). According to the psychology, this approach should decrease the discontent of the user in not finding what was looking for. This possibility is directly made available also in the main page of this section. The `Become a peer` part is composed of two activities, reported in Fig. 3.5(e) and (f), that allows the user to modify or to insert additional personal and academic information and to join the community of peers through the button `Join us!`. To reduce the effort of the user, his/hers already available information are shown as default values of the fields, yet allowing s/he to edit them. Additionally, we provided buttons to go back and forth between the two pages for the data insertion.

Another highly requested feature, especially by the high school students, is the presence of a psychometric test that offers useful insights about the future field of study that the user may undertake, based on his/hers answers. To implement this we decided to provide a page, i.e. Fig. 3.6(a), from which the user could be either redirect to the local test, via clicking on the `Do our test!` button, or a page with external links to additional tests using `Give me other tests!`, as shown in Fig. 3.6(f), from which it is then possible to go back to the main page. As regards the former option, each question of the test is shown onto the full layout along with its four answers (Fig. 3.6(b), (c) and (d)). Pressing on one of the answers allows the user to proceed with the next question. For each page, showing a question, there are few buttons that allow the user to go back to the previous page or to start from scratch (the second question doesn't have the latter since both options coincide). In addition there is a progress bar to give to the user an hint about what remains left. The last question possesses also a button, i.e. `Show result`, that redirects the user to the result page, depicted in Fig. 3.6(e), from which it is possible to start the test from the beginning, to explore other external tests or to view the courses that match the resulting area of expertise.

Providing information about the academic world is fundamental to guide novice students, therefore we have inserted in our application several guidelines to learn the most important notions about how different aspects of the academy work. The main page of this `Services` section is shown in Fig. 3.7(a), that, through the same gallery that extensively characterizes our application, it is possible to reach the dedicated pages in which a scrollable content should give enough internal and external resources to the future university students. An example about the layout of the `Accomodations` service is reported in Fig. 3.7(b). Finally, it is worth noticing the `Back` button that allows the user to go back to the services' main page.

[3]This depends on the tool used to actually implement the system.

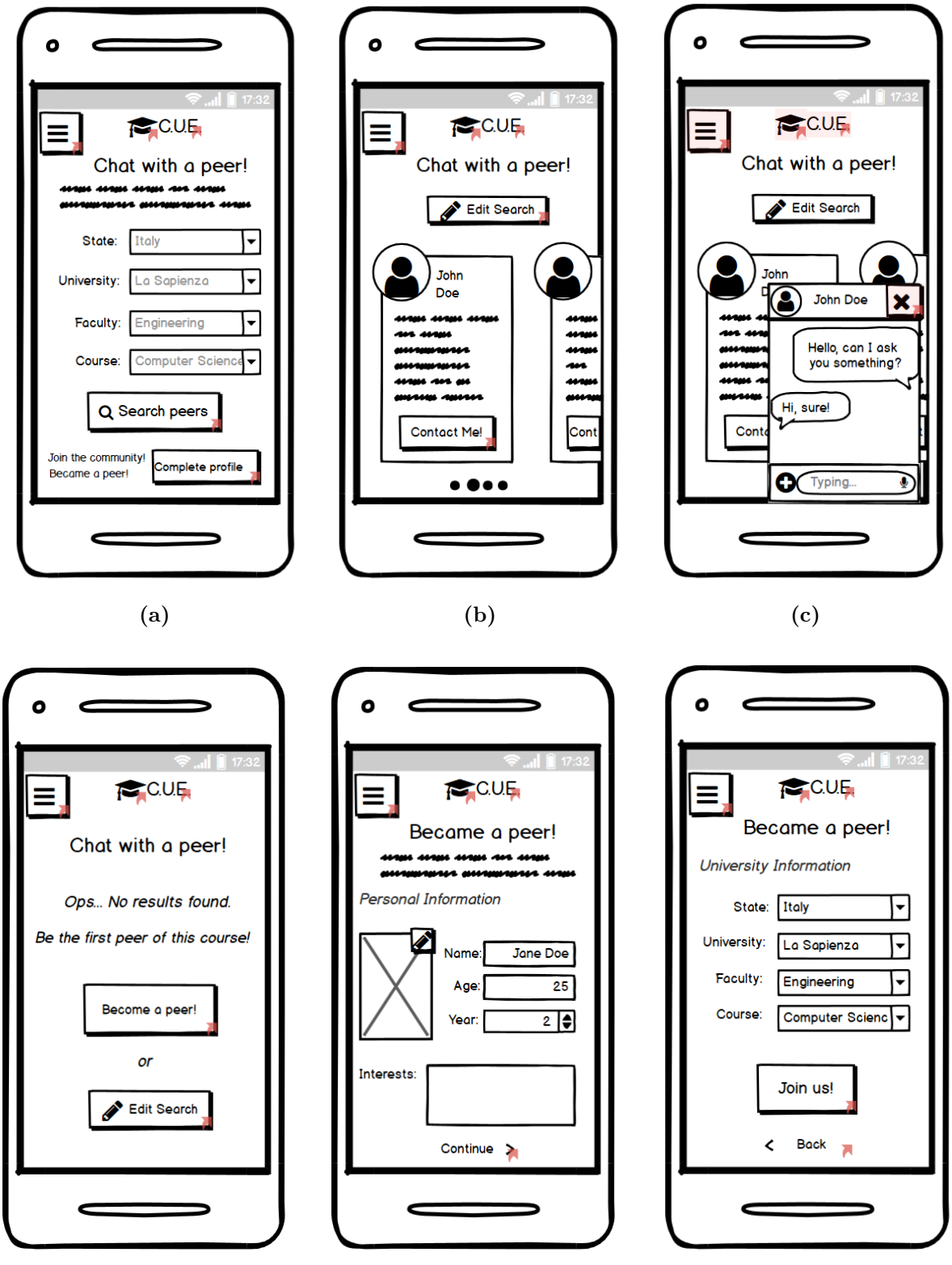


Figure 3.5. Set of mockups for the `Chat with Peers` section: *(a)* section homepage; *(b)* results display; *(c)* chat display; *(d)* become a peer option; *(e)* become a peer personal data requested; *(f)* become a peer academic data requested.

