

A Decision Support System for Portuguese Higher Education Course Selection – First Round

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Abstract: Application for higher education courses is a delicate and important process. In this phase students face a great number of possibilities of choice. In order to help students in the decision making process a decision support system called C.U.R.S.O was developed. Based on a structured questionnaire the system determines de profile making use of a knowledge base and proposes a ranked list of the most suitable courses. Input variables take into account not only social and economic aspects but also the aptitude for a particular area. The first version of C.U.R.S.O was tested by hundreds of Portuguese students and schools. This paper presents and discusses the results attained during the first round.

1 INTRODUCTION

A Decision Support System (DSS), more precisely the decision models associated with it, will never be effective if the variables that affect the operating model and the associated data are unframed from the context in which it occurs. Any system of this nature, treating data incorrectly will present to the user misaligned answers from their expectations and requirements.

The main objective of this project is the development of decision models based on the comprehensive study of the environment in which it is inserted, more specifically, the variables that a system must consider and their correspondence to the data model.

C.U.R.S.O. (Centre for Universal Gathering of Oriented Suggestions) is a DSS designed for assisting students who are in transition year between college and high school to choose the most suitable course according to their profile.

This paper is divided into five sections. The first section introduces the problem. Then, in the second section a set of related concepts and some similar tools are presented. The third section presents the DSS and the knowledge phases. The fourth section present the questionnaire results and makes a review and an analysis of the questionnaire results. The sixth section presents the system features and the prototype deployed. Finally, some concluding

remarks are done and future work is outlined.

2 BACKGROUND

2.1 Decision Support Systems

In his work on data structures, Alfred V. Aho (Aho et al., 2001), considers a decision model as a sequence of operations that branch execution based on comparisons of data, referring to a generic model simply making decision analyzing a large number of variables regarding to a previously order established.

Decision is a choice among alternatives based on estimated weights of these alternatives and the decision model will help to establish parameters for this choice generating these estimates, changes or comparison and choice. A decision model is characterized by (Sprague and Carlson, 1982):

- Treat unstructured problems;
- Combining the use of modelling techniques, with traditional functions of access and retrieval of information;
- Create a user-friendly interface that allows interaction with the user;
- Emphasize the flexibility and adaptability for monitoring changes, both the environment and the different needs of use by the users.

The theoretical component of this project is mainly based on two authors: Herbert A. Turban Sharda and Simon (Simon, 1978; Turban, Sharda, & Delen, 2011). Simon was the first to carry out extensive studies in decision models and established a methodology for their development. The model of Simon is divided into four major steps (Simon, 1978). Turban (Turban, Sharda, & Delen, 2011) added a fifth step that allows for monitoring the system after its implementation:

- 1) **Intelligence** - Collection of information inherent to the process;
- 2) **Design** - Design of decision model;
- 3) **Choice** - in this phase the alternatives previously developed in the design phase are evaluated in order to choose one of them;
- 4) **Implementation** - Implement the selected course of action. Normally this phase includes an implementation plan.
- 5) **Monitoring** - this phase evaluates the implementation and can contribute to improve the models, being the results used in the intelligence phase of next iterations.

2.2 Accessing to Higher Education in Portugal

The National competition for accessing higher education at public sector, Portuguese legislation (Ordinance nº 195/2012 of the Ministry of Education and Science) reports: "(...) To apply for courses in public higher education institutions is done through a national competition organized by the General Direction of Higher Education, unless in the case of exceptions under the rule of law." Briefly, the application process in Portuguese public higher education is accomplished through the seven steps.

This process starts after completion of internal studies in the 12th year of schooling and finishes after the application period by DGES with the selection of candidates. The candidates are ranked per course. The process is repeated in a second round for the open positions.

2.3 Similar Tools

After an exhaustive search, it was not possible to find a system with similar characteristics.

