

Visualisation of data related to the origin of students from DETI courses and similar

Information Visualization - Prof: Paulo Dias (paulo.dias@ua.pt) & Beatriz Santos (bss@ua.pt) - Academic Year 2023/24

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Abstract—This report presents a comprehensive visualization solution for exploring and understanding data related to the origin of students from courses offered by the Department of Electronics, Telecommunications, and Informatics (DETI) at the University of Aveiro. Motivated by the desire to analyze enrollment patterns and academic performance across different courses, the authors aim to provide valuable insights into the dynamics of DETI. The visualization solution includes interactive charts and graphs, allowing users to compare courses, analyze application trends, and gain insights into choice preferences. The application is based on a dataset created through web scraping from the website of DGES - Direção-Geral do Ensino Superior. The report discusses the motivation, objectives, user personas, questions addressed by the application, dataset details, and the visualization solution's development process. Additionally, the authors share their implementation challenges, evaluation results, and user feedback, highlighting areas for future improvements, such as refining the color scheme and enhancing graphic interaction.

All the files used to develop the application can be found in our GitHub repository [here](#). To test the application, that can be done [here](#).

Index Terms—Data Visualization, DETI Courses, Academic Performance, User Feedback, Interactive Charts, Web Scraping.

I. MOTIVATION AND OBJECTIVES

The motivation behind our project stems from the desire to shed light on the intricate landscape of courses offered by the Department of Electronics, Telecommunications, and Informatics (DETI) at the University of Aveiro. As current students within the DETI framework, we recognize the importance of comprehending and comparing the various courses within the department. Our motivation is fueled by the belief that a detailed analysis of student origin data can provide valuable insights into the strengths and areas for improvement across these programs.

In terms of objectives, we aim to conduct an in-depth comparison of the different courses housed within DETI. By examining enrollment statistics and academic performance metrics, we aim to the possibility, for example, to identify

patterns and trends that can contribute to a better understanding of the department's dynamics.

Furthermore, we aspire to present in our approach, the creation of an intuitive representations that enable easy interpretation of complex information.

Ultimately, our goal is to provide insights that can inform strategic decision-making within DETI. By highlighting key metrics related to student metrics and course performance, we aim to empower relevant entities to make data-driven decisions and formulate effective strategies.

II. USERS AND THE QUESTIONS

As the application unfolds, it becomes evident that its primary purpose aims to clarify the panorama of DETI courses — unveiling trends across the years, facilitating course comparisons, and scrutinizing grade distributions and preferences.

Within this section, we explore the diverse personas that engage with our application, each driven by unique motives and perspectives.

A. Characterization of the users and their context

Meet Johnny, an external expert contracted to lend his proficiency in data visualization, strategically contributing to the overarching objectives of the university's DETI programs. Meanwhile, faculty members, such as course directors, find in our application a valuable tool for deciphering course data, enabling them to make strategies to get more applicants or elevate course averages.

Administrative personnel, stationed in the DETI secretariat, discover a resourceful ally in our application, swiftly accessing pertinent information. Even students, seeking to navigate the academic landscape, get advantage of our application to compare grades across the courses.

B. Questions to Answer

The "Questions to Answer" subsection serves to unravel complexities, seeking clarity in the following questions that our application seeks to answer:

- **Annual Enrollment Overview:** How many students applied to DETI in each academic year? Delve into the yearly flux of aspiring minds entering the realm of DETI.
- **Course-specific Applications:** How many students applied to a DETI course in a specific year? Uncover the nuances of course-specific application trends over time.
- **Peak Year for Course Applications:** In which year did a particular DETI course witness the highest influx of student applications? Identify the pinnacle of interest for each course.
- **Choice Option Analysis:** How many students applied to a DETI course with a specific choice option in a given year? Explore the diversity of preferences within DETI's candidates.
- **Last Placed Candidate Grade in a Specific Year:** What was the last grade by the final student entering in a DETI course in a particular year? Defines the mean grade of a course. Allows you to understand whether this value is increasing or decreasing over the years.
- **Lowest Placed Candidate Grade Across Universities:** What was the lowest last grade by the final student across different universities for a similar DETI courses? Allows you to understand whether DETI students have better academic metrics and also allows to understand the behavior of this value over the year, where is increasing and where is decreasing.
- **Grade Interval Applications:** How many students applied to a DETI course with grades falling within a specified interval? Analyze the distribution of applicants based on academic performance brackets.
- **Option Chosen Preferences:** Among the candidates for a DETI course, which option of choice was the most popular over the years? Gain insights into the prevailing preferences that shape a DETI course.

