

Selecting the Future: on the Motivations of Young Students to Choose Mechanical Engineering at FEUP

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Introduction

In Portugal, admission to public higher education (PHE) is subject to quantitative limitations, resulting from the number of places (*numerus clausus*) fixed annually by PHE institutions for each cycle of studies (CS). For each institution/CS pair, applicants are ordered by their application mark, ApM . The weight $k \in [0, 1]$, the national exams compulsory to calculate S and the minimum marks required for ApM and E are decided by the PHE institution/CS pair. For Mechanical Engineering (ME) CS, all Portuguese Universities require the national exams of "Mathematics A" (M) and "Physics and Chemistry" (PQ), where $M, PQ \in [0, 200]$. In the last years the students' ApM for the ME CS at Faculty of Engineering University of Porto (FEUP) have been the highest among all Mechanical Engineering CS (Figure 1, values for 2020/2021).

$$ApM = k.S + (1-k).E$$

$$E = 0.5(M + PQ)$$

S - Achievements at secondary school for a period of three years
 E - National exams grade

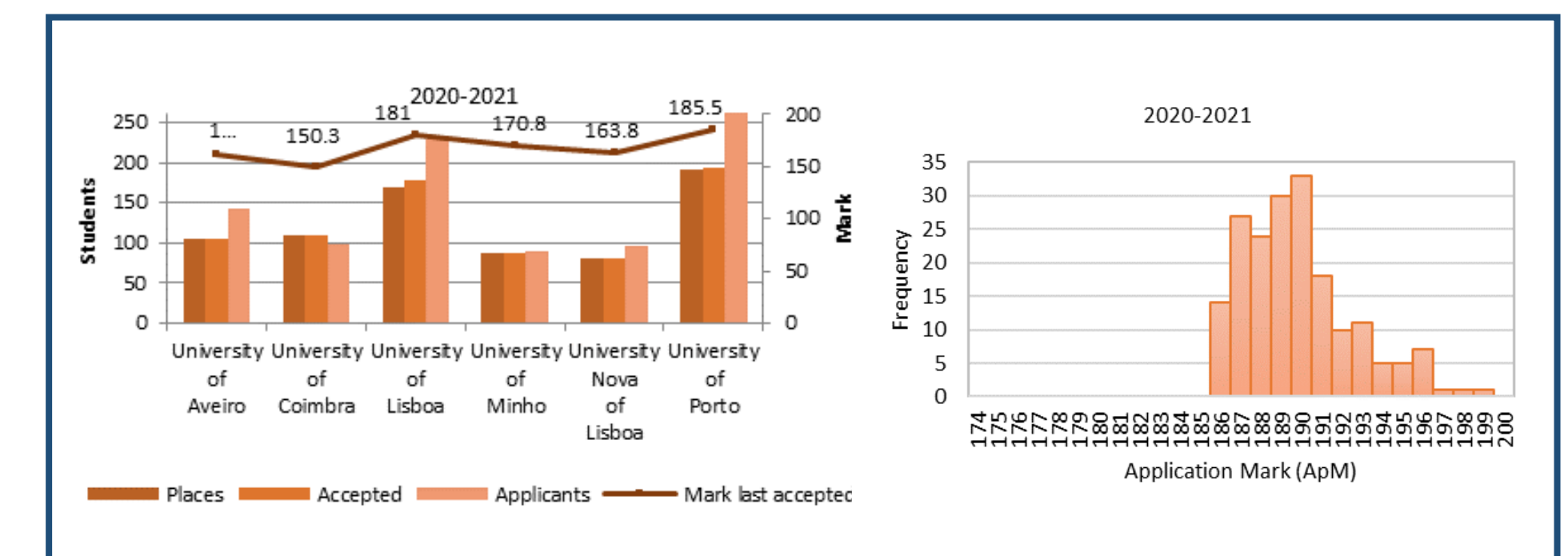


Figure 1 - Students' entry grades in ME CS at several Portuguese universities and the distributions of ApM for all ME students accepted at FEUP in 2020-2021.

But, why do students choose Mechanical Engineering at FEUP?

When choosing a higher education institutions (HEI)/CS, the candidates take into account a large number of factors. Many have been addressed in the literature, but the way the young students weight each one varies. In what concerns the Mechanical Engineering degree at FEUP no study exists about the students' choices. Nevertheless, a number of aspects that are thought relevant to attract potential candidates to the HEI/CS were implemented and are in practice:

- The HEI/CS provides institutional data about FEUP, DEMec and the Mechanical Engineering CS (online and printed prospect);
- Active posture for the dissemination of FEUP "products", with emphasis on secondary schools - study visits to FEUP's laboratories and talks at secondary schools are organized in a regular basis;
- The Mechanical Engineering CS prepares engineers capable of pursuing national and international professional careers with technical and personal skills of recognized importance, taking advantage of the scientific quality of its teaching staff;
- High employability rates, near 80% get their first job up to 3 months after CS conclusion.

ME at FEUP has revealed strong appeal for the young students who seek a PHE/CS in engineering. However, despite some general perceptions about the motivations of the candidates to choose this course, their real motivations are unknown.