In Portugal only are available two online services to help users searching for a higher education course: the site of the General Direction of Higher Education (DGES) and the Office of Higher Education. These services are based on pre-established criteria in order to filter the questions. In both sys-

tems the user can search for courses filtering them by location, type of institution, field of study and specific ingression of the same. Similar systems can be found in other countries.

Table 1 presents some tools to help students and if they are based in a search engine or in a questionnaire.

Table 1: Similar tools.

Institution	Country	Search	Questions
Empresário	México		X
Univafu	México		X
Universidades.com	Argentina	X	
UK Course Finder	United Kingdom	X	
Go2Uni	States	X	
Guia do Estudante	Brazil	X	
Universities Guide	Australia	X	
Guia da Carreira	Brazil		X
Gab. Ensino Superior	Portugal	X	
DGES	Portugal	X	

2.4 Psychometric Tests

Psychometric tests have been used since the early part of the 20th century and were originally developed for use in educational psychology (Psychometric-success, 2012; Them, 2011). Psychometric tests are very usual instruments to help in the decision process. Helped by a psychologist through a series of questions and mental exercises, candidates identify a number of potential professions.

Psychometric tests aim to measure attributes like intelligence, aptitude and personality (Psychometric-success, 2012). However, this type of tests isn't direct competitor of the DSS in development. Although it is for the same user segment, they are for different situations. The DSS can be more general and include the psychometric tests.

2.5 RIASEC (Holland Codes)

RIASEC is a test (system, 2012) that has the objective to answer to the question: "Which Career Pathway is right for you?" This test is composed by a set of different questions from different areas.

The final output of this approach consists in one of six areas (Holland and Gottfredson, 1992): Realistic (Doers), Investigative (Thinkers), Artistic (Creators), Social (Helpers), Enterprising (Persuaders), and Conventional (Organizers). With the result the students get a set of areas to continue the academic

career according to the classification: R, I, S, A or C.

3 DECISION SUPPORT SYSTEM

DSS is a computer program that uses knowledge to solve complex problems. In this case, the knowledge is acquired in order to help the students to choose the most suitable course. In the first round a very simple decision model based in rules was implemented. In order to develop a knowledge based DSS, the following methodology was adopted (Rezende et al., 2003)

- Planning (Identification of the knowledge domain; Selection of the Team Development; Selection of the Tool Development)
- Knowledge Acquisition (Identification; Conceptualization; Formalization;
- Implementation (Representing the knowledge in the tool; Implementing the Interface; Documenting of the KBS;
- Test and refinement (Validation and Verification; Refinement of SBC)

4 STUDENTS PROFILE

In order to better understand the target users of the DSS, a study on Portuguese student population has been carried out. Two different questionnaires were deployed to different populations. The first was designed to students that are:

- in the High Scholl (HS) (10nd to 12nd);
- studying in Portugal;

The objective of the first questionnaire was to understand if the students have notion / idea about which course to choose in the Higher Education (HE) and if they know any tools to help them. The second questionnaire was made to students that are:

- In the Higher Education (Lic or MsC);
- From the most important Portuguese's HE Institutes;

The objective of the questionnaire made for HE students was to analyze all Portuguese HE institutes and had as main goal understand if the students made the right decision and if they thought about changing course. Both the questionnaires were made using the internet and divulgated through email, forums and directly in some institutions. As mentioned, in this study two different types of students (profiles) were considered:

CS – High school students applying for a higher education course; and

HS - Higher education students who intend to change course;

In order to percept the requirements for the decision support system both types of students were inquired. CS community has been confronted with the following question: Do you know what area you intend to choose?

By observing Figure 1, 29% of respondents said they still have no idea of the area to which they will

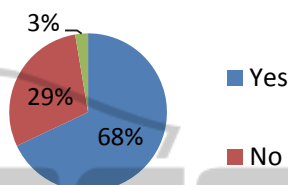


Figure 1: Do you already know what area to choose in HS?

apply, in other words, about five months to conduct nominations, three in ten students do not know yet how to fill out the application.