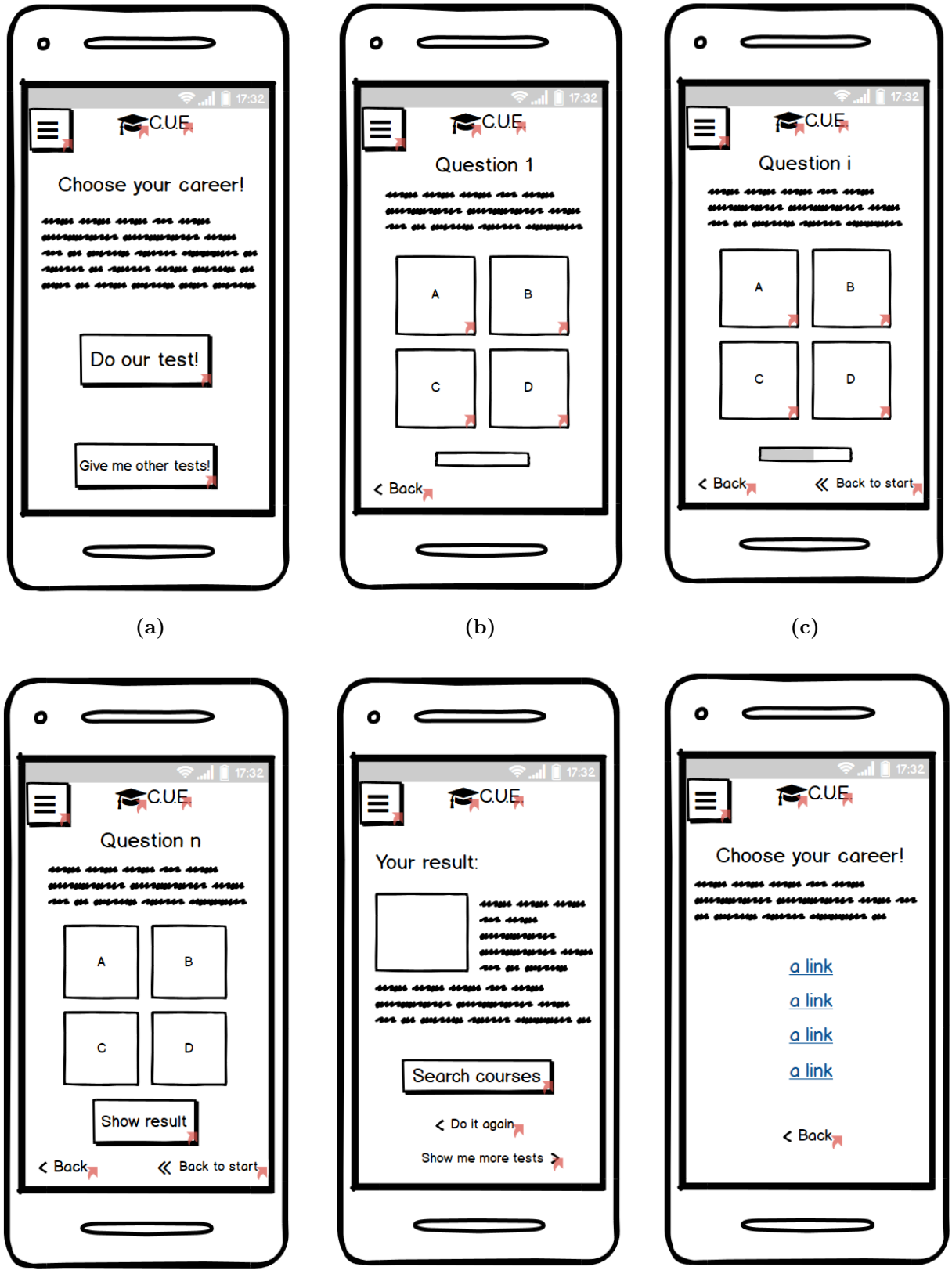
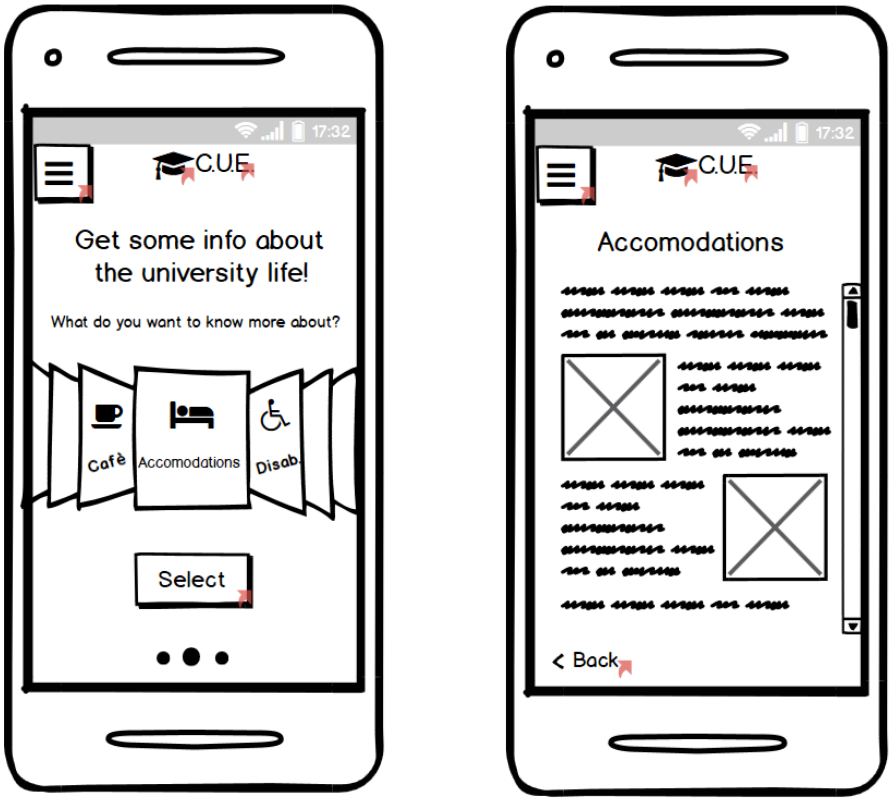


Figure 3.6. Set of mockups for the `Choose your Career` section: *(a)* main page of the section; *(b)* example of the layout of the first question; *(c)* example of the layout of an intermediate question; *(d)* example of the layout of the final question; *(e)* result display; *(f)* page for the external links.



(a) (b)

Figure 3.7. Set of mockups for the `Services` section: *(a)* services main page; *(b)* example of a service layout.

Another highly requested aspect, more complicated than the ones treated in the Services, is the founding mechanisms of the scholarships. Due to the particular intricate and varied nature of the funding opportunities, we decided to offer an external section, i.e. `Scholarships`, aimed at explaining as much as possible the different sources of funding, the eligibility criteria, the deadlines and additional constraints. The categorization of the opportunities is at the base of this section, whose mockups are reported in Fig. 3.8. The usual gallery allows the user to choose, via the `Select` button, among:

- *European opportunities*: all the funding opportunities coming from the European Union (Fig. 3.8(a)). This option is then divided into different categories (Fig. 3.8(d)) that in the same way redirect the user to an informative dedicated page (Fig. 3.8(g)).
- *Italian opportunities*: all the founding opportunities handled by the Italian State (Fig. 3.8(b)). As the European option also this one provides an additional subdivision into different categories, such as Regional, Public or Private scholarships (Fig. 3.8(e)). Each of these brings the users to the selected informative page (Fig. 3.8(g)).
- *International opportunities*: all the funding opportunities offered by international states (Fig. 3.8(c)). The subdivision comes from state (Fig. 3.8(f)), as the final informative page (Fig. 3.8(h)).

Each page has a button, in the same position, allowing the user to go back to the previous layer of the search and to choose different options.