Results and Discussion

1. Questionnaires and Data Collection

With the objective of understanding whether the actions in practice at the HEI/CS for attracting young students are actually relevant and also to know if other measures should be implemented, an online questionnaire with closed questions was prepared and applied to $N = 200$ students, one month after their enrolment at FEUP, in the academic year 2020-2021. The questionnaire was structured with the objective of capturing information relevant to understand the reasons of the students for choosing Mechanical Engineering in the following aspects:

- Importance of information and advertising about the HEI/CS;
- Importance of factors directly related to the HEI/CS;
- Students emotional condition before and after choosing the CS;
- General aspects.

To analyse the data, the number of responses obtained in each possible category was counted and plotted. Moreover, a quantitative simple measure, to be denoted by $SCORE$, was defined to help summarizing the results, where $f_i, i = 1, \dots, 5$, stand for the number of answers in the classes *Very low*, *Low*, *Neutral*, *High* and *Very high*, and w_i are weights.

$$SCORE = \sum_{i=1}^5 w_i \cdot f_i$$

2. Importance of information and advertising about the HEI/CS

Figure 2 compares the results obtained for each of three main groups of questions, namely those related to information, advertising and opinions. The most important information source is the CS syllabus, but the CS and FEUP websites are also relevant. For the advertising actions, the "UP Exhibition" and the CS activities are considered significant, while the visits to FEUP and talks are secondary. The most respected opinions are those of professionals, experienced colleagues and family to formulate a decision. In contrast, opinions of teachers and colleagues of the same year are less important, and psychologists are almost ignored.

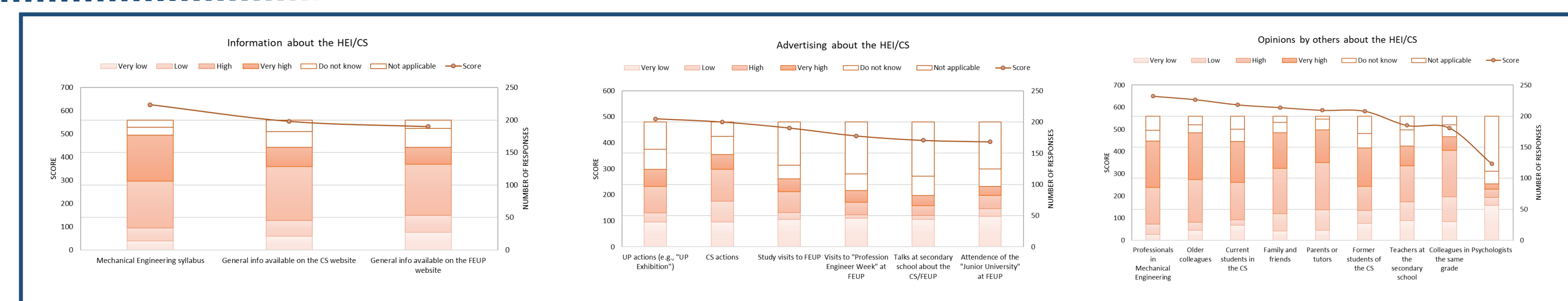


Figure 2 - From left to right: importance of information, of advertising and of opinions of others on the HEI/CS choice.

3. Importance of factors directly related to the HEI/CS

Figure 3 compares groups of related factors to allow a better understanding of their importance. Besides the quality of training and the HEI/CS reputation, the scientific excellence on the teaching staff is more important than their pedagogical capacity. The remaining factors in the group were considered as having similar relevance, with the exception of the HEI location, which seems to be not influential at all. Regarding the questions about employability and professional activity, the versatility of the CS is of paramount importance, which is, naturally, not independent of aspects such as employability, economic return and professional success. The social status seems not be on the list of factors influencing the choice. The aspects related to the professional career have similar weight. Finally, with respect to other influencing factors, the aptitude for the areas of mathematics and physics is important. This is not surprising, since those are fundamental for a Mechanical Engineering CS.

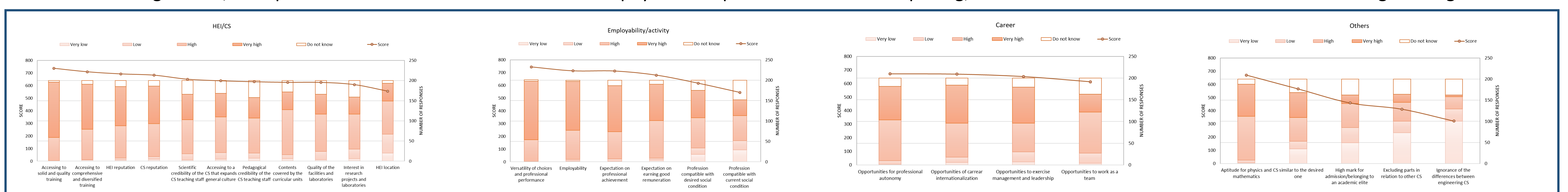


Figure 3 - From left to right: importance of HEI/CS factors, employability and professional activity, career related issues, and other factors.