III. DATASET

In relation to the data utilized, as there was no available dataset, we had to create our own dataset through web scraping from the website of DGES - Direção-Geral do Ensino Superior.

The courses used for this visualization were Aerospace Engineering, Computational Engineering, Computer and Information Engineering, Electrical and Computer Engineering, and Computer Engineering.

The universities used for comparison were the University of Aveiro, Faculty of Sciences and Technology of the University of Coimbra, Faculty of Sciences of the University of Lisbon, Coimbra Institute of Engineering, and Porto Institute of Engineering.

Regarding the data used, we considered the number of candidates, both in total and for each course, the preferences that candidates indicated for their chosen courses, application grades, and the grades of the last admitted candidate for each course.

IV. VISUALIZATION SOLUTION

In the pursuit of conveying complex information effectively and enhancing data-driven insights, a comprehensive visualization solution has been developed. Leveraging a diverse set of visualization techniques, including bar charts, line charts, grouped bar charts, and bubble charts, this application aims to provide a visually compelling and insightful representation of the data.

A. Low Fidelity Prototype and User Feedback

Our low fidelity prototype is represented in Figure1 and Figure2.

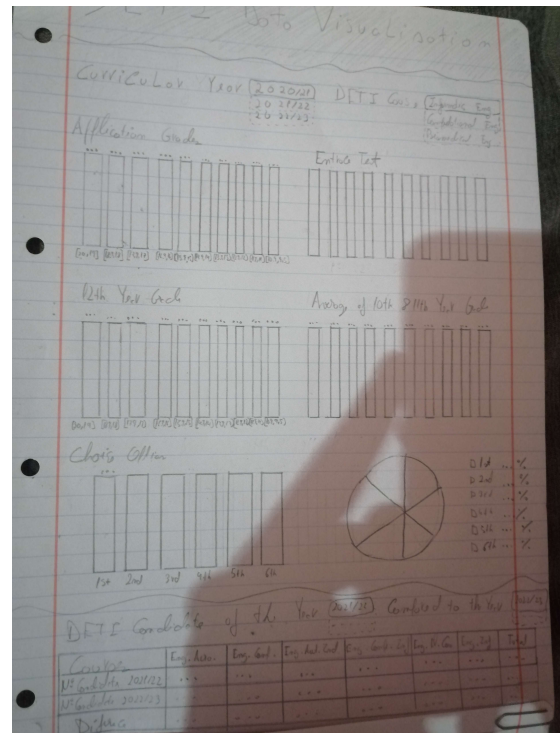


Fig. 1: Low Fidelity Prototype - Part I.

As it is possible to see in Figure 1 and Figure 2, our initial idea was very bold because we want to show a lot of information and draw a lot of graphics. Here we had planned to use bar charts, pie charts, tables and line charts.

In Figure 1 we would select a specific year and a DETI course and would have information in a bar chart about application grades, entrance test grade, 12th year grade, average of 10th and 11st year grade and choice option; in a pie chart the same information, the choice option but in percentage. At the end, a table where two different years would be selected and the number of candidates of each DETI course in that two years would be possible to compare.

In Figure 2, in the first line chart, after choosing, again, two different years, a line for each year would be plotted where information about the last placed student application grade would be shown against each DETI course.

