UNIVERSITY OF CAPE TOWN
DEPARTMENT OF COMPUTER SCIENCE

# Computer Science Honours

# Final Paper

# 2017

**Title:** Co-design of a web-based data management tool with members of a chef school

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**Project Abbreviation:** CHEFREG

**Supervisor(s):** Brian DeRenzi

| Category | Min | Max | Chosen |
|---|---|---|---|
| Requirement Analysis and Design | 0 | 20 | 20 |
| Theoretical Analysis | 0 | 25 | 0 |
| Experiment Design and Execution | 0 | 20 | 10 |
| System Development and Implementation | 0 | 15 | 0 |
| Results, Findings and Conclusion | 10 | 20 | 20 |
| Aim Formulation and Background Work | 10 | 15 | 10 |
| Quality of Paper Writing and Presentation | 10 | | 10 |
| Quality of Deliverables | 10 | | 10 |
| Overall General Project Evaluation (*this section allowed only with motivation letter from supervisor*) | 0 | 10 | |
| **Total marks** | | **80** | **80** |

# Co-design of a web-based data management tool with members of a chef school

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## ABSTRACT

Co-design has been demonstrated to advocate improved user acceptance and overall quality of design artefacts [6]. We investigated the usability of a web-based data management system co-designed with users from a chef school. We evaluated users' usage and interaction with the system through cognitive walkthroughs, post-test focus groups, usability questionnaires and heuristic evaluation.

In this paper, we present our findings and share insights about the key lessons we learned. Our findings show that users were satisfied by the system, its user interface and the quality of information it provides. Through observations, we discovered how users interacted with the system. We also identified the features that users found to be the most important in the system.

We draw from our findings and experiences to provide recommendations for similar projects.

## Keywords

Human computer interaction, HCI, co-design, data management system

## 1. INTRODUCTION

In this paper, we investigate Human Computer Interaction (HCI) and usability in design. We worked with Infinity Culinary Training, a chef school in Cape Town, to understand their needs and design a system that addressed those needs. In our initial interactions with members of the school, we discovered that the administration staff experienced challenges with their current system of storing and retrieving information about past and current students. The key challenge with their spreadsheet-organised system was that it was becoming increasingly difficult to manage with a growing number of graduates. While there are numerous prominent commercial solutions available, they present implementation barriers such as costs, customisation, graphical user interface (GUI) and technical support [16]. Infinity Culinary Training sought a solution that would bear minimal costs to the school, require no technical support, and provide an easy-to-use interface that would meet their exact requirements. We employed co-design methods in an iterative development methodology to design and evaluate a data management system.

Our final system was composed of the following self-contained components:

- A web-based data management system with the following components:
  - Data entry and data reporting system to store student information and display visualisation of the school's statistics
  - Data management system to view and update student information
- A mobile application for students to update their information

In the first iteration, we designed and evaluated an application to compile student information and automatically generate a curriculum vitae (CV). The aim of this application was to relieve users of the manual task of creating CVs for students to send to prospective employers. Results from this phase revealed that more focus had to be placed on the data management tool because it was of greater importance to the school and had more features to be implemented. In order to allocate our work properly, we then decided to limit the scope of our project by excluding the CV generator. Instead, we divided the data tool into a data management component and a data visualisation component. In the second iteration, we performed usability tests on the visualisation tool, which received positive feedback from users. In the last iteration, we developed and evaluated the application for adding students to the system, in addition to the visualisation tool. The final deliverable of this project was a usable system that enables the admin of the chef school to store student information and view statistics about students.

### 1.1 Infinity Culinary Training

Infinity Culinary Training is a non-profit organisation that aims to alleviate unemployment by training young South Africans from disadvantaged backgrounds to be chefs [17]. The school has an intensive curriculum which, in addition to professional culinary skills, focuses significantly on life skills to equip students with the necessary skills to thrive not only in the working industry but in their personal lives as well [17].

Currently, the school uses well-maintained Excel spreadsheets to keep track of student information and statistics about the progress of the school. In our engagements with the school, it was realised that the current system used is difficult to maintain with increasing numbers of graduates.Thus, there was a need for Infinity Culinary Training to find an efficient data management tool to enable admin to store information about students and graduates, and chart the statistics to manage the growth of the school and attract sponsors.

The following research questions were investigated:

- How do users perceive the system?
- How would users want to interact with the system?
- What features do users identify to be the most important in the system?

## 1.2 Outline

In Section 2, we examine and evaluate background information and literature relevant to our project. We first survey Human Centered Design (HCD) techniques and methods, and provide examples of how co-design has been applied in Information and Communication Technologies for Development (ICT4D) projects. Finally, we discuss ethical, professional and legal issues and how they have been addressed. In Section 3, we discuss the methodology followed, the design process, and the methods employed in the design and evaluation of the system. In Section 4, we present and analyse our results, which revealed additional features, which parts of the system were most important to users, and how users would like to interact with the system. In Section 5, we summarise our findings and reflect on the methods used and design process followed. We also review the contributions of this project and discuss future work.

# 2. BACKGROUND AND RELATED WORK

In this section, we discuss and analyse literature relevant to our work.

## 2.1 Human Centered Design

In HCD researchers and developers work together with potential users of the products or services they are developing. HCD aims to collaborate with the end-users and involve them in the design process in order to develop products or services that meet their needs and requirements [13]. While many definitions of HCD are congruent, Krippendorff [5] extends these definitions with his perspective that human centeredness considers the close association between behaviour and understanding, and maintains that there is an inseparable link between design artefacts and how their users perceive and engage with them in their lives. In addition, Krippendorff suggests that people do not respond to physical objects but rather to what the objects mean to them. The implication of Krippendorff's view is that human-centred approaches must be concerned with understanding the motivation behind people's interaction with artefacts and their experiences, rather than the product itself. HCD methods conform to four key principles namely the active participation of users in design, iterative design solutions, multi-disciplinary design teams and an appropriate distribution between user and system tasks [14].