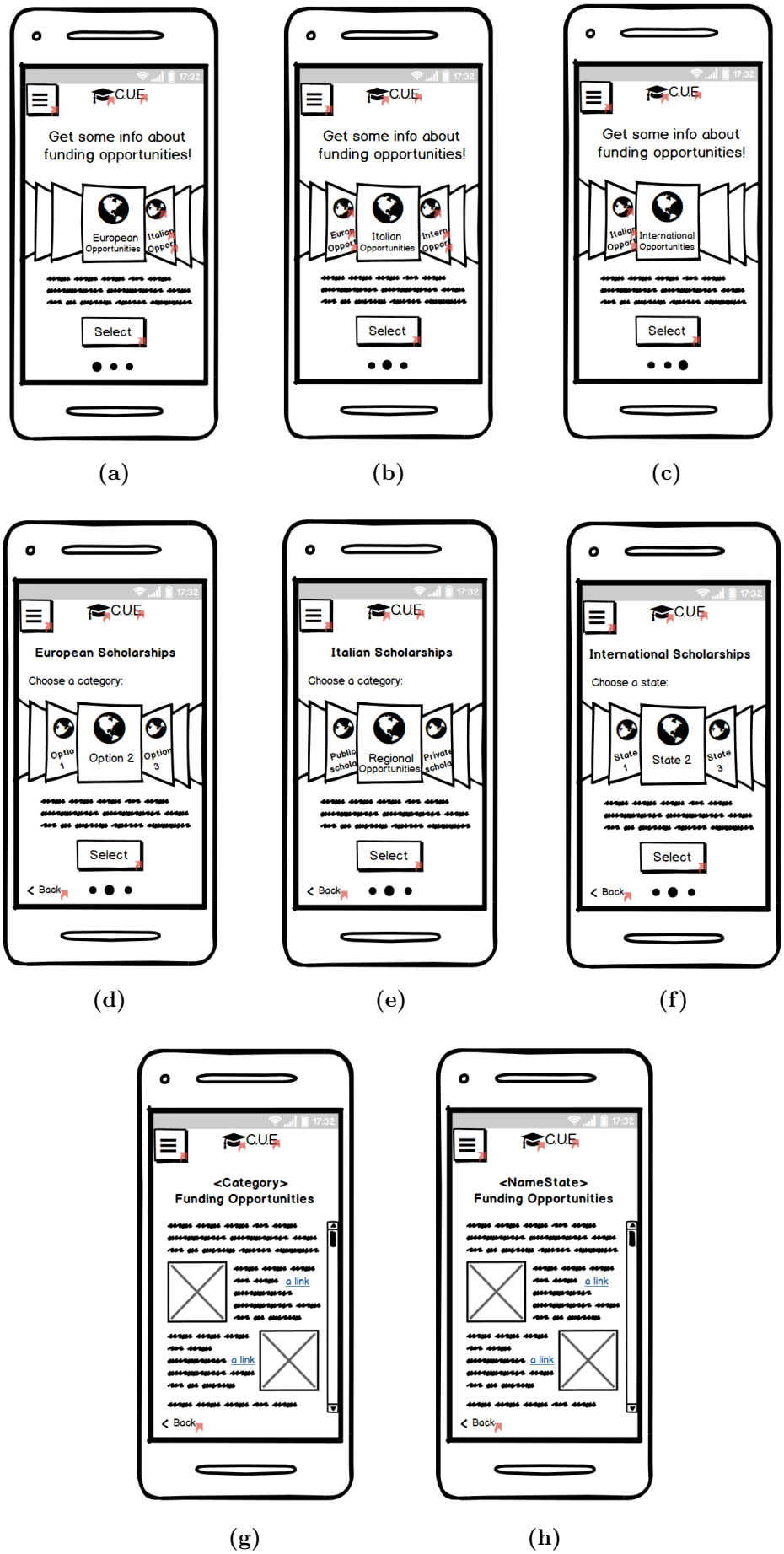
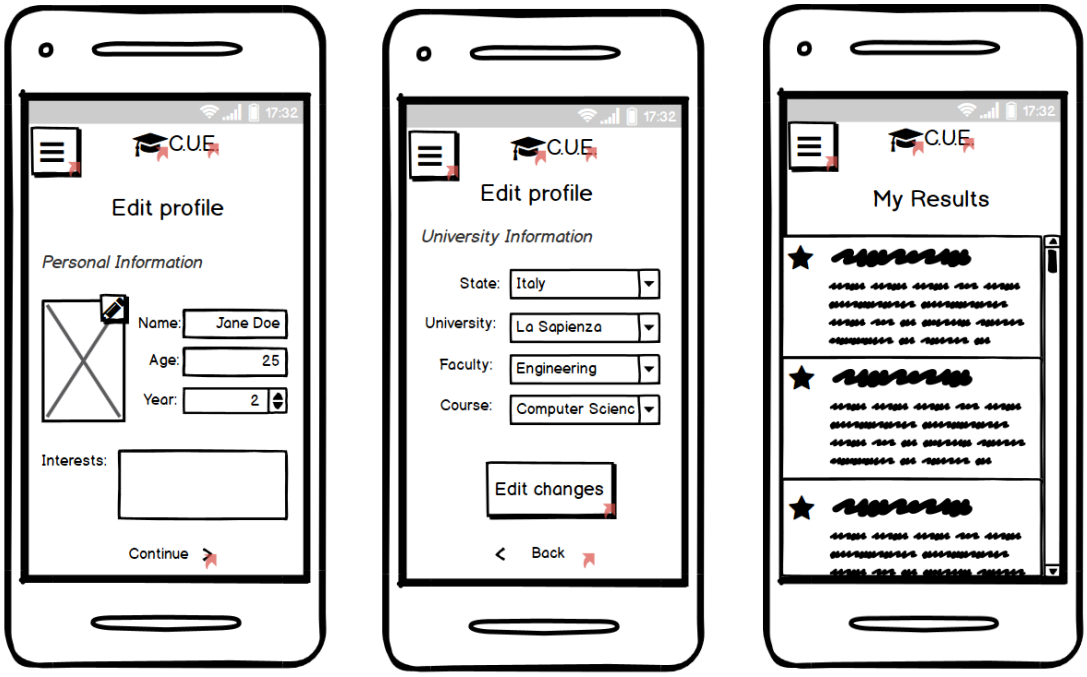


Figure 3.8. Set of mockups for the `Scholarships` section: *(a)* main page of the section after swipe to the left; *(b)* main page of the section; *(c)* main page of the section after swipe to the right; *(d)* European scholarships options layout; *(e)* Italian scholarships options layout; *(f)* International scholarships options layout; *(g)* informative page layout for the categories; *(g)* informative page layout for the states.

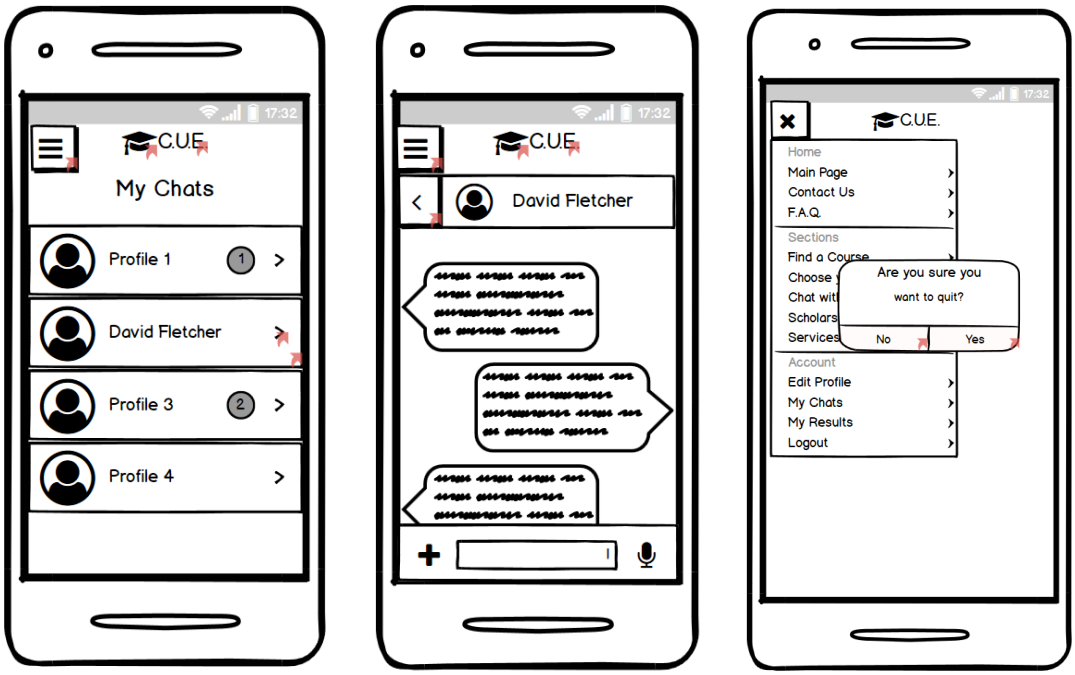
Finally, the last set of mockups regards the *private area* of the user, in which s/he can interact with his/hers own preferences, such as the saved results, as in Fig. 3.9(c), and the ongoing chats in Fig. 3.9(d) and (e), where the latter is an expanded version of a conversation with a particular peer. Moreover, in this area the user can edit his/hers profile through an interface similar to the one provided in the `Become a Peer` option (Fig. 3.9(a) and (b)). Finally, the user can logout from the application through the `Logout` item in the main menu, after having confirmed his/hers desire in the alert box, as depicted in Fig. 3.9(f).

3.2 Implementation Details

Concurrently to the last steps in the mockups development, we have started to actually implement the application. We have decided to use the well-known *Android Studio* framework for its deployment. We have created a functional prototype maximizing code reusability and therefore minimizing the quantity of space used by our application. We have set as minimum SDK the API 19 (Android 4.4) that acted as a good trade-off between new advanced functionalities and the possibility of wider fan out: in fact we expects that nowadays this application could run on approximately 98.1% of devices.
We have created this application using several *Constraint Layouts* to provide scalability in the design according to the screen dimensions.
More details about the implementation can be found in the source scripts. For the full code of our application, please refer to the GitHub repository to which this report is attached.
This prototype was then employed in the evaluation techniques involving user participants, as further explained in the following chapter.