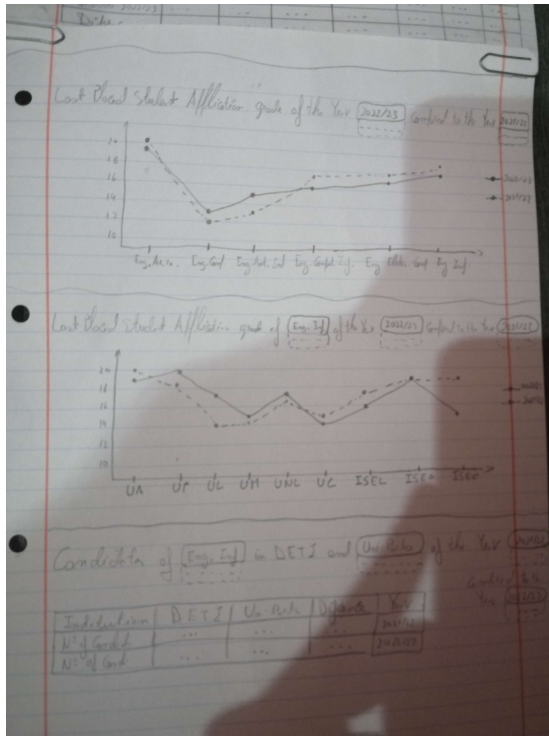


Fig. 2: Low Fidelity Prototype - Part II.

The other line chart it would plot the last placed student application grade of a selected course against different universities that had a similar course; the lines represented two different years, previously selected.

Finally, a table that would allow a course choice, and university choice and two years to select. The information plotted would be the number of candidates.

The user feedback's passed by the fact that there was a lot of information and it would be difficult to navigate and find information. It was also mention that the interaction, like selecting a course or an year, should be at the beginning and a general feature, that is, to change the entire web page or its majority to be more intuitive.

B. Functional Application Developed

Our final solution is totally different than the one presented in the low fidelity prototype. Instead of a single scrollable page, we divide our solution in two different web pages: the first one aimed to be a more general and quick at showing information; the second one, a web page for each DETI course where it is possible to find a more specific information about that course.

It is possible to divide the home page in 4 sections, illustrated in Figures 3, 4, 5 and 6.

In the header, Figure 3, of main page it is possible to find six buttons, one for the home page and five others for each DETI course, allowing the user to navigate.

In the first graph, Figure 4 is represented a bar chart. Each bar represents a course and the value on top, the number of

Fig. 3: Home page header.

Curricular Year 2021/22 ~

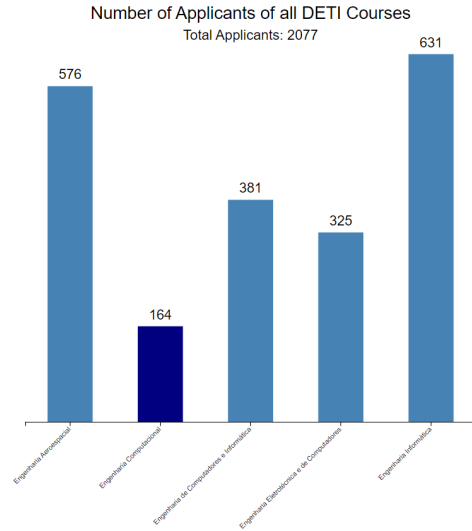


Fig. 4: Home page - Number of Applicants of all DETI Courses.

applicants to that course in the year selected in the drop list above. It is also represented the total applicants, below the title of the graph. This one can answer to the "How many students applied to DETI in each academic year?" and "How many students applied to a DETI course in a specific year?" questions, mention in Section II-B.

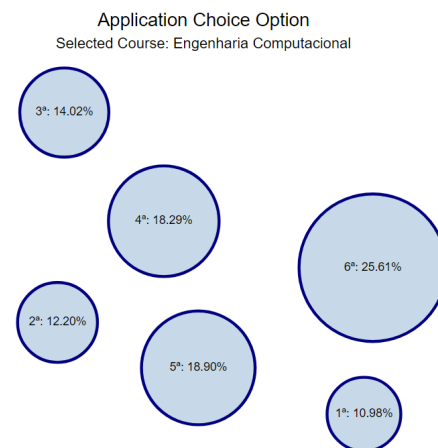


Fig. 5: Home page - Application Choice Option for a selected course.