Various studies show that effective user involvement in a system design yields the following benefits: capturing more accurate user requirements and consequently improved overall quality of the system; better understanding of the system by the user; improved quality of the system and improved user acceptance [6].

There are numerous HCD techniques, however for this project only contextual design, co-design and empathic design will be highlighted. Contextual design gathers data through observing and interacting with end users while they work to gain a deep understanding of current practices and bring that understanding into the design process to design a system that supports users' work [1]. In empathic design , researchers attempt to understand and share users' experiences [13]. Implementation of this approach often involves a five-step process led by observations; followed by data capturing; then reflection and analysis; brainstorming; and finally developing prototypes [7]. Co-design enables users to actively participate in designing solutions to their problems [3]. The primary objective of co-design is to enable all participants to jointly contribute their skills and knowledge to create products that meet the needs of users involved in the process [15].

For this project, we employed co-design techniques and collaborated with members of the chef school in all phases of design. We also adopted contextual design and empathic design principles to gain insight into users' needs and empathise with their experiences to understand how they engage with and perceive the system.

## 2.2 Co-design in ICT4D projects

Ramachandran et al. [10] investigate the role of technology in improving the livelihoods of people in developing areas. The researchers use what they refer to as early stage co-design to engage stakeholders in order to understand stakeholders' needs, current practices, and factors that influence how they interact with technology. Through research methods such as contextual enquiry, ethnography and cultural probes, the researchers were able to gather contextual and cultural information from stakeholders, which was then used to inform the design of technology artefacts. Findings from this study show that early engagement with stakeholders in design is effective in designing artefacts that match stakeholders' needs and practices. Furthermore, the study encourages designers working with groups to observe social dynamics to understand their effect on how stakeholders use and perceive technology.

In another co-design project [12], researchers introduce the concept of informant design, which promotes involving various users in design to maximise their contributions at different phases of the design process. Based on their experiences in designing with diverse users, researchers highlight the need to identify where each user's contribution will be most valuable in the design process. Findings from this project show that different informants contribute different inputs that shape the design in different stages.

## 2.3 Ethical issues

We obtained ethics clearance from the Faculty of Science Research Ethics Committee at the University of Cape Town (UCT), which enabled us to use members from Infinity Culinary Training as participants in the study. In addition, we obtained approval from the Department of Student Affairs to conduct usability tests and heuristic evaluations with UCT students. Finally, we also ensured that our project posed no threats or risks to participants involved.

# 3. DESIGN

In this section we discuss the methodological framework of the system.

## 3.1 Methodology

We used an iterative human centered design (HCD) methodology to design the system. The HCD component of our approach was focused on techniques to design a useful and usable system, and involve users early in the design process; while the iteration component was concerned with designing rapid prototypes to cater for evolving user needs [19]. The value of iteration in HCI

points to a realisation of usability issues early in the design process. This is best illustrated in a study by Karat [4].

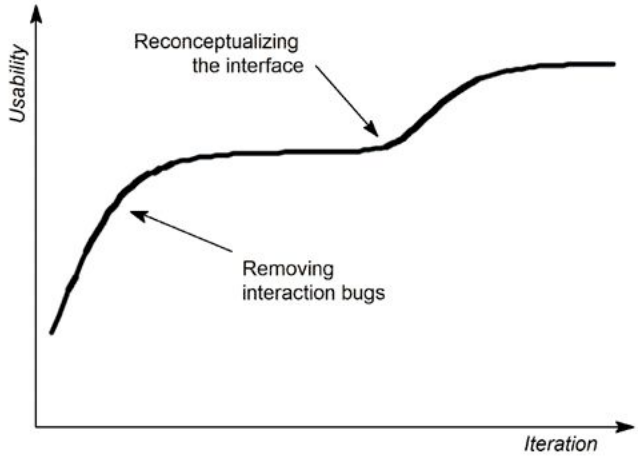


**Figure 1. Quality of a user interface measured against the number of design iterations [4]**

Figure 1 shows the relationship between design iterations and interface usability. Essentially, every iteration is an improvement from the previous one until design reaches its plateau. It is evident from this graph that the first few iterations yield better usability as it is in these stages that major issues are identified and fixed.

An iterative HCD approach was suitable for our project because collaborating with members of the chef school from the beginning to create prototypes enabled us to reflect their requirements in the design and avoid unexpected issues in the final design of the system.

## 3.2 Design Process

The design process was separated into two phases, with the first phase dedicated to data gathering and the second phase design.

In the first phase of the project, we used various data gathering techniques to help identify user needs and establish requirements. We first conducted focus groups and semi-structured interviews with the executive director, admin staff and lecturers to introduce the project and learn about the school. From this interaction, we were able to create an initial map of the stakeholders and their interests in the project. We then conducted more interviews and one-on-one meetings with staff, graduates and students; and observed a lesson. From these engagements, we could identify challenges faced by stakeholders .

The second phase was separated into three iterations of ideating, prototyping, and testing. In ideation, we brainstormed and generated ideas; while prototyping involved creating prototypes to model our ideas; and testing was concerned with evaluating the prototypes to identify issues and improve the next iteration. Throughout the design process we adopted empathic design techniques to interact with users and put ourselves in their shoes to better understand their needs [7].

In the first iteration, we created low-fidelity paper prototypes; which were followed by medium-fidelity prototypes created in Microsoft Powerpoint; and finally high-fidelity prototypes implemented in Python using the Django framework [20]. We started with paper prototypes because they introduce users to rough versions of the idea and draw focus to the behaviour of the interface. According to Rettig (1994), paper prototypes enable designers to try many ideas, get results early in development and make changes [11]. The medium-fidelity prototypes had limited functionality, which enabled users to visualise the interactions and navigation possibilities of the system [21]. The high-fidelity prototype then conveyed the feel and functionality of the final system, enabling us to evaluate overall usability and user satisfaction [22].