(a) (b) (c)



(d) (e) (f)

Figure 3.9. Set of mockups for the *private area*: *(a)* first layout for editing the user's profile; *(b)* second layout for editing the user's profile; *(c)* page that shows the results saved by the user; *(d)* ongoing chats of the user; *(e)* expanded vision of a conversation with a peer; *(f)* logout process.

Chapter 4

Evaluation Techniques

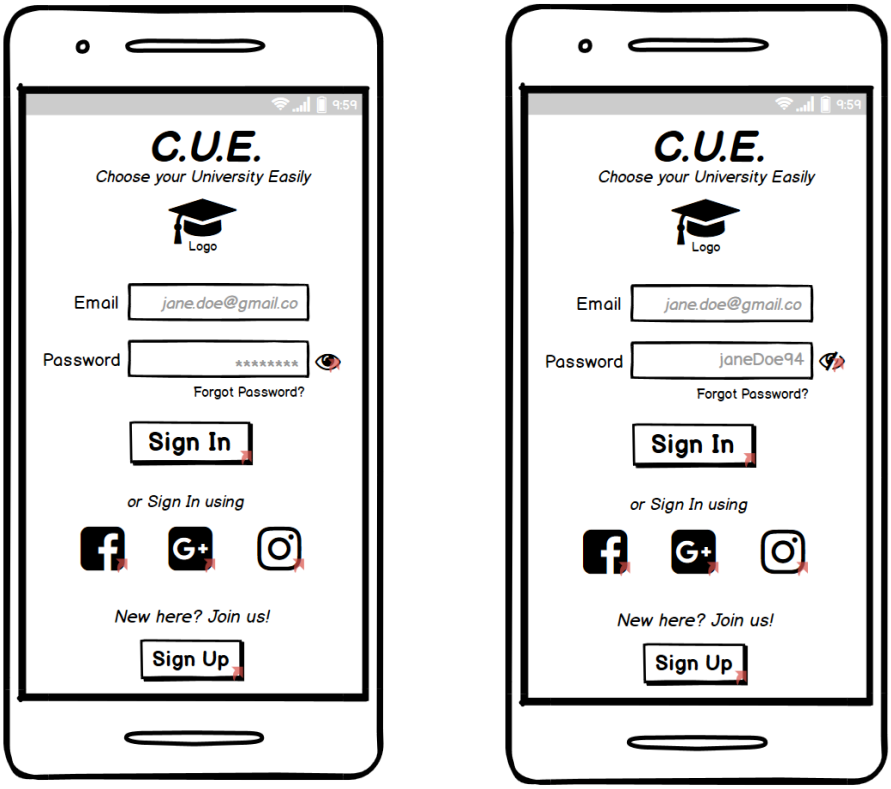
One of the key steps in human-computer interaction systems is the evaluation of the prototypes. It aims at assessing usability principles and, for example, to detect potential sources of error. The evaluation process can be performed at a different moments in the life-cycle of the product, therefore we have decided to apply different types of evaluation techniques in diverse moments during the development of our application. In the next sections we will disclose all the evaluation steps that we have performed in this work.

4.1 Heuristic Evaluation

The first evaluation was performed shortly after having designed the mockups of the application. This was guided by the intuition that modifying the wireframes to recover to the detected errors, is easier than doing it in a fully functional implementation. We have decided to rely onto an *Heuristic Evaluation* performed by an expert. We forwarded to the expert a copy of the mockups and a brief description of the application purposes and of the target user. The expert has then analysed the wireframes searching for violations of the *10 Nielsen's heuristics* and the severity of these violations in a scale from 0, i.e. *I don't agree that this is a usability problem at all* to 4, that is *Usability catastrophe*. The expert sent to us the report of this evaluation with the results in Table 4.1. The table is structured as reporting in the first column the references to the figures of the mockups that have raised the violations. The second column shows which heuristic was violated while the third reports the severity level of the violation. Finally, the last column collects the corresponding comments.
To address the first violation we have added the possibility of log in using social platforms or Google, by simply clicking on the corresponding icon. The elements on the wireframes were rearranged as to maintain an intuitive appearance and prevent from resulting in an excessively cluttered display. The updated mockups solving this violation are reported in Fig. 4.1.

Frame	Heuristic Violated	Severity	Comments
Fig. 3.1(b)	Flexibility and efficiency of use	2	Offer alternative methods of registration such social login or Google login. It is in Sign Up but not in Sign In.
Fig. 3.3(b)	Flexibility and efficiency of use	3	Consider to group Faq in categories.
Fig. 3.4(b)	Flexibility and efficiency of use	3	Consider adding city as filter.
Fig. 3.9(d)	User control and freedom	2	Consider adding a search function.

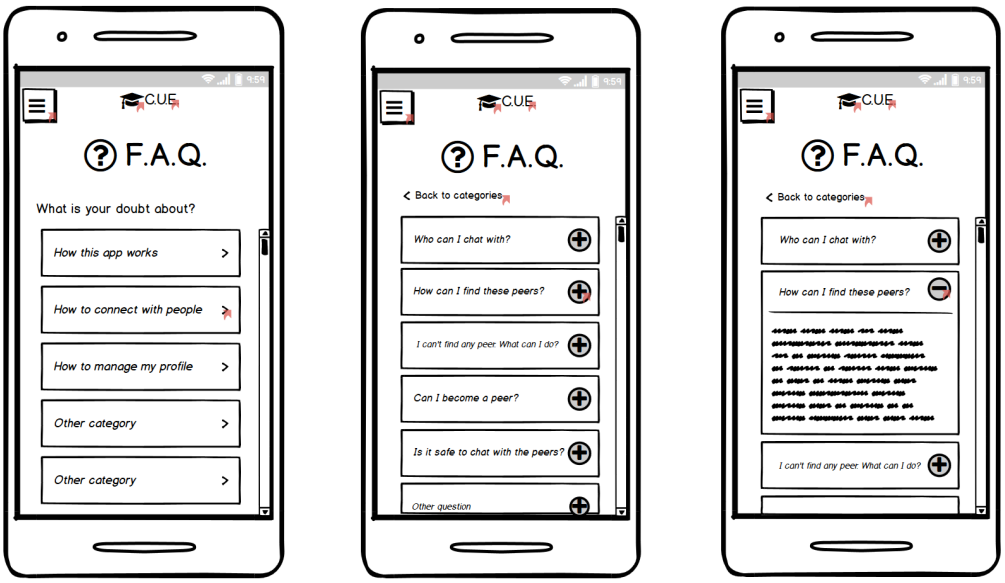
Table 4.1. Results of the Heuristic Evaluation on the application mockups.



(a) **(b)**

Figure 4.1. Updated wireframes to solve the login violation: *(a)* new Sign In page; *(b)* new clear Sign In page.