The graph on Figure 5 aims to answer the "How many students applied to a DETI course with a specific choice option in a given year?" question. This graph is summon when a bar of Figure 4 is clicked. It is a bubble chart that represents the percentage of each position of choice that candidates applied to a course. The size varies with the percentage. The highest percentage has the biggest radius.

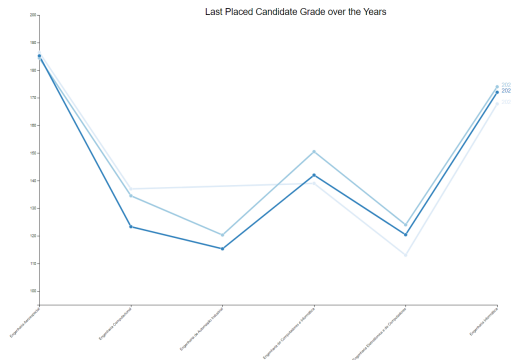


Fig. 6: Home page - Last Placed Candidate Grade over the Years of DETI courses.

The final graph of the home page, Figure 6 aims to compare the last placed candidate grade over the years of all DETI courses. Each year is represented by a line allows you to understand whether this value is increasing or decreasing over the years and compare the grades with other DETI courses; it answers the question "What was the last grade by the final student entering in a DETI course in a particular year?". If the user hovers his mouse on points, a tool-tip will pop-up showing more detailed information avoiding viewing errors.

Now, for the course page, it is also possible to perform a division, this time in five sections illustrated in Figures 3, 7, 8, 9 and 10.

The first one, Figure 3, is the header again, allowing user to continue to navigate throughout the courses and web page.

Now, in a selected course, the graph on Figure 7 answers the question "How many students applied to a DETI course with grades falling within a specified interval?". It has the number of applicants against the grades and each line represents an year. In the top left corner is the legend that is interactive. By clicking on each one, the line disappears so it facilitates the user view. It also has the tool-tip mechanic in each point explained before.

Here, in Figure 8, the question answered is "In which year did a particular DETI course witness the highest influx of student applications?". Has it possible to see, it is represented the number of applicants by year for the selected course.

In Figure 9 it is represented a line chart to visualize the grade of last place applicant over the years and answer the question "What was the lowest last grade by the final student across different universities for a similar DETI courses?". The dynamics and mechanics are the same as in the graph in Figure 7.

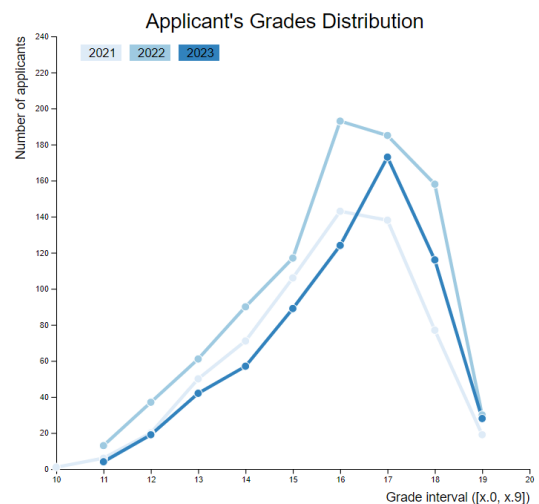


Fig. 7: Course page - Applicant's Grades Distribution.

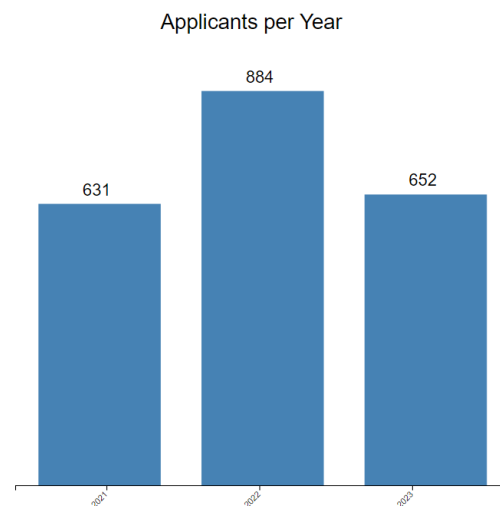


Fig. 8: Course page - Applicants per Year.