## 3.3 Evaluation Methods

We used various qualitative and quantitative methods to test the usability of the system, namely cognitive walkthroughs, questionnaires, focus groups, and heuristic evaluation. Cognitive walkthroughs were aimed at examining how users interacted with the interface; focus groups and questionnaires enabled us to validate the assumptions we made during the walkthrough and allowed users to share their experiences; and heuristic evaluation enabled us to assess usability of the final prototype against a selected criteria.

In total, we recruited ten subjects to participate in evaluations. We recruited four participants from the chef school to participate in cognitive walkthroughs, questionnaires and post-test focus groups. We also selected six students from the Computer Science honours class at UCT to participate in a heuristic evaluation of the software prototype. For the latter, we recruited participants who were familiar with HCI and design principles.

### *3.3.1 Cognitive Walkthroughs*

The first part of evaluation included a cognitive walkthrough of the prototype, in which one team member would briefly describe the system and process; another one providing the user with tasks to carry out; and the final member recording responses. For the first iteration, the user was expected to create a CV for a specific student. For the second iteration, the user was expected to view statistics for all students, filter by year, and filter by class. The final iteration included tasks to add students to the database and view statistics. (See appendix A for comprehensive tasks).

### *3.3.2 Focus Groups and Questionnaires*

The cognitive walkthroughs were followed by a focus group with participants to discuss their perceptions about the system, how they engaged with it and their experiences during the walkthrough. For the final iteration, each participant was also given a questionnaire to complete,which was designed to gauge user satisfaction with the interfaces. Participants were given the IBM Post-Study System Usability Questionnaire (PSSUQ) [8]. (See appendix B for a copy of the questionnaire and instructions). Responses from the PSSUQ were then analysed to calculate scores for overall satisfaction, system usefulness, information quality and interface quality.

### *3.3.3 Heuristic Evaluation*

To conduct a heuristic evaluation of the final prototype, we first introduced the system and main user tasks, which were ‘Add New Student’ and ‘View Statistics’. Each participant was required to perform user tasks and evaluate the system according to Jakob Nielsen's Ten Usability Heuristics [9]. (See appendix C for heuristics). We selected Nielsen's heuristics because they are

widely-used in the user experience community and provide an objective criteria for identifying usability problems [2]. Evaluators were asked to firstly identify issues individually for an hour then rank the severity of all issues identified as a group using Nielsen's rating scale (Table 1). We then discussed the results with all evaluators and brainstormed solutions.

**Table 1. Nielsen's severity scale [23]**

| Ranking | Description |
|---|---|
| 0 | Positive: has a positive effect on user's ability to perform given task |
| 1 | Cosmetic issue: need not be fixed unless extra time is available on project |
| 2 | Minor issue: fixing this should be given low priority |
| 3 | Major issue: important to fix, so should be given high priority |
| 4 | Catastrophic issue: imperative to fix this before product can be released |

# 4. RESULTS AND DISCUSSION

In this section we review the outcomes of our evaluation.

## 4.1 Data Gathering Phase

In the data gathering phase, we were able to identify admin as the primary stakeholders because of their high impact and high influence in the project. The key interests of admin were keeping track of student information and creating CVs for students that seek employment. Another stakeholder with a high interest in the project was the Executive Director, whose main requirement was charting the progress of the school for prospective sponsors. As illustrated in the stakeholder map (Figure 2), we had varying levels of engagement with the stakeholders depending on their contributions in the project. The stakeholder map also informed our methods for addressing stakeholders' needs. It was evident that admin was a key player in the project and their needs had to be prioritised in design decisions. From our assessment of stakeholders' abilities to contribute to the project, it was clear that even though the executive director had an interest in the project, he would not be available to participate in all stages of design. The decision was taken to keep him updated about the project but not inform him about the detailed design decisions.

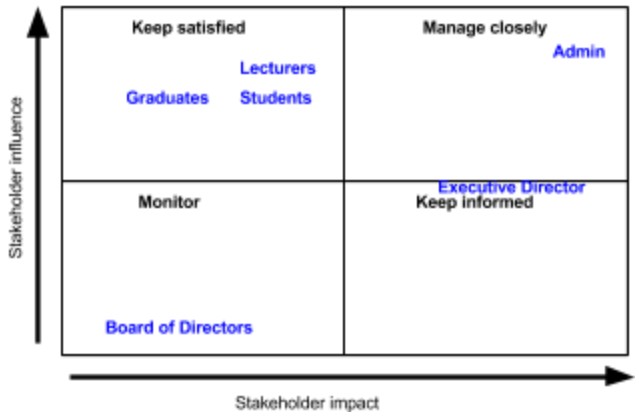


**Figure 2, Stakeholder Map. Adapted from [24]. Influence measures stakeholder's active involvement and contribution; impact measures the project's influence on stakeholder.**

## 4.2 Iteration 1

Users reported that they found the design of the CV generator prototype, (see appendix D for screenshots), to be simple and intuitive. One user pointed out that the school used a standard template for all CVs so the functionality of a customisable template was not necessary. Some observations we made were that users were not aware of the help button and they did not know that they could explore the interface on their own to perform tasks other than those specified. A recommendation about the interface was to make the help button more visible and provide a screen for it so novice users who face challenges can navigate with limited intervention. Overall, users had a good experience and the prototype was received with favourable responses.

During the post-test focus group, we discovered more features to be added in the data management tool designed by another group member. When asked to list which aspects of the system were most important, users reported automatic CV generation to be the least important. Users also shared their spreadsheets with us, from which we identified the important statistics to track as the numbers of accepted, graduated, dropout, deceased, employed, and unemployed students.