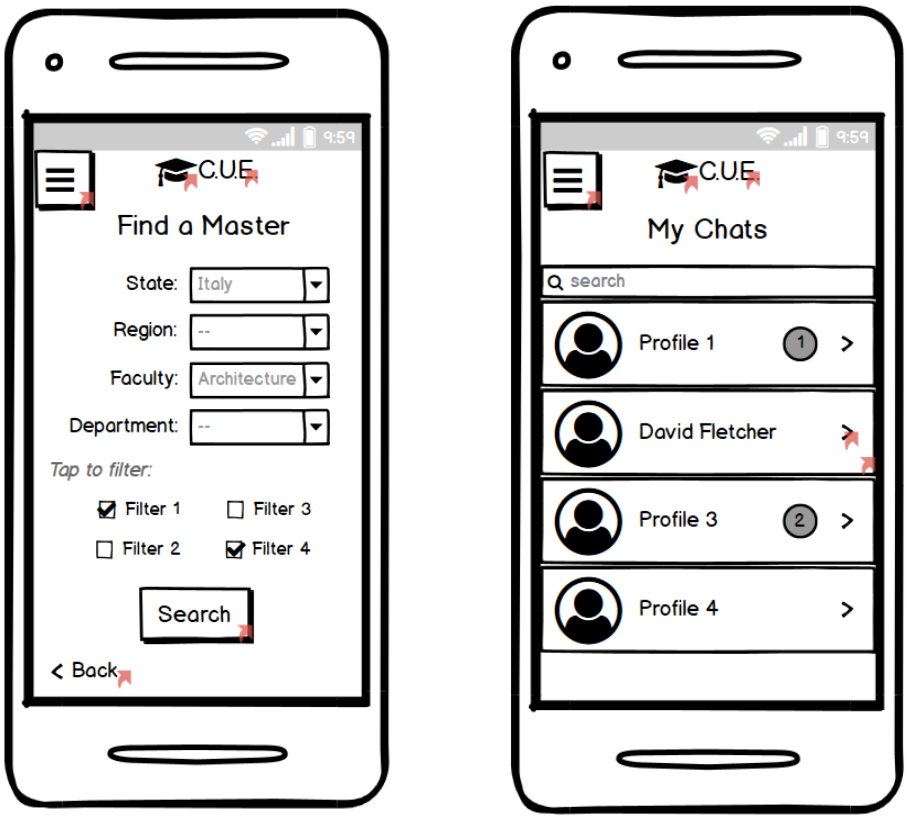
The second violation required the addition of a new wireframe to solve it. This page, shown in Fig. 4.2(a), groups into categories the frequently asked questions, in a list of areas that can be scrolled and clicked to open the wireframe in Fig. 4.2(a) that contains the corresponding list of questions. The arrangement of the categories mirrors the above-mentioned one of the questions. In Fig. 4.2(b) and (c) are shown the filtered questions according to the selected category both non-expanded and expanded, respectively.



(a) **(b)** **(c)**

Figure 4.2. Updated wireframes to solve the F.A.Q.s violation: *(a)* added category wireframe for the F.A.Q.s; *(b)* grouped questions; *(c)* expanded grouped questions.

The third violation was more complex to address since we had to find a geographical filter that was the best trade-off between the granularity of the search and avoiding sparsity of the results while keeping consistency for all the states taken into consideration. In fact, choosing to filter according to the city, would have been the most precise filter that would have allowed to narrow down the results to the selected areas. However, due to the lack of university for every city, the quantity of searches that would have ended up in zero results was too high that quite surely would have caused negative feelings to the users. The same reasoning could have been applicable for the provinces. We decided therefore to increase the level of generality, pointing to the *region* as the best trade-off, due to the strong enough ability in filtering the results while providing always a results. In addition a manageable number of regions could be found in every state taken into consideration in this work. We have decided to add the region filter as a drop-down menu under the state one, updating the values of the items for the former according to the selected one for the latter. This change can be seen in Fig. 4.3(a).
Finally, the last violation was solved with the addition of the default search bar at the top of the scrollable area containing the chats from which it was possible to find a particular conversation with more ease. The updated mockup can be found in Fig. 4.3(b).



(a) (b)

Figure 4.3. Updated wireframes to solve the course search and chats violations: *(a)* solution for the course search violation; *(b)* solution for the chats violation.

4.2 Cooperative Evaluation

The first evaluation technique through user participation performed in this work was a *cooperative evaluation*. We have decided to execute initially this kind of evaluation rather then *think aloud* to retrieve the highest amount possible of data through which clarifications the users would have asked to ourselves.
In order to conduct this evaluation technique we have grouped twelve real users that matched the target user definition of Section 2.2.1, in particular the details of the selected population are:

- *Age*: one user of 18 years old, one of 19 y.o., two users of 21 y.o., three of 24 y.o., two users of 25 y.o., one of 26 y.o. and finally two users of 28 years old.
- *Gender*: 5 male and 7 female.
- *Location*: 3 users from Caserta, 2 users from Latina, 2 users from Padua and 5 users from Rome.
- *Education level*: two users enrolled to an high school, five users enrolled to a Bachelor's degree, three users enrolled to a Master's course and finally two users are taking a PhD.
- *Family*: 9 users unwed, 2 users unwed but with children and one user married.
- *Level of Knowledge of technology*: three users declared as beginner users, seven users declared as average users and two users declared as expert users.

Even though this method provides useful insights to evaluate the prototype, it is selective, so it became crucial to detect the most relevant part of our application to perform the cooperative evaluation on it. The task chosen was therefore to *find and save a course*. We have disclosed the task to the group of users asking for questions and we received several doubts regarding which course they had to find and save. We have explained that there were no requirements about the course to find, hence no specific values for the filters to set. Ideally this task may have being performed by selecting the `Find a course` section through the gallery of the main page or by the corresponding tab in the menu. Both solutions bring the user to the page of the filters in which it is possible to select the characteristics of the course to find, such as the state, the region, the faculty, the department and a series of attributes that the course must possess[1]. The clicking of the `Search` button redirects the user to the page containing the results, that can be scrolled until the desired course is found. To save the result the user can simply press the star icon. The notes on the session were taken via paper and pencil and audio registration as support. Initially, we have considered also video taping as additional help to prevent from loosing certain information, however the majority of the users involved in the process preferred not to be filmed and therefore we avoided this mean to prevent also the users from being distracted. It is worth to mention that we have never had to repeat to keep talking since all the users involved in this evaluation naturally continuously commented what they were doing, giving useful feedbacks.
We have collected and analysed the information gathered from this cooperative evaluation, providing a solution to the most relevant issues found. The processed findings are reported in Fig. 4.4.
As it is possible to see in Fig. 4.4, only one user unsuccessfully tried to click on the image of the slider rather then pressing on the corresponding `Explore` button, therefore we have limited to increase the size of the button to make it more visible without modifying the functioning, since the rest of the population have not encountered this issue. One of the most relevant problem found with this technique was that the majority of users, exploiting the freedom in the choice of the characteristics that the course should possess, tried to select more than one option in the same menu of the filter page, in order to reduce the time needed to check more than one category and to allow comparisons. We have decided to tackle this issue by changing the menu type to one that allows multiple items selection.
Another relevant issue was that some users have not understood that the star on each course description must be clicked to save the course. When we have asked why they have not clicked it, they said that it was not enough evident. For this reason we have decided to add the `Save` keyword under the icon to disclose its function and make it more visible.
Finally, it is worth pointing out that seven users reached the main page of the section using the slider menu and five through the navigation one. When we have asked the reasons behind one choice in place of the other, the first group answered that *search a course* was the first thing they have read, due to the fact that it is in the first page after the login, while the latter group has claimed that they did not pay attention to what was written in the page, but just followed the usual way in which they are used to navigate in a mobile application.
With this cooperative evaluation technique we were able to identify some issues and transform them into sources of enhancements. Overall it turned out that the interface was pretty user-friendly.

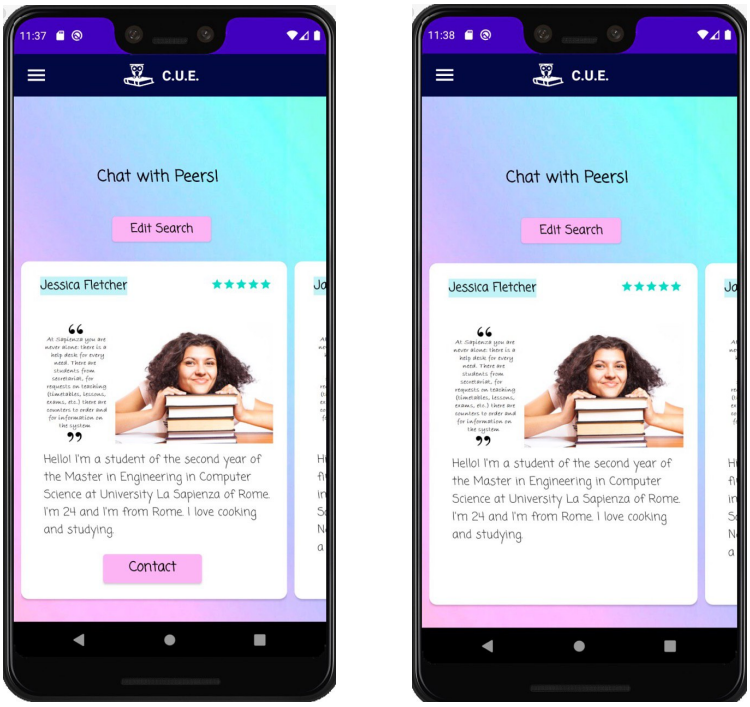
[1]The region and the department have also the void option, denoted as -, as to represent no additional requirement to set.