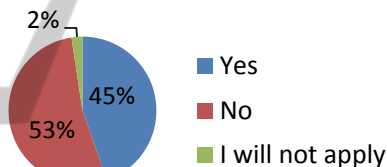


Figure 2: Do you already know what course to choose in CS?

To further understand the problem, CS students were asked if they knew the course in the concrete that would apply. Figure 2 shows the number of students who have not yet decided. More than half of students in secondary education still don't know what course will choose to apply in higher education.

Figure 3 shows that 16% of students have already changed the course at least once time, and 9%, although has not changed, ever thought about it.

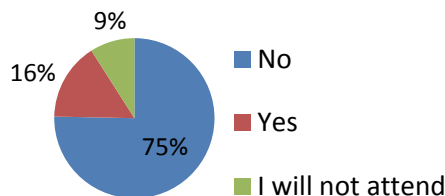


Figure 3: In your academic career, did you ever changed of course?

Based on these results, the HS students were asked, if when applied to higher education, they previously

knew what course would put in the application (figure 4).

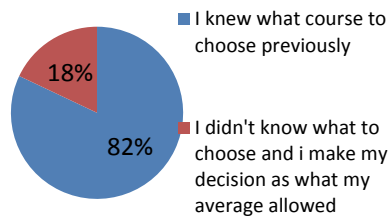


Figure 4: Did you know that the way you'd apply at the time of application?

Final results demonstrate that a DSS to support the application process to Higher Education is very important for both profiles CS and HS.

4.1 Exploring Profiles

To gather information about potential users of the DSS it was used an online survey to reach the largest possible number of individuals. This phase of the project was essential to:

- Understand the behaviour of those who will use the system;
- Create a tool in order to identify the best course for future students in Higher Education, and what kind of variables that tool must consider in terms of decision models.

Thereby, it was undertaken a nationwide survey through an email message sent to all high schools and higher education establishments of Portugal, in order to communicate with all their students.

Tables 2 and 3 present the characteristics of the students that answered the survey in terms of CS and HS students. For example, the CS students have an average of 17.2 years, are mostly female and are studying in the 12nd year. In this context only it wasn't possible obtain answers from two of twenty districts.

Table 2: High school students.

Nº of respondents	381
Sex	Male - 35% ; Female - 65%
Age average	17,2 years
Scholar year	10 th - 7% ; 11 st - 20% ; 12 nd - 73%
Portugal Districts	18 of 20 (total) answered

Next steps involved direct inquire to both profiles (CS and HS) in order to elicit the most important variables/qualifiers to form de decision model.

Table 3: Higher Education students.

Nº of respondents	1699
Sex	Male - 33% Female - 67%
Age average	23,03 years
Stage of studies	1º- 56%; 2º- 28%; 3º- 16%
Districts	Every single higher education establishments of Portugal answered the survey.

4.2 CS Profile

CS community have been asked on the following points (Q1 to Q3). Q1 (Figure 5) was used to understand if employment rate and institution reputation were the most important for to the students decision. Q2 and Q3 show that students are interested in a tool that can help them defining a profile based in the tests.

Q1: How much will these factors influence your choice?

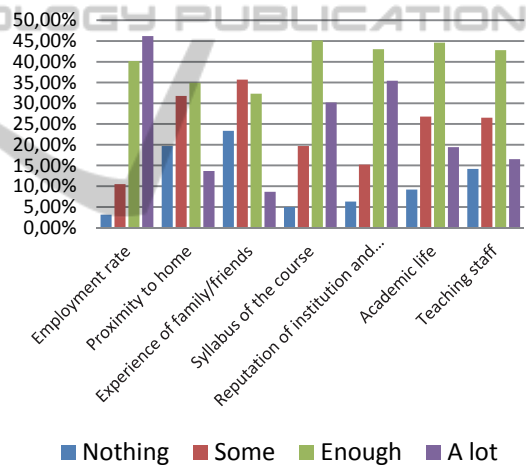


Figure 5: How much will this factors influence your choice, when you attend to higher education?