From these findings, it was evident that the data management tool took priority over the CV generator. Upon analysing user requirements against our timeline, it was clear that it was imperative to narrow the project scope and appropriately allocate the workload among designers. Therefore, we decided to exclude the CV generator from the scope of the project. Instead, the data tool was broken down into two components, data management and data visualisation. My work in the second iteration is on the latter.

## 4.3 Iteration 2

The design of the medium-fidelity of the visualisation tool showed overall statistics, and included functionality to filter statistics by a year or class number selected from a dropdown list. The prototype, see appendix D for screenshots, was then shown to four users for evaluation. From our observations during the walkthrough, all users responded positively to the prototype and had no challenges completing tasks. In the post-test discussion, users indicated that they found the system to be "user and admin friendly" and that it was efficient because it was going to save the school a lot of time. Users also conveyed that they were pleased to see that their ideas were valued and were integrated in the system in an intelligent manner. Users indicated that they wanted to be able to filter by class number or year range rather than a single class or year.

During evaluation, we observed that users were more interested in the functionality of the prototype than the interface. In the post-test discussion, users expressed that they did not have strict requirements about the interface and thus will be open to our discretion about user interface features. This highlighted the need for us to understand that different users bring different strengths to the design process and consequently cater for those strengths.

## 4.4 Iteration 3

The following key design decisions were taken about the final prototype:

- Animation on the graph to make changes visible when filtering. This was necessary because even though the axes and numbers on the graph were changing, one had to concentrate closely to notice the changes.
- Integer sliders to constrain user input. In addition, dragging to select year or class number by which to filter seemed more intuitive than clicking from a dropdown list.
- We also restricted the types of files users can select to images only. This was to make it easier for users to navigate and to prevent errors caused by selecting incorrect file types.
- Preview selected images to provide users with feedback of their actions and make them aware if they have accidentally selected the wrong image.

### *4.4.1 Cognitive Walkthrough and Questionnaire*

The prototype was shown to three users for evaluation. Results from the PSSUQ (Table 2) showed an overall satisfaction score of 1.79, system usefulness score of 1.38, information quality score of 1.14 and interface quality score of 1.67. According to the IBM PSSUQ scoring method [8], scores range from 1 for strongly agree to 7 for strongly disagree. From these results, it is evident that, overall, users were satisfied with the system and its user interface. General comments about the prototype were that it was "very user friendly" and "the general design and layout is beautiful and it looks professional". However, some key issues were raised during evaluation. Users wanted to display the percentage of employed students on the statistics page and separate students who were dismissed from those who dropped out by changing the label to 'Total dropouts/released'. Users wanted to change the ordering of statistics to view deceased students last because they were uncomfortable with and disturbed by the valued being at the center of the graph. Finally, users felt that it was unnecessary to mention that the numbers were totals because it was apparent to everyone who will be using the system. During the post-test discussion, users pointed out that they would have liked to test the system after it had been integrated with the management tool and mobile application in order to get the complete experience.

**Table 2. Results from usability questionnaire**

| Score name | Score |
|---|---|
| Overall satisfaction | 1.7894736842 |
| System usefulness | 1.375 |
| Information quality | 1.1428571429 |
| Interface quality | 1.6666666667 |

### *4.4.2 Heuristic Evaluation*

We found that the system conformed to Nielsen's heuristics in these areas:

1. Visibility of system status
    - The login page immediately informs users when a problem with login information occurs
    - The add student page informs users when a student has been saved successfully or when a problem occurs
2. Match between system and the real world
    - System language is familiar to intended users
    - System follows traditional standards for logging in
    - Calendar on add student page complements year input
3. Error prevention
    - Image upload restricts users to choosing image files only
    - Add student page restricts class number and year input to appropriate values
    - Placeholders on forms help provide help about required information
    - Hover boxes on forms inform users about compulsory fields
4. Recognition rather than recall
    - Headings on pages help users recognise where they are
5. Flexibility and efficiency of use
    - System accommodates novice users
6. Help users recognise, diagnose, and recover from errors
    - When users enter incorrect login credentials, system informs users immediately and prompts users to try again
    - Error messages convey messages in simple language

The following recommendations were made:

1. Visibility of system status
    - When trying to add new student or view statistics without logging in, show pop-up message to inform users they are not logged in and point to login page
    - System should inform users that they have been signed in or signed out before redirecting to other pages
    - Add label in navigation bar to verify that users are recognised by system e.g. "Signed in as username"
    - Increase colour contrast of navigation bar to make links easily distinguishable
2. Match between system and the real world
    - Change "Submit" button title on add student page to "Save" and increase button size
    - Rename "Reset" button on add student page to "Clear"
    - Graph title and axes should be specific
3. User control and freedom
    - When users enter incorrect credentials and try to login, the system should have a link that makes it easy to return to login page and try again
    - On the add student page, reset should also clear image
    - Test that cancel button on add student page works as expected
    - Add links to make it easy for users to return to main menu
4. Consistency and standards
    - Make graph fit on page so users do not have

to scroll down unnecessarily
    - Select a consistent colour scheme across all pages
    - Add logo to navigation bar to create brand identity
5. Error prevention
    - Users who have not signed in should be redirected to the login page
    - Add asterisks to make required fields easily identifiable
6. Recognition rather than recall
    - Show the values on the graph so they are visible without users having to hover over
    - Align the buttons on add student page to the center to give clear indication that they are for the whole section and not just the left column
7. Flexibility and efficiency of use
    - Experienced users need a way to quickly filter statistics. Eliminate the filter button and load results automatically to reduce time and effort needed.
8. Aesthetic and minimalist design
    - Increase size of menu buttons on main menu page and increase contrast between text and background color to make buttons stand out from background
9. Help users recognise, diagnose, and recover from errors

No issues.

10. Help and documentation

No issues.