Finally, in the course page, the question "Among the candidates for a DETI course, which option of choice was the most popular over the years?" is answer through the graph represented in Figure 10. It is represented a grouped bar chart where in the X axis is represented the six possible option choices and, each of the three bars represent an year. The legend is interactive. Its dynamic is the same as the legends in the grpahs on Figures 7 and 9. Although, in this graph, there is a button on the top left corner that allows the suer to switch the data between absolute values and percentage values.

C. Evaluation and User Feedback of the Functional Application Developed

We performed an heuristic evaluation/Usability Test in order to evaluate our application. The evaluation was performed on a google forms and it can be found [here](#).

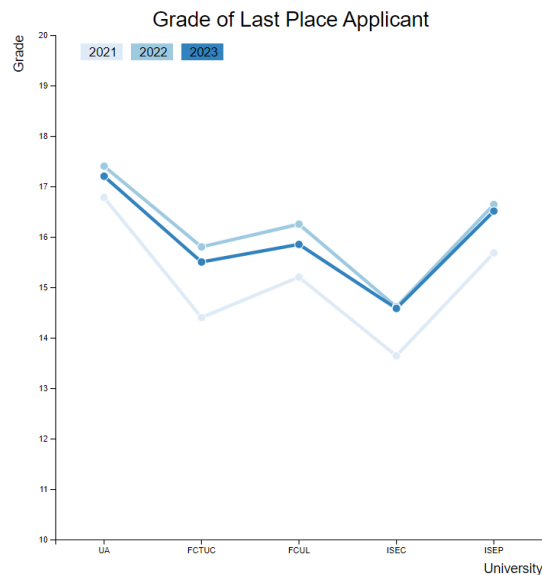


Fig. 9: Course page - Grade of Last Place Applicant over the years.

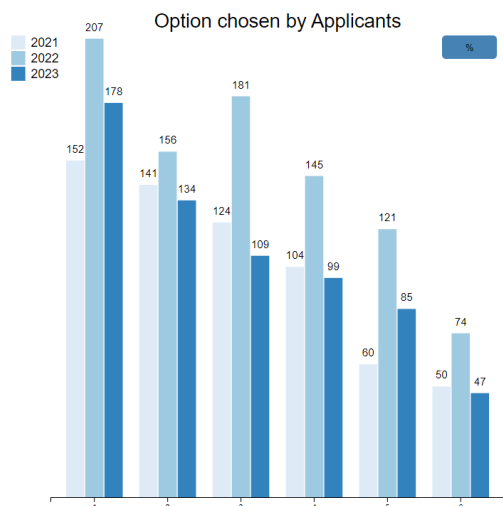


Fig. 10: Course page - Option chosen by Applicants over the years.

At the time of writing this report, we received responses from 16 participants. The forms consisted in 10 questions of multiple choice and, for each question, an evaluation from 1 to 5 on how difficult was to answer that question, being 1 very hard and 5 very easy.

The ages of the participants are between 20 and 26 years old and their area of activity or academic training or professional experience includes economics, biomedical, mechanical and computer engineering, law, game design, etc.

The overall statistics is represented in Figure 11.

It is possible to notice that the average score was 8.63/10 which implies that the users answered correctly more than 8

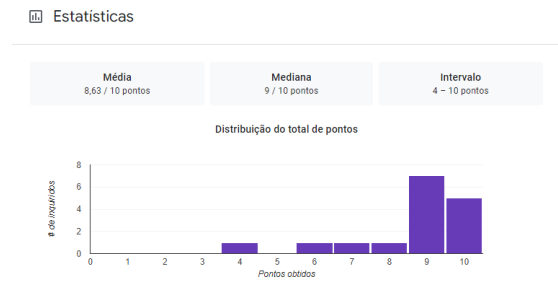


Fig. 11: Overall Statistics of the Quiz.

questions right.