Q2: Will you consider useful a tool (web or smartphone) that would help you (through a series of questions) to choose the most suitable course for you, or to ensure that the course you have chosen is really the most adequate?

Table 4: Will the tool be useful?.

YES	93%	NO	7%
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Q3: Considering that this system will scan your profile, what aspects should be taken into account to analyse which course is right for you?

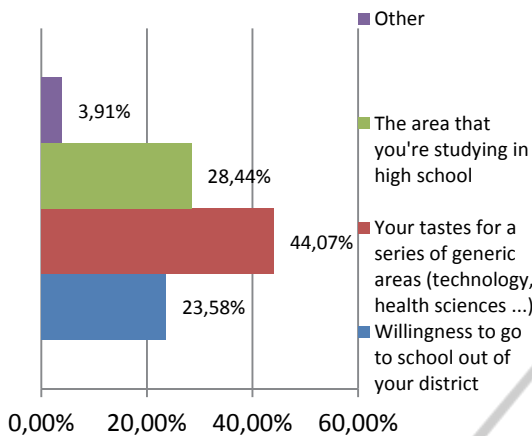


Figure 6: What aspects should be taken into account to analyze which course is right for you?.

4.3 HS Profile

HS community have been asked on the following points (Q4 to Q11). The next seven questions are about the Higher Education and change of course.

For example, Q5 (table 6) shows that students normally change course in the first year. Q6 (table 7) shows that almost 50% of the students when change course also change area. Q8 (figure 7) shows the main reasons for the change. Experience of family or friends and the teaching staff are not the only reasons for change, reputation of the institution and the syllabus of the course are also refereed. Q9 (table 9) shows the importance of having a tool to help defining the best profile and to choose the most suitable course /area.

Q4: Have you ever changed course during the academic journey?

Table 5: Changes of course.

Yes	16%
No	75%
No but I had already thought about it	9%

Q5: Which academic year did you changed the course?

Table 6: Year of change.

1 st	69%	2 nd	20%	3 rd	9%
4 th	1%	5 th	1%		

Q6: Why have you changed course?

Table 7: Reason of change.

I changed to the same course but in another educational establishment	12%
Course in the same area but different studies	39%
Also changed area	49%

Q7: How do you characterize the information you had about the course in which you entered at the time you made your application to Higher Education?

Table 8: Quality of the Information.

Null	2,47%	Good	25,31%
Weak	28,31%	Excellent	3,59%
Enough	40,32%		

Q8: How much the following factors will influence your choice?

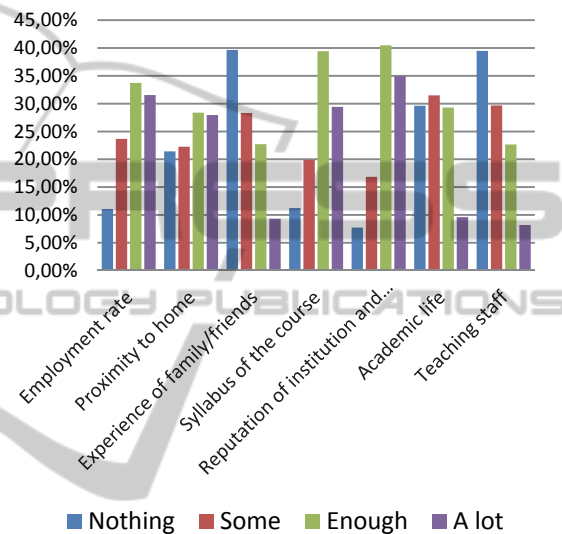


Figure 7: How much the following factors will influence your choice?.

Q9: Have you ever undergone a psychometric test?

Table 9: Have you ever undergone a psychometric test?.