From these findings, it is evident that even though users from the chef school were satisfied with the system, there were still several issues to be addressed before the final system can be presented.

## 4.5 Methods and Design Process

We believe that using a combination of evaluation methods enabled us to elicit more comprehensive feedback than we would have received had we used a single method. Cognitive walkthroughs enables us to observe how users interacted with the system, while discussions enables us to assess how users wanted to use the system. The questionnaire allowed us to assess how users perceived the system. Heuristic evaluation enabled us to identify several issues with the system which were not recognised by users.

It is also important to identify when users contribute their knowledge to the design. At the beginning, we engaged with all stakeholders to help us elicit requirements. However, in the design and evaluation, we interacted with admin staff and the executive director. We believe that this allowed all users to share their experiences and influence the project in their own way.

# 5. CONCLUSIONS

We investigated the usability of a data management system designed collaboratively with members of a chef school. We evaluated the system using a mixed methods approach to establish how users would perceive and interact with the system, and which aspects of the system were most important to users. Our results show favourable responses concerning overall satisfaction, system usefulness, information quality and interface quality. We identified that users wanted a system that will enable them to save students to the database, view overall statistics of the school, and filter statistics by year and class. We have shown how co-design methods can be used to engage and co-create with users from a chef school. We consider it important for researchers to identify the knowledge each user contributes to the design and indicate where and how users will provide input. We believe that it is essential for all users with a significant influence and impact in the project to be involved in key design decisions. The challenge is for researchers to find appropriate means of engaging with users who are unavailable to actively participate in activities. In timeboxed projects, it is important for researchers to set realistic goals and ensure that users are informed about what can and cannot be done in the set timelines.

The next step for the project is to implement the feedback from the final iteration and integrate all components of the system before the final system is shown to users.

# 6. ACKNOWLEDGMENTS

We are indebted to all the participants of Infinity Culinary Training for their involvement in the project. We also acknowledge the support and guidance of Dr. Brian DeRenzi. Finally, we thank all the students from UCT who participated in the project.

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# APPENDIX A

## Low-fidelity prototype user tasks

Create CV:

1. Navigate to Create CV on website
2. Select student x
    a. Click student name OR
    b. Tap student picture OR
    c. Enter student name in name field
        i. Click the search button
    d. Click OK button
3. Click Preview button
    a. Select template a
    b. Click the OK button
    c. Click the Close button
4. Click Download button
    a. Select template b
    b. Check Download checkbox
    c. Check Email checkbox
        i. Enter email address in email field
    d. Click OK button

## Medium-fidelity prototype user tasks

1. Navigate to View Statistics on website
2. Click Year dropdown menu
    a. Select 2012
    b. Click Filter button
3. Click Class dropdown menu
    a. Select 10
    b. Click Filter button

## High-fidelity prototype user tasks

Add Student:

1. Navigate to Add Student on website
2. Complete name, ID number, contact details and year fields
    a. Click Submit
3. Complete class field
4. Click Choose File button
5. Locate an image and click open
6. Click Submit button

View Statistics:

1. Navigate to View Statistics on website
2. Select Year from the Filter By dropdown menu
    a. Drag left slider to 2010
    b. Drag right slider to 2014
    c. Click Filter
    d. Drag both sliders to 2016
    e. Click Filter
3. Select Class from the Filter By dropdown menu
    a. Drag left slider to 5
    b. Drag right slider to 12
    c. Click Filter
    d. Drag both sliders to 20
    e. Click Filter

# APPENDIX B

## The Post-Study System Usability Questionnaire (PSSUQ)

*Instructions.* The questionnaire's instructions are:

This questionnaire, which starts on the following page, gives you an opportunity to tell us your reactions to the system you used. Your responses will help us understand what aspects of the system you are particularly concerned about and the aspects that satisfy you.

To as great a degree as possible, think about all the tasks that you have done with the system while you answer these questions.

Please read each statement and indicate how strongly you agree or disagree with the statement by circling a number on the scale. If a statement does not apply to you, comment N/A.

Please write comments to elaborate on your answers.

After you have completed this questionnaire, I'll go over your answers with you to make sure I understand all of your responses.

Thank you!

1. Overall, I am satisfied with how easy it is to use this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

2. It was simple to use this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

3. I could effectively complete the tasks using this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

4. I was able to complete the tasks quickly using this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

5. I was able to efficiently complete the tasks using this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

6. I felt comfortable using this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

7. It was easy to learn to use this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

8. I believe I could become productive quickly using this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

9. The system gave error messages that clearly told me how to fix problems.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

10. Whenever I made a mistake using the system, I could recover easily and quickly.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

11. The information (such as on-screen messages) provided with this system was clear.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 **STRONGLY DISAGREE** |

**COMMENTS:**

12. It was easy to find the information I needed.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 **STRONGLY DISAGREE** |

**COMMENTS:**

13. The information provided for the system was easy to understand.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 **STRONGLY DISAGREE** |

**COMMENTS:**

14. The information was effective in helping me complete the tasks.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 **STRONGLY DISAGREE** |

**COMMENTS:**

15. The organization of information on the system screens was clear.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 **STRONGLY DISAGREE** |

**COMMENTS:**

*Note: The interface includes those items that you use to interact with the system. For example, some components of the interface are the keyboard, the mouse, the screens (including their use of graphics and language).*

16. The interface of this system was pleasant.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

17. I liked using the interface of this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

18. This system has all the functions and capabilities I expect it to have.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

19. Overall, I am satisfied with this system.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRONGLY AGREE** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | **STRONGLY DISAGREE** |