ID of the indicent	Related Incidents	Priority of the incident 1=highest 4=lowest	Description of the incident	How the incident was found	Good or Bad	Potential solution to the incident if bad
#1	**None**	**3**	**User was not able to access the section by clicking on the image of the gallery**	**Only one user tried to click on the slider image instead of clicking on the Explore button**	**Bad**	**Making the Explore button more visible**
#2	None	1	User was not able to select more than one option at the same time on the filter menus	8 users claim that was not possible to select more than one options in the filter menus	Bad	**Changing the filter menus in order to make possible to choose multiple items at the same time**
#3	None	3	Users were able to achieve the task following two different paths	7 users reached the task passing through the main slider while 5 users have achieved it through the navigation menu	Good	-
#4	None	1	The user has not found the saving button	5 users have not understood that in order to save the course they would have pressed the star button	Bad	**Adding the "Save" word right under the star symbol to clarify its meaning**

Figure 4.4. Findings of the cooperative evaluation for the *find and save a course* task.

4.3 Controlled Experiment

We have then performed a *controlled experiment* in order to define which, between two versions of the same system differing by only one aspect, was the best one. Differently from the Heuristic evaluation, this technique is based on the actual implementation of the application, rather than the mockups, moreover it is performed by real users, instead of an expert. The problem we have tackled with this evaluation technique was to understand whether there was a statistically significant difference between a system that starts the chat with the desired peer whenever the user clicks anywhere on the card and a system that starts the chat only after the clicking over the corresponding `Contact me!` button. Snapshots of the two systems, i.e. *Button* and *Card*, can be seen in Fig.4.5(a) and (b), respectively.



(a) **(b)**

Figure 4.5. Appearance of the two systems under consideration: *(a)* system *Button*; *(b)* system *Card*.

Straightforwardly, the task that we have imposed was to open the chat of the *fifth* peer on the list presented to the user. To set the focus of this experiment on the difference of these versions we have considered the scope of the task from the click on the `Search peers` button, that automatically shows the list of the peers, to the opening of the chat of the fifth peer of that list. The part that from the main page brings the user to the list of peers, including the filters setting, was not taken into consideration in this analysis due to the homogeneity of the two systems over this process.
The two hypotheses formulated for this experiment are the following:

Hypothesis 1 (Null hypothesis) *There is no difference between the* Card *and the* Button *systems.*

Hypothesis 2 (H_1) *Users will open the correct conversation more easily by clicking the button rather then the cardview.*

The purpose of this experiment is to disprove the null hypothesis, in favor of the H_1 one, hence to prove that there is no difference in the dependent variables caused by changes in the independent variables.
As regards the *independent*, i.e. manipulated, variable we have chosen the *way to open* the conversation: via button or via cardview. The *dependent* variables, instead, are the time, in seconds, elapsed until the opening of the correct chat and the number of mistakes, i.e. all the actions that deviate from the normal flow to reach the goal. To measure the time, we have coded a timer in the application able to return the time elapsed between the beginning of the experiment and the predetermined stopping point, while for the number of mistakes we have relied on a human observer.
In order to have a pool of real users wide enough to be representative, we have involved 16 students that matched the target user defined in Section 2.2.1. We have carefully selected the participants to this experiment to obtain two groups of 8 people each that possessed approximately the same characteristics in order to limit the user variation that may cause biased results. In particular, the details of the selected population are:

- *Age*: 2 users of *18 y.o.*; 2 users of *20 y.o.*; 4 users of *23 y.o.*; 4 users of *24 y.o.*; 2 users of *25 y.o.*; 2 users of *28 y.o.*.
- *Gender*: 8 users *male* and 8 users *female*.
- *Location*: 8 users from *Rome*, 4 users from *Venice* and 4 users from *Cosenza*.
- *Education level*: 4 users enrolled to an *High School*, 4 users enrolled to a *Bachelor's degree*; 6 users enrolled to a *Master's degree* and 2 users that are taking a *PhD*.
- *Family*: 14 users *unwed* and 2 *married*.
- *Level of knowledge of technology*: 4 users declared as *beginner users*, 6 users declared as *average users* and 6 users declared as *expert users*.
- *Disabilities*: no particular disabilities were reported for any user.

To perform the controlled experiment we have chosen the *within groups* design, hence each user performed the task under both conditions in a sequential manner. In order to mitigate the transfer learning effect half of the users, i.e. a group, have executed the experiment starting with the system *Button* and the other half with the *Card* one. The task was then repeated with the other systems. The overall results of these experiments are reported in Table 4.2(left) for the time-elapsed metric and in Table 4.2(right) for the number-of-mistakes one.

Sys. Button	Sys. Card	Sys. Button	Sys. Card
8.54224083	13.10263699	0	0
6.99025130	14.35907357	0	1
10.46822003	13.78392290	0	2
11.54487432	16.36600966	0	0
12.00742919	12.80926905	0	1
9.16667126	14.06920305	0	1
8.78349658	13.27097103	0	0
8.41883133	14.68097945	0	0
5.46183447	12.94289981	0	2
5.44148793	13.19497347	0	0
7.58403303	9.95050951	0	0
5.91419537	10.78214129	0	0
5.56288654	13.09209252	0	1
6.90220178	13.26472187	0	1
3.58011108	10.93811981	0	0
5.27388491	13.84869285	0	0

Table 4.2. Overall results of the metrics for the controlled experiment: *(left)* Time spent to reach the goal for both systems. Measures are in seconds; *(right)* Number of mistakes done to reach the goal for both systems.

Using the values in Table 4.2, we have then performed an *Analysis of Variance* (ANOVA), to statistically test whether the means of the groups would have been equal, to accept or discard the null hypothesis. The result of the single factor analysis is reported in Table 4.3 for the time metric and in Table 4.4 for the number of mistakes one.

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	16	121.6426	7.602666	5.81863
Column 2	16	210.4562	13.15351	2.454237

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	246.4953	1	246.4953	**59.59127**	1.3e-08	**4.170877**
Within Groups	124.093	30	4.136433			
Total	370.5883	31				

Table 4.3. ANOVA results of the time metric for the controlled experiment.

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	16	0	0	0
Column 2	16	9	0.5625	0.529167

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.53125	1	2.53125	**9.566929**	0.004259	**4.170877**
Within Groups	7.9375	30	0.264583			
Total	10.46875	31				

Table 4.4. ANOVA results of the number of errors metric for the controlled experiment.

As regards the number of mistakes it is worth to mention that they are all due to the same problem: in the act of scrolling, the users accidentally ended up in pressing the card of the peer, thus opening the unwanted chat, forcing them to go back to continue the search of the fifth peer. We have noticed this behaviour especially in the beginner users and we have not observed any relevant enhancements when the users performed the task with this particular system after the *Button* one.
As it is possible to see the ANOVA analyses, both according to the time and number of mistakes metrics in Table 4.3 and 4.4 respectively, provide F values that are greater than the corresponding F *crit* ones, hence allowing us to conclude that is safe to reject the null hypothesis: the means of the two populations are not equal. In addition it is worth to mention that the p values suggest that for the time metric the analysis is *extremely statistically significant*, while for the number of mistakes one it is *highly statistically significant*. By looking again at the results in Table 4.2, it clearly stands out the pressing of the button as the best way to start the chat rather then pressing the cardview.