4. Students emotional condition before and after choosing the CS

The results for the third part of the questionnaire, which assessed the students' mood both before and sometime after their decision about the HEI/CS, are presented in Figure 4. The answers unveil that more information about the CS and about other engineering CS would have been helpful, that the decisions seem to be taken without any sort of external pressure, and that the students feel comfortable, since they are aware of the possibility for changing to another HEI/CS in case they want.

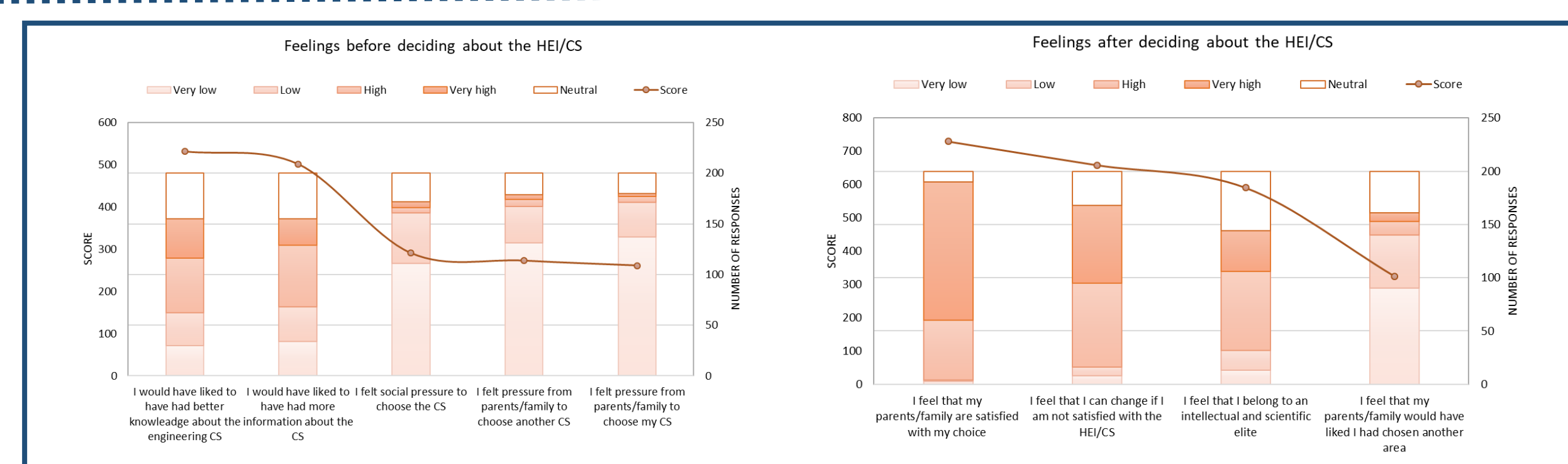


Figure 4 - Level of agreement of feelings before deciding about the HEI/CS, and feelings after deciding about the HEI/CS.

5. General aspects

Most students start deciding during the last two years of the secondary school, but there is a high percentage (16%) who decide near to the application time. The amenity, confidence and happiness about the choice at the time of decision and at present are generally high (Figure 5).

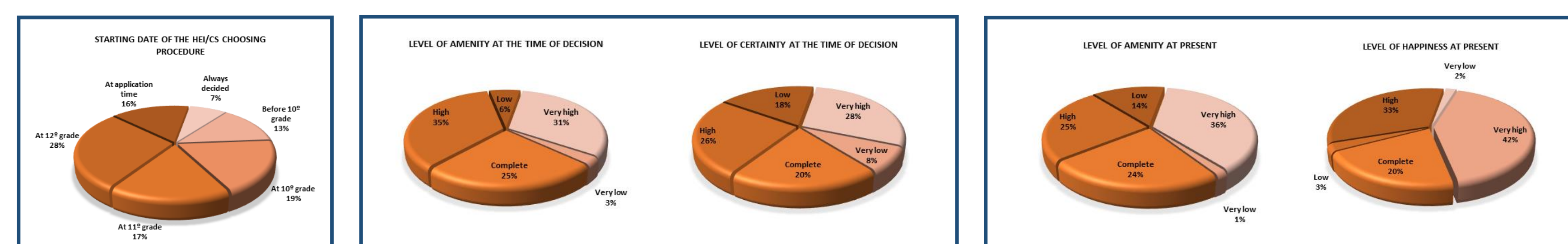


Figure 5 - Results related to the time when the decision was taken, and the degree of confidence about the choice.

Conclusions

This work studied the main reasons that determine the interest of students in Mechanical Engineering at FEUP. Quantitative data were collected by applying a questionnaire to the first year students enrolled on ME at FEUP in 2020-2021. The results suggest that the opinions of others, the quality of the information about the CS, the versatility and employability rates, the quality of training and the reputation of the HEI/CS are decisive. On the other hand, advertising actions, social issues and the location of the HEI have small influence on the decisions. The choices seem to be made in full awareness of all facts and the students feel comfortable with their decisions. The findings can be used to strengthen the Mechanical Engineering ability to compete for the best potential candidates. Nevertheless, to have more strong conclusions, more questionnaires have to be applied, for instance, in an annual basis, to collect and further analyse larger volumes of data.