Yes and the result was that I followed in my academic career	30%
Yes but the result turned out to not be what I followed in my academic career	32%
I never attend one	38%

Q10: Did you consider useful a tool (web or smartphone) that would help you (through a series of questions) to choose the best suited course(s) to you or to ensure that the course you have chosen is the more indicated?

Table 10: The tool will be usefull?.

Yes	86%	No	14%
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Q11: Considering that this application would parse your profile which aspects should be taken into account to analyse the most suitable course for you?

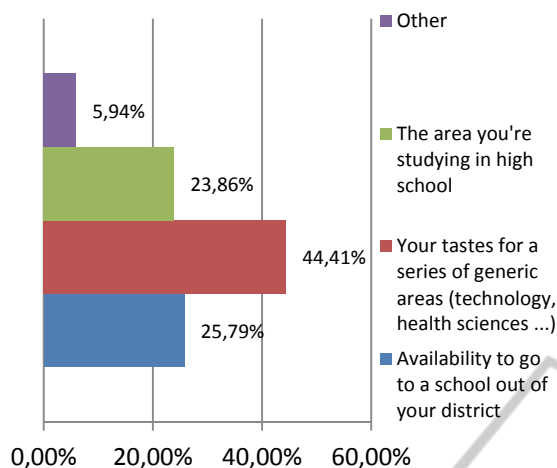


Figure 8: What aspects should be taken into account to analyze which course is right for you?

4.4 Discussion

Due to the high number of responses and geographical diversity of the online survey, C.U.R.S.O. was revealed to be an excellent tool for analysing the national panorama of those who applied recently, or are about to apply in future for higher education courses.

This instrument can be used to find evidences that prove the existence of a high number of students who are about to perform the application and still do not know in concrete what course to choose.

For the respondents the most important indicators to choose a course are very similar. High school students select in the Q1 the employment rate (85%) and the reputation of the course and institution (78%) in the Q3 the possibility of experiencing generic areas (44%) was chose as the main variable to decide. Higher education students gave more importance to the reputation of the course and institution (Q8) (76%) and they decide based on generic areas (Q11) (44%).

More specifically, students who are currently attending high school, 3 in 10 (30%) have no idea of the area that they will being study in higher education, and of these 5 per 10 students (50%) do not know the course in concrete that they will apply for.

Regardless to students who are currently attending higher education, about 2 out of 10 (20%) have changed at least once the course, and from those 5 per 10 (50%) also changed the area. This means that a high number of students undertake their application for higher education wrongly.

From the above evidences we can foresee a huge potential of C.U.R.S.O.

5 C.U.R.S.O.

First an expert system was implemented in format of a tool called C.U.R.S.O. (Universal Collection Center of Guided Suggestions). The main objective was to assist individuals who are attending secondary school in the process of Application to higher education, particularly with regard to the choice of the course they will put in the application.

5.1 Objectives

The creation of this tool has three goals based in the characteristics of the prospective DSS:

a) Maintain Decision Support Models

The main objective of the system is to maintain modes for assisting students find the most suitable course;

b) Collecting Information

The information collected from the users can be used to produce indicators very useful for specific entities, such as High Schools, Universities, Ministry of Education and others.

c) Adaptability

The system should improve its performance year after year using the collected information in order to optimize the decision models.

5.2 DSS Design

5.2.1 Planning

In this phase it was understood the context of the problem in a Higher Education approach and defined the research team as also the development tool: Corvid.

5.2.2 Knowledge Acquisition and Representation

The main data source was the DGES website where was queried data relevant to all courses of Portuguese Public Education. This knowledge was used in the logic blocks. Two types of variables were considered:

Informative

- Higher Education Institution (HEI) (Name, Ranking, District);
- Course (Name, Employability Rate, Average, Scientific Area, prerequisites and specific subjects).

Standings

- High school area;
- Students Desires.

bases will be also explored in order to assure the appropriated information about the courses offered. A second round is being prepared in order to test the models in a broader environment.

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