In Figures 12, 13, 14, 15, 16, 17, 18, 19, 20 and 21 are represented the statistics for each question of the quiz.

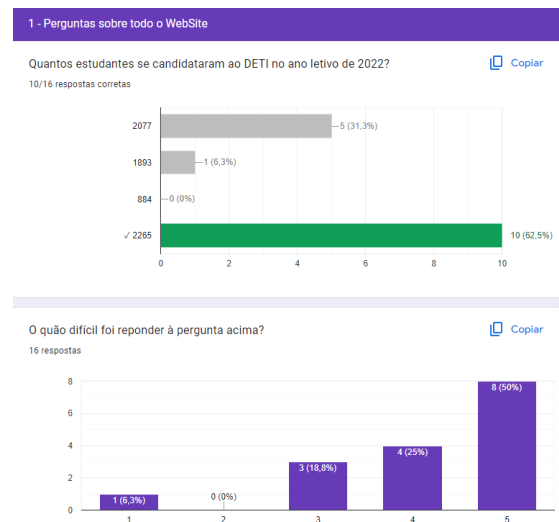


Fig. 12: Question 1 of the Quiz.

It is possible to conclude that, for all questions that that vast majority chose the correct answer each means that in general, the application developed is usable taking into account that the participants were not familiar with the applications, they never saw it before taking the quiz, it was the first time they were interacting with it and did not know the theme of the project.

The questions that the users struggled more to answer were the questions 3, Figure 14, 4, Figure 15 and 8, Figure 19. The others were classified in its majority by being easy or very easy to answer.

The users, at the end, were encouraged to make some comments, report problems and make suggestions for improvements.

Some of the comments:

- Two similar comments from different participants: "Visual hints when something was clicked, like different colors" and "When an year was selected in line charts, in

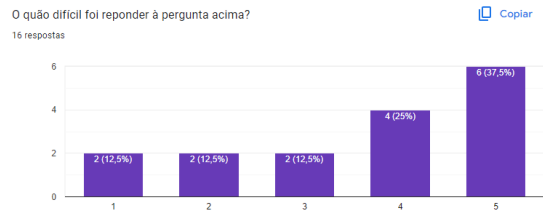
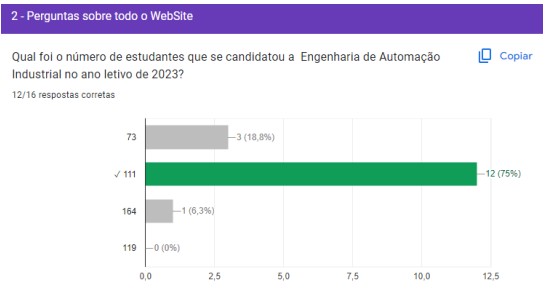


Fig. 13: Question 2 of the Quiz.

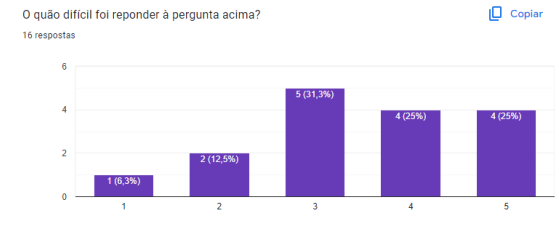
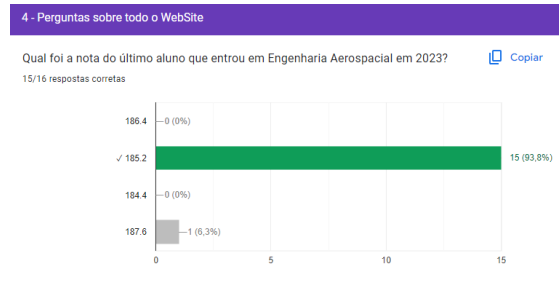


Fig. 15: Question 4 of the Quiz.