4.4 Think Aloud

The last step in the development of this work was to perform a final evaluation technique over a manifold of tasks. The preceding evaluation methods performed either by an expert or real users matching the ideal target one, were used to breakdown the two main functionalities of this project, i.e. the *find a course* and *chat with peers*, to find any usability issues. Both tools have highlighted interesting insights, that once tacked became sources of enhancement of our prototype. One of the key points of our application is that we have designed it and then implemented it in such a way that the same functioning could be applied under different context. An example is the *gallery* element that through horizontal swiping allows to choose different sections in the main page or to choose a level of education within the *find a course* section, or to choose of which service to get information in the *services* section. Independently from the use of the elements in the application, we provided *consistency* for user's actions: the same gesture onto the same element provided the same way of functioning and therefore accessing to the results. For this reasons when we have made the users analyse the two main functionalities of our application, they provided useful hints also for other parts of the application that once solved increased the overall usability of the prototype.

We have decided to perform a final evaluation technique over almost all the sections as to have the confirmation that no new relevant problems would have risen. The method selected for this last step was an *observational evaluation* technique: *think aloud*. We have involved new twelve users, again matching the target user description in Section 2.2.1, in particular, as the previous techniques the details are:

- *Age*: 3 users of *18 y.o.*; 1 users of *19 y.o.*; 3 users of *22 y.o.*; 2 users of *24 y.o.*; 2 users of *26 y.o.*; 1 users of *28 y.o.*.
- *Gender*: 8 users *male* and 4 users *female*.
- *Location*: 6 users from *Rome*, 3 users from *Venice* and 3 users from *Cosenza*.
- *Education level*: 2 users enrolled to an *High School*, 4 users enrolled to a *Bachelor's degree*; 4 users enrolled to a *Master's degree* and 2 users that are taking a *PhD*.
- *Family*: 10 users *unwed*, 1 user *unwed with children* and 1 *married*.
- *Level of knowledge of technology*: 2 users declared as *beginner users*, 8 users declared as *average users* and 2 users declared as *expert users*.
- *Disabilities*: no particular disabilities were reported for any user.

We have organized a session in which we have explained the purpose of our work, the reasons behind the meeting and which tasks they should have achieved using our application. Since it was not possible to provide clarifications or ask to the users the reasons behind their actions, according to the way in which this technique must be performed, we have follow each user individually, by taking notes and using audio tapes to search at the end of the session for interesting points. Each of us has followed three different users. Since the tasks that we have requested for this session were several, we have specified that they were not forced to stay if they preferred to go, in fact in the very end of our session two users have to go earlier due to previously taken commitments. The tasks that we have asked to perform were:

1. *Search a course*: whichever characteristic for the course was accepted;
2. *Chat with a peer*: whichever peer was accepted;
3. *Read about university accomodations*: only the accomodations service was accepted;
4. *Do a test*: only the local test was accepted;

For all users we firstly have collected the personal information needed to provide the characteristics distribution, then for each of the above-mentioned tasks we have followed the schema in Fig. 4.6.
Initially we have explained the task to be performed, then we have answered to all the questions that raised and have given to the user the system at its starting point, i.e. the main page in order to only evaluate the part of the application pertained to the current task. Then we have started the recording and we have observed the user while taking notes. We have noticed that the users tended to be progressively more and more silent, especially when performing the lasts tasks, behaviour that we have charged to the tiredness. In each case we have reminded to keep talking. Whenever the user has reached the goal we have stopped the recording and labelled all the collected material in order to allow a post-session analysis.
It is worth to mention that the first three tasks were performed by all the twelve users, while the latter was performed by only ten persons due to the above mentioned earlier commitments.

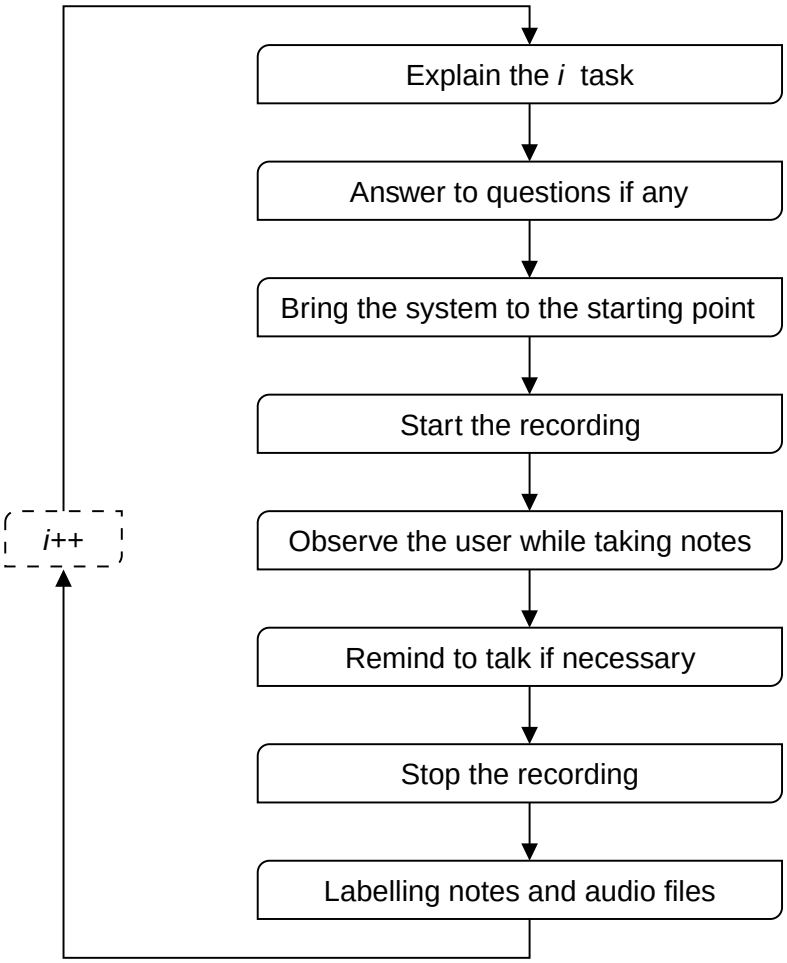


Figure 4.6. Think aloud procedure executed for each task and for each user. *i=1,2,3,4*
.

We also have noticed that towards the last tasks the users have become more aware of the first part of the procedure to achieve the goal, since it was common to almost all the tasks and therefore subjected to the transfer learning problem. Even if this may degrade the evaluation during normal sessions, in this case the part affected by this phenomenon was not at the center of the tasks, therefore it has not strongly affected our measurements. In addition, we have considered this as a primordial indicator of the *learnability* of the system since the users needed only two times to master the functioning.
After a careful analysis of the collected material we have not detected any relevant findings neither bad nor good that could motivate the construction of a table as the one in Fig. 4.4. However, we have seen the achievement of all the tasks by all the users, also in a reasonable amount of time that was within 10 minutes[2]. With this information we were able to conclude that no additional changes should have been necessary to increase the usability of the application, neither structurally nor aesthetically.
In summary, after the application of this evaluation technique we were able to stop the prototyping process for our application, therefore concluding this work.
In the next chapter we will draw the conclusion.

[2]This time refers to the only active parts of the users for all tasks, therefore all the actions performed by us were not part of this data. We also have specified the users to take the time needed to explain well their actions as opposed to the idea of the-sooner-the-better that most of them had at the beginning of the session.

Chapter 5

Conclusions

In this work we have addressed the deployment of a mobile application named *C.U.E.* aimed at guiding future university students in the choice of their academic career. This application offered a manifold of services: from the search engine of the academic courses, to the possibility of chatting with peers, passing through informative pages about the university functioning and the presence of tests for additional hints.
We have implemented a prototype of this application following the Human-Computer Interaction pipeline. Initially we have surveyed the market to analyse the competitors of our application, both web and mobile based, studying their weaknesses, strengths, customer bases and presence of a set of core features. We have then defined the target user and build several personifications of it and scenarios of its application. A questionnaire was then drafted and forwarded to possible future users to collect useful insights, then analysed to extract the features that complied most with the findings. Finally, we have performed the Hierarchical Task Analysis and designed the State Transition Networks of diverse relevant tasks. We have proceeded with the design of the first set of mockups, that was subjected to the *Heuristic evaluation* made by an expert, with the purpose of finding violations of the 10 Nielsen's usability heuristics. According to the report received, we have modified this first set to solve the issues raised during this evaluation step. The following phase was to start the actual implementation of the application by means of Android Studio. We have then completed our work by running several evaluation techniques on our application, that allowed us to further solve usability issues and make it more intuitive and less prone to errors.
Through a tight bond with possible future users, created by the continuous involvement of them in our deployment, we were able to create a product that could encounter the needs of each person that is beginning to face to the university world, becoming an essential tool in everyday life.