**COMMENTS:**

# APPENDIX C

## Jakob Nielsen's Ten Usability Heuristics

**Visibility of system status**
The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

**Match between system and the real world**
The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

**User control and freedom**
Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

**Consistency and standards**
Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

**Error prevention**
Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

**Recognition rather than recall**
Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

**Flexibility and efficiency of use**
Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

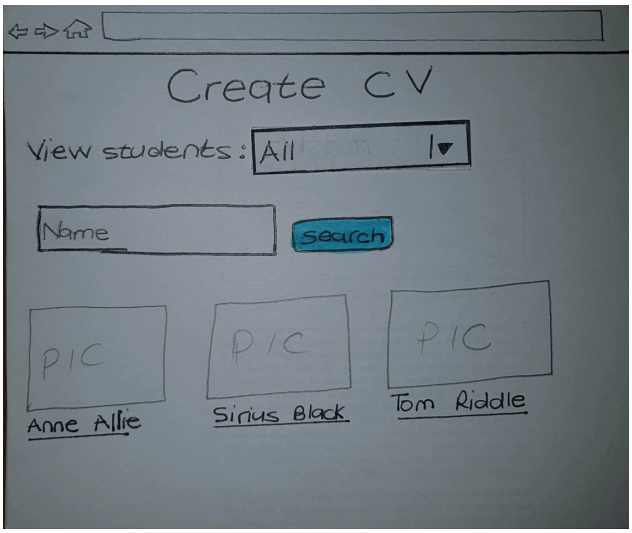
**Aesthetic and minimalist design**
Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

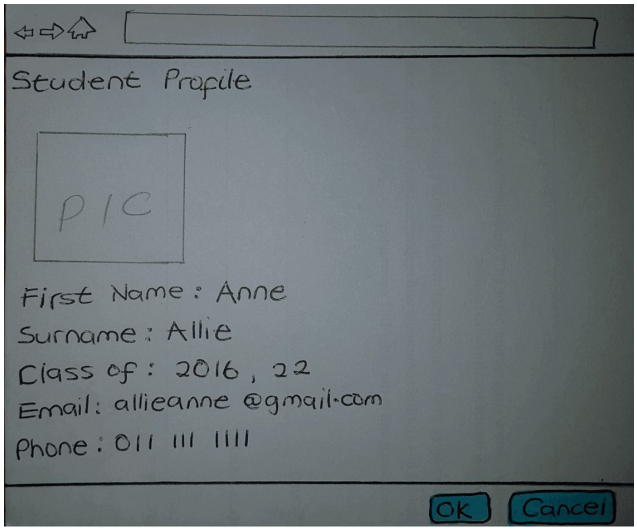
**Help users recognize, diagnose, and recover from errors**
Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

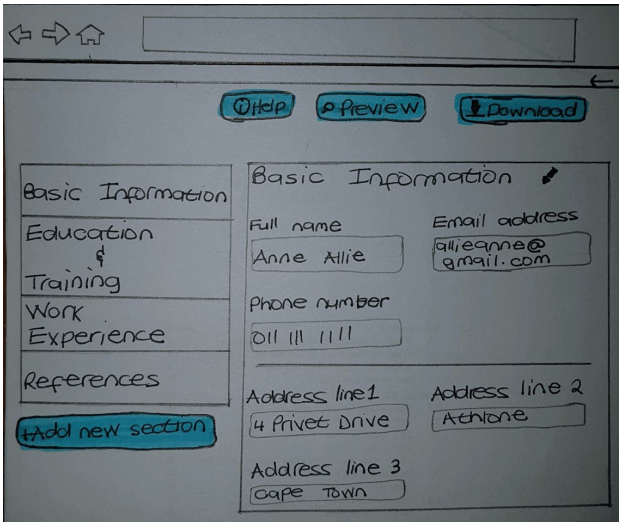
**Help and documentation**
Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