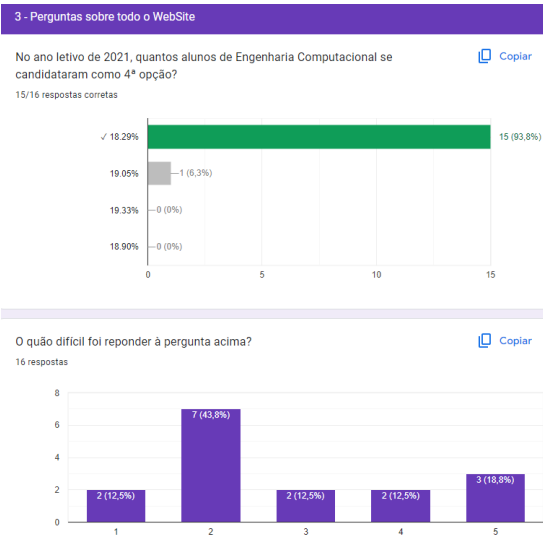


Fig. 14: Question 3 of the Quiz.

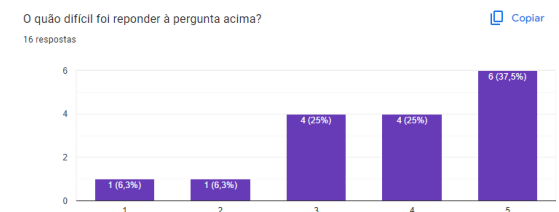
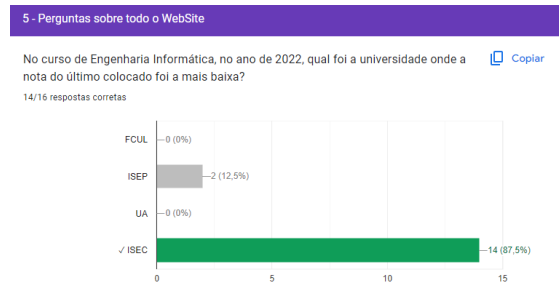


Fig. 16: Question 5 of the Quiz.

the legend, make a line crossing the legend so it would be noticed what was clicked". This leads us to conclude that little things like a line over the clickable legend would facilitate users performing the tasks and not being worried looking for what to click.

- About the colors: "With the color scheme used, sometimes its hard to distinguish information." and "... despite the colors meeting a standard, having weaker or stronger shades of the same color for each year highlights some years and not others ... A cold color palette helps maintain the same pattern and would not highlight any of them.". With this comments, we can understand that there some flaws on the colors chosen for some users.

- Some users said that showing instructions on how to interact with the graphs or make them more intuitive to use because for people who are not used to interact or see this kind of graphs may not find it as intuitive as we would have liked.
- In the graph in Figure 10, users commented on how the button to switch between absolute and percentage values confused them because when absolute values were shown, the button would have the % sign. Other user suggested having two buttons, one for each data.

V. CONCLUSION & FUTURE WORK

To conclude, after analysing and reading the users feedback on our application, in general we can say that if an user

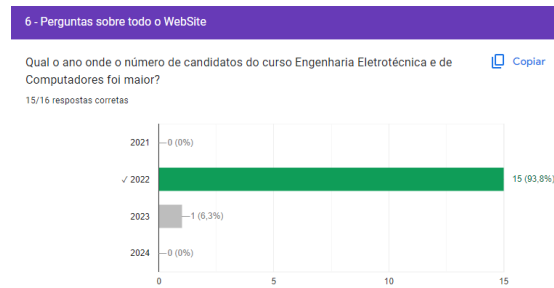


Fig. 17: Question 6 of the Quiz.



Fig. 18: Question 7 of the Quiz.

