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## DETECTING MAJOR FACTORS FOR UNIVERSITY SUCCESS

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**Abstract.** A purpose of this research was to identify the most relevant educational factors for decision making process by applicants for an undergraduate university course. This work is based on the results of the analysis of cohort of 13.487 students of the first year full-time undergraduate entrants' in the University of Alicante taking into consideration the university study areas, the high school study programmes as well as the entrance exams results and credit pass rate of each student. The research proved the scientific high school education to be such a key indicator with the highest relevant school/university performance correlation and securing higher retention rate in the university study areas.

**Key words:** pass rate, drop rate, entrants, study programme, high school background, career choice, decision support system.

### INTRODUCTION

In the modern rapidly changing world young people have to face their first life defining decisions at the age of 15 when opting between the existing high school educational study programmes [1]. Having taken one of the educational options the high school students limit themselves to the consequences of such in respect of their professional career, where to study, which country to live in as well as the family and personal life aspects [2].

It's a common knowledge that an adolescent person lacks own life experience and is unable to be objective in decision making process. Their choices are mainly based on the commercial propaganda, peers' opinions, and also in many cases they are defined by their parents' aspirations. Due to this there are so many young people unsatisfied by their life choice who wouldn't build up a long term career and instead they would rather queue up in a job-centre for many years forming a large population group of those who

have never worked in their life. This is a really big challenge for the social life in modern Spanish society. Besides, Spain offers a financial support to students (loans, grants or fellowships) depending on academic achievements. As such, students have to meet set targets to receive funding, e.g. passing sufficient numbers of credits per year or completing a degree in a limited period of time [3]. They become a real burden and preoccupation for their parents and other family members, as well as for the government. Recent research on youth labour markets in the OECD countries shows that a considerable share of potential workers experience long unemployment spells, which are particularly prominent among very low educated individuals [4].

At the same time being a student is not a solution in itself. Students have weak understanding of the skills and degrees that will best help them find a job. Most students are not sure what educational program will help them find a good job. They cannot really

see what these programs will mean for their career [5].

According to some researches these days, the rate of unemployment among young people in Spain exceeds 50%, and the time of job search has been expanded. In general, overeducated workers have higher mobility than other comparable workers. It is declared that in Spain the so-called “lost generation” cannot find an adequately matched job [6].

This is why a research in this particular area shall be of utter importance for all the parties named and especially for young and upwardly motivated people in order to specifically point out some important aspects to keep in mind before choosing a University study course/career. The contextual data can also be utilised to identify students with school qualifications that may not only reflect the extent of their academic potential, but also to help identify those at risk of underperforming once they are in a higher education institute [7].

### INVESTIGATION ENVIRONMENT

The modern Spanish Education System demands that each and every student should make the first career orienting decision at an age of 15-16 years [8] choosing between finishing the secondary education, taking a professional 4 years course or making a two-year high school programme (“Bachillerato”) which is to prepare the students for the entrance exams in a Higher Education institution.

We agree that the largest share of growth in jobs is likely to come from the high-skill, rather than the low-skill end of the labour market [9]. A modern Italian sociologist Domenico di Masi believes that in the post-industrial era over 70% of the working population have intellectual or creative jobs [10]. That is why good education is getting more and more important for the new generations.

In the perspective of the Europe 2020 Strategy, it's declared to have at least 40% of the 30-34 year olds holding a tertiary education qualification by 2020 and at least 15% of adults should participate in lifelong learning [11]. The Higher Education institution applicants need to have an objective and practical information in order to adequately assess their level of knowledge and prepare themselves for a selected Higher Education institution and a chosen study course correspondingly. Besides, students improve their academic performance when they know how much they will earn [12].

We agree that “even at the point of matriculation, students may vary in how connected they feel to their university and these pre-entry perceptions and connections may be particularly important for newcomer outcomes” [13].

We solicited the necessary for our research information at the department of Sciences and Health at the University of Alicante. The University of Alicante provided us with detailed information on a large sample of university entrants. The data included the entry scores, first year credits claimed vs. credits passed, career areas, starting years, high school background and high school scores etc.

### OBJECTIVES

Our targets were to identify and to range the factors affecting the university performance and work out a draught of a decision making road map for all those considering to taking an undergraduate course at the University of Alicante as well as for the admission officers [14]. In order to identify interrelations between the key indicators and work out the approach as to how to use those parameters for the benefit of the applicants we defined the targets of this article as follows:

1. To identify the share of students who continued the university career areas in line with their high school study programmes.
2. To identify the correlation between the entry scores and the first year pass rate (fig. 1) at the university.
3. To identify the interdependence between the high school study programme and the university career area.

### METHODS

Our investigations are based on the admission notes (entry scores) and the first year performance. The University of Alicante provided us with three MS Access database tables:

- Table.Alu – with the student's identification codes (70.454 entries).
- Table.Sel – with the first year performance in the University of Alicante (101.130 entries).
- Table.Pre – with the University entry scores (on each subject) as well as the high school average scores and the school information (77.732 entries.)

The entity relationship model (Fig. 1) demonstrates that all the tables were linked by the student's identification code (ID\_PK). A process of data refinery permitted exclude the erroneous and/or incomplete entries. We made use of the principles previously described in other articles [2]. Having organized the information in an entity relationship model (ERM) we received a representative database with a large (N = 13.487) sample students of the University of Alicante for the period from 2010 to 2017 whose identities were concealed for personal protection policy.