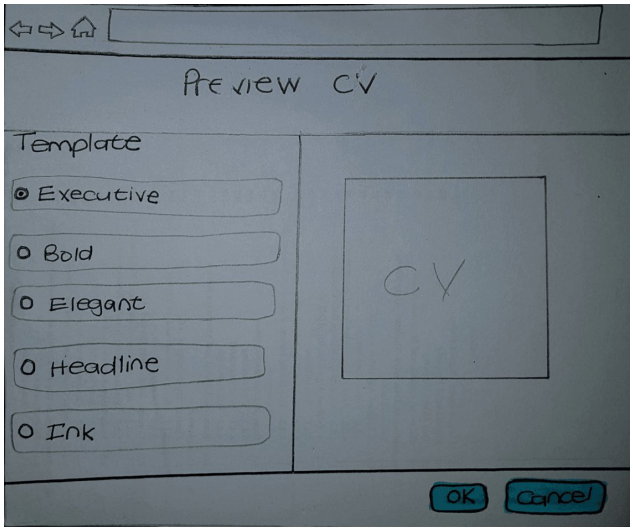
# APPENDIX D

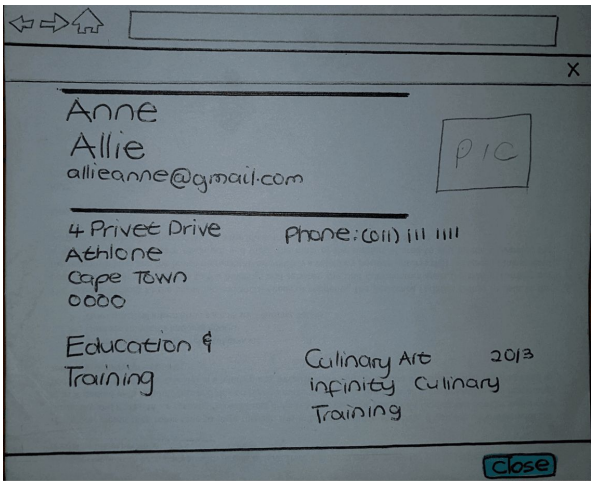
**Low-fidelity prototype**



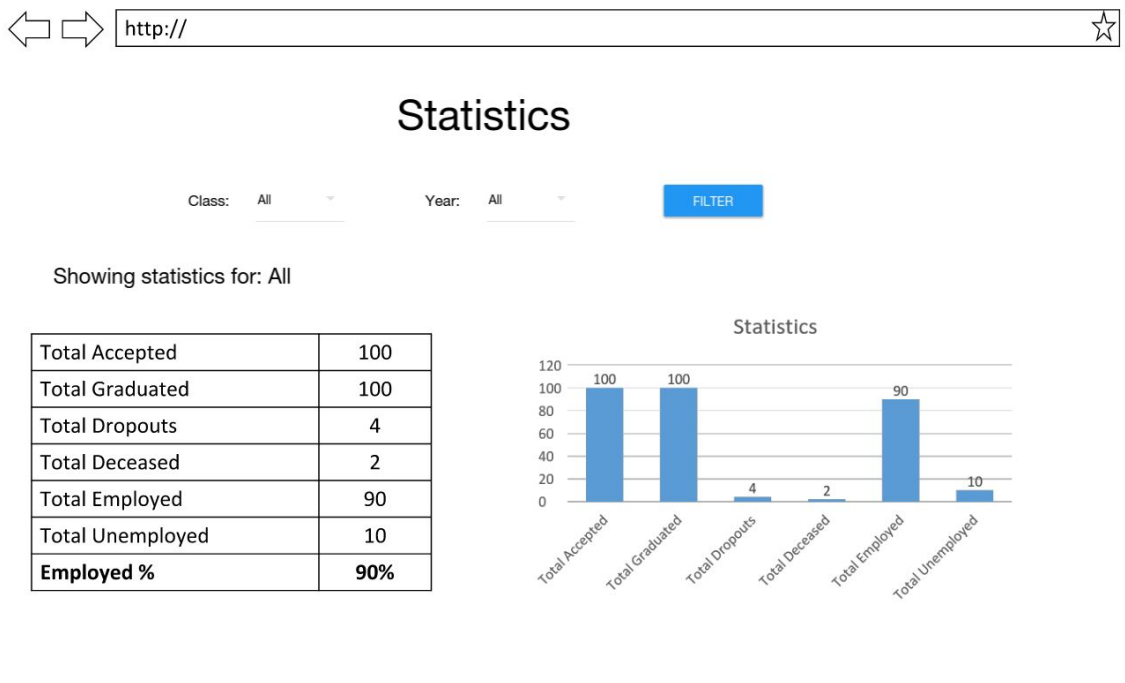



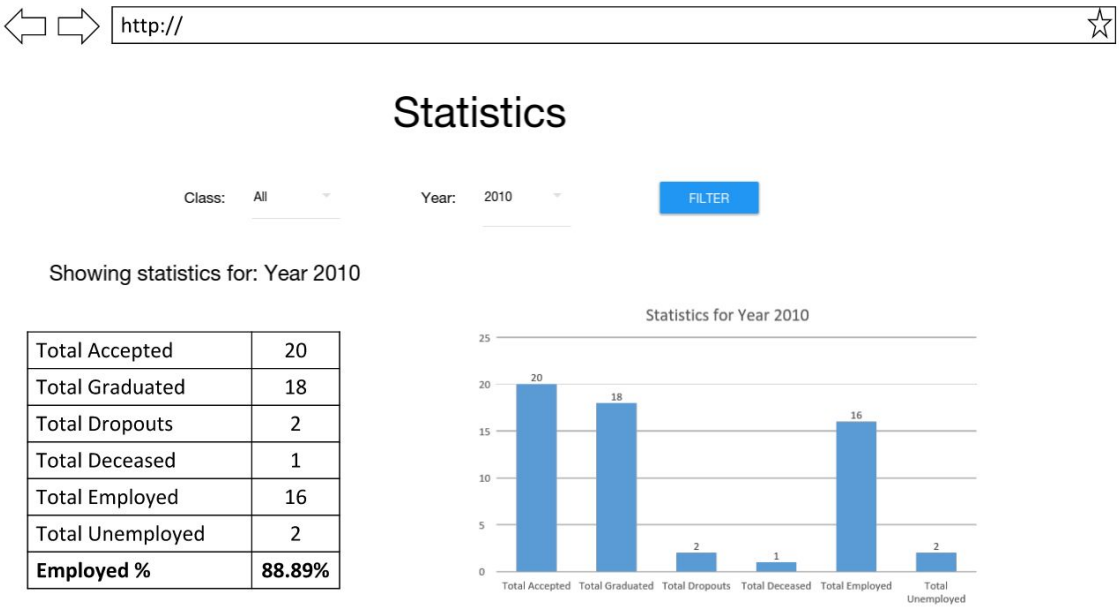



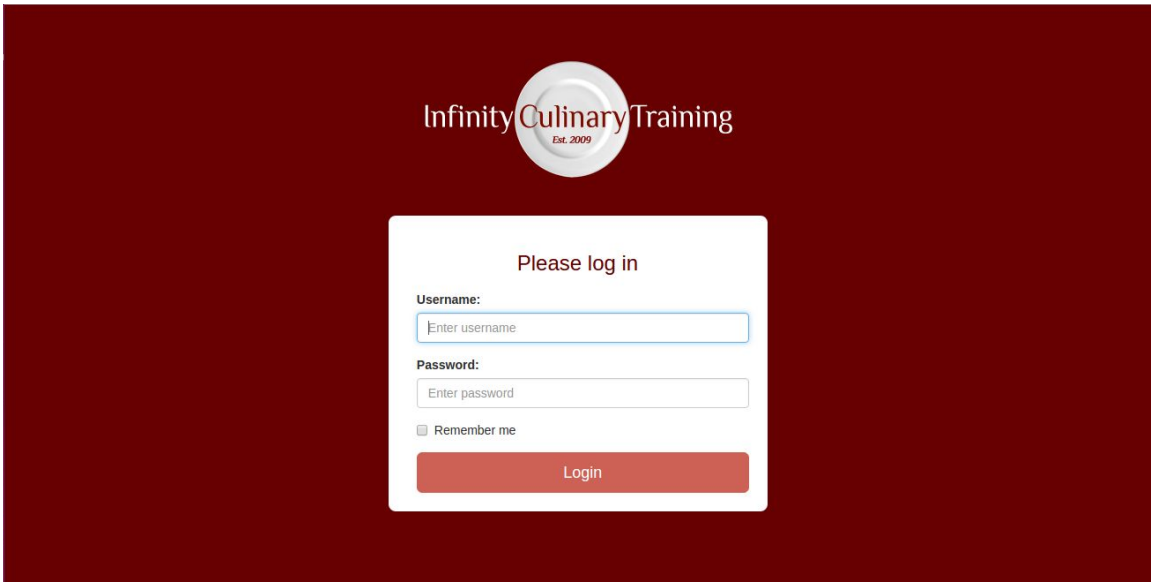



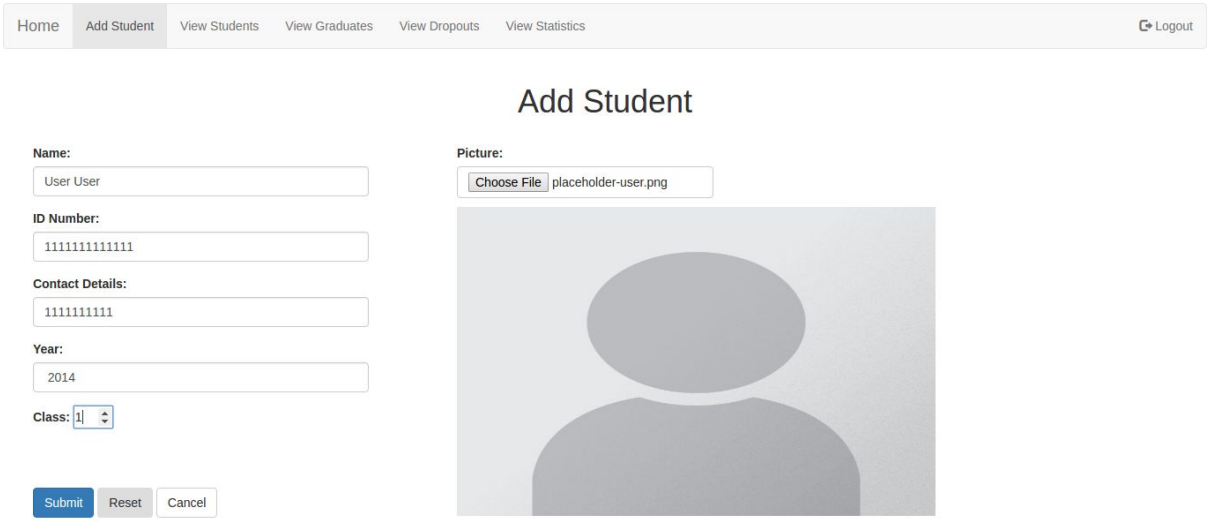