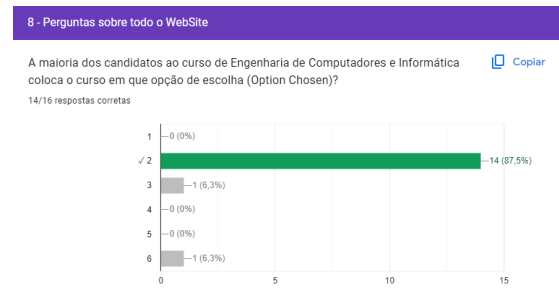
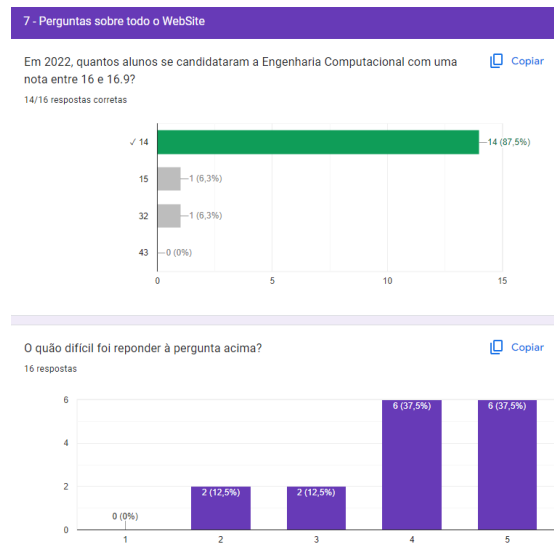


Fig. 19: Question 8 of the Quiz.

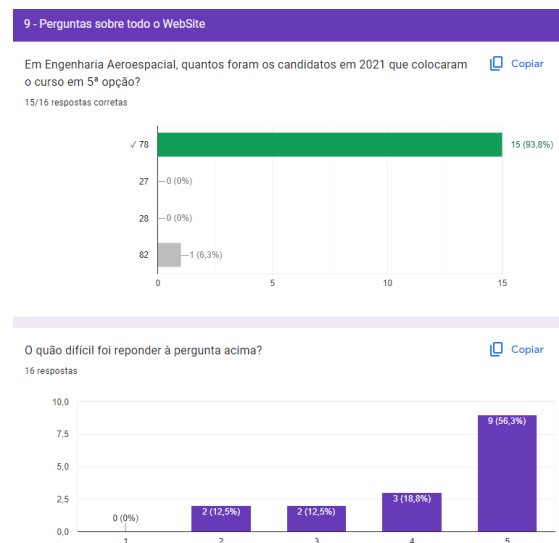


Fig. 20: Question 9 of the Quiz.

that had zero previous contact with the platform and did not know what the web page was about, was able to answer, on average, more than 8 questions right, like it is shown on Figure 11, and taking into account that one of the personas, already familiarized with DETI and possible data, whose platform was developed for them to use, with an initial heads up and training on how to things work, we consider that the personas would perform their tasks without any problem and the platform would be very intuitive.

With that, we can affirm that the work we developed was concluded with success.

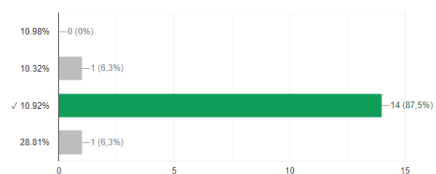
For future work, implementing a new color scheme and more intuitive graph interaction, as the quiz participants re-

ported, would be a priority. Then, another user quiz would be made to ensure that the new changes were working correctly and only after that, star to implement new visualizations and/or implement new data so the target personas for this platform would work more efficient. Over the time, new heuristic evaluations would be performed to the workers to analyse what were their needs to facilitate their job.

10 - Perguntas sobre todo o WebSite

Em Engenharia Computacional, qual foi a percentagem de alunos que se candidatou em 2023 como primeira opção? [Copiar](#)

14/16 respostas corretas



O quão difícil foi reponder à pergunta acima? [Copiar](#)

16 respostas

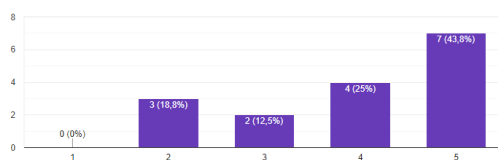


Fig. 21: Question 10 of the Quiz.