Appendix A

Supplementary Material

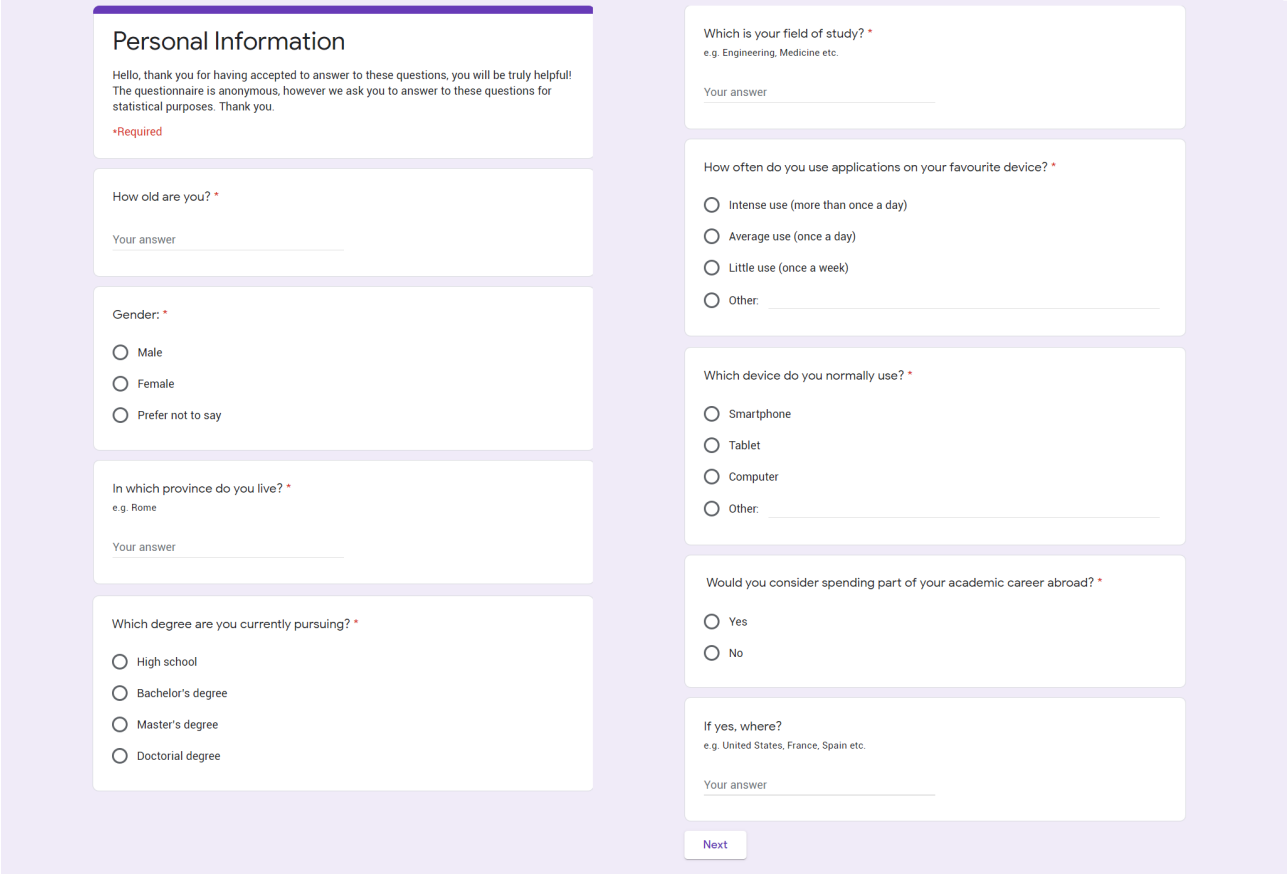


Figure A.1. First section of the first questionnaire, devoted to collect personal information about who answered it.

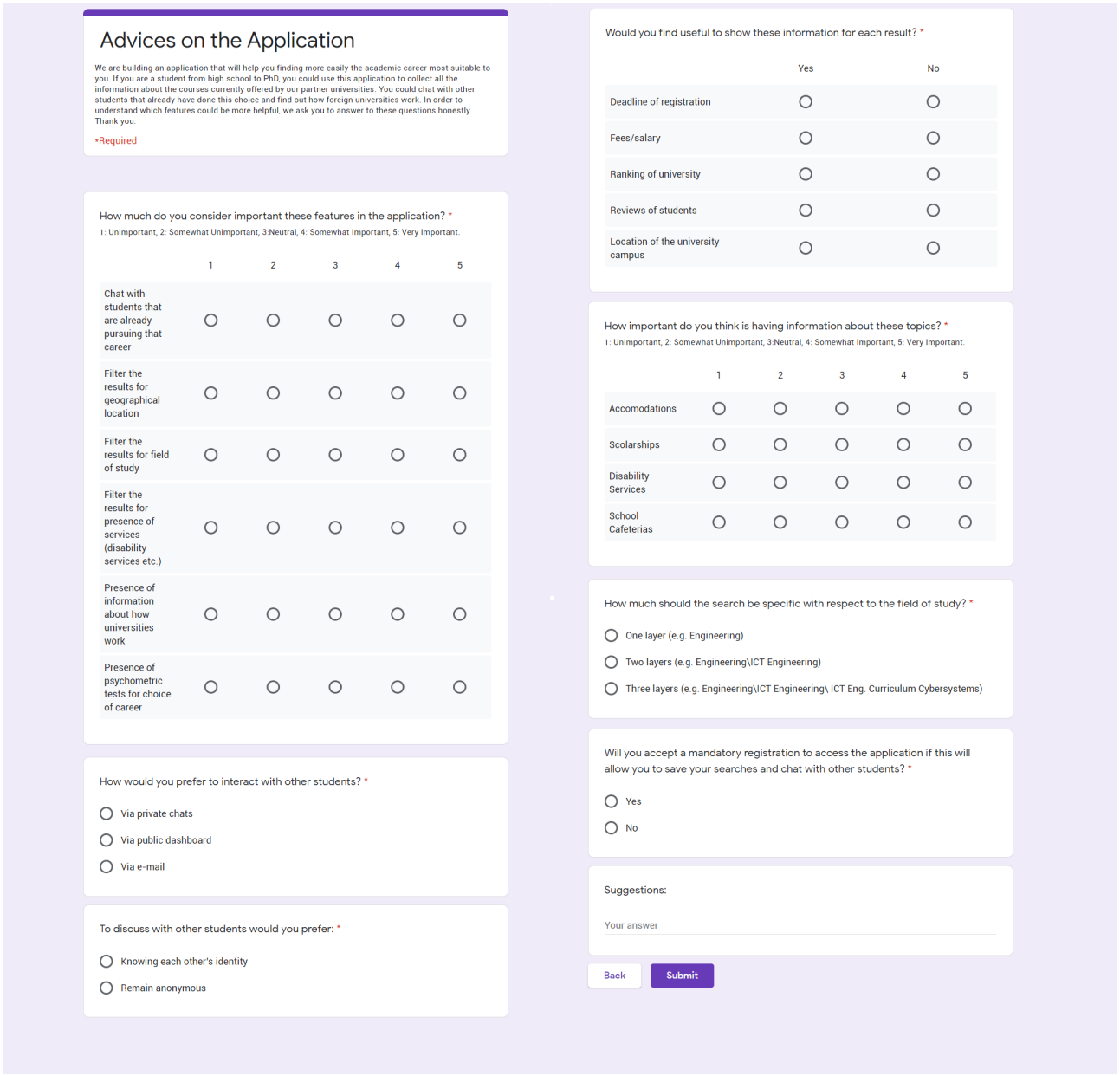


Figure A.2. Second section of the first questionnaire, devoted to collect information about the features that we intended to insert in the application.