## Medium-fidelity prototype

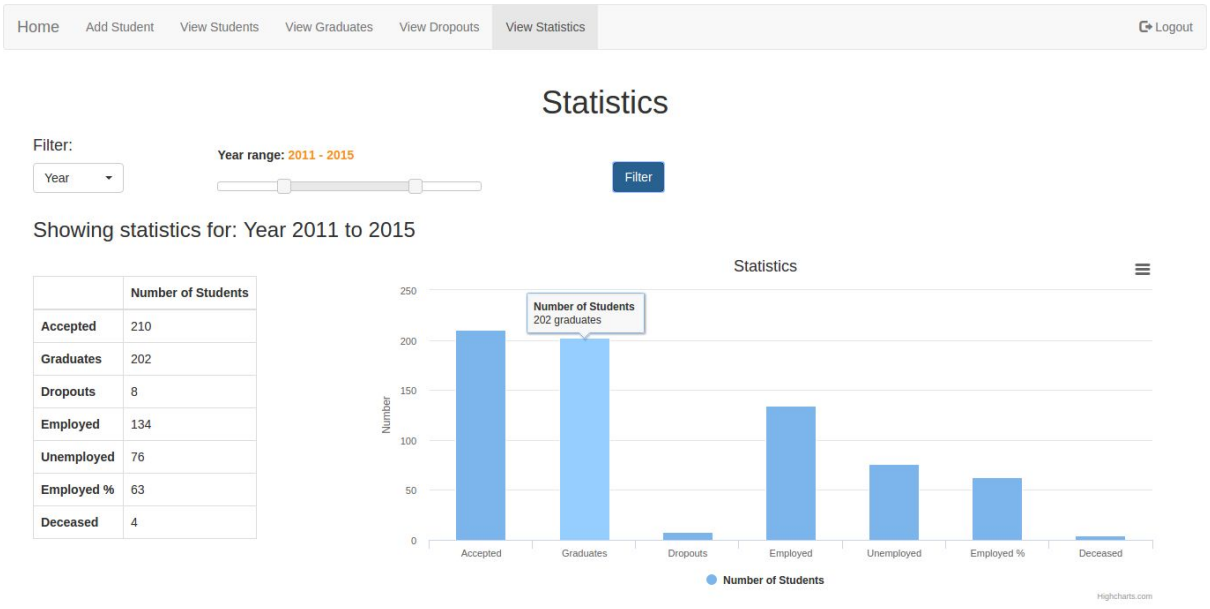


## High-fidelity prototype




| | Number of Students |
|---|---|
| Accepted | 210 |
| Graduates | 202 |
| Dropouts | 8 |
| Employed | 134 |
| Unemployed | 76 |
| Employed % | 63 |
| Deceased | 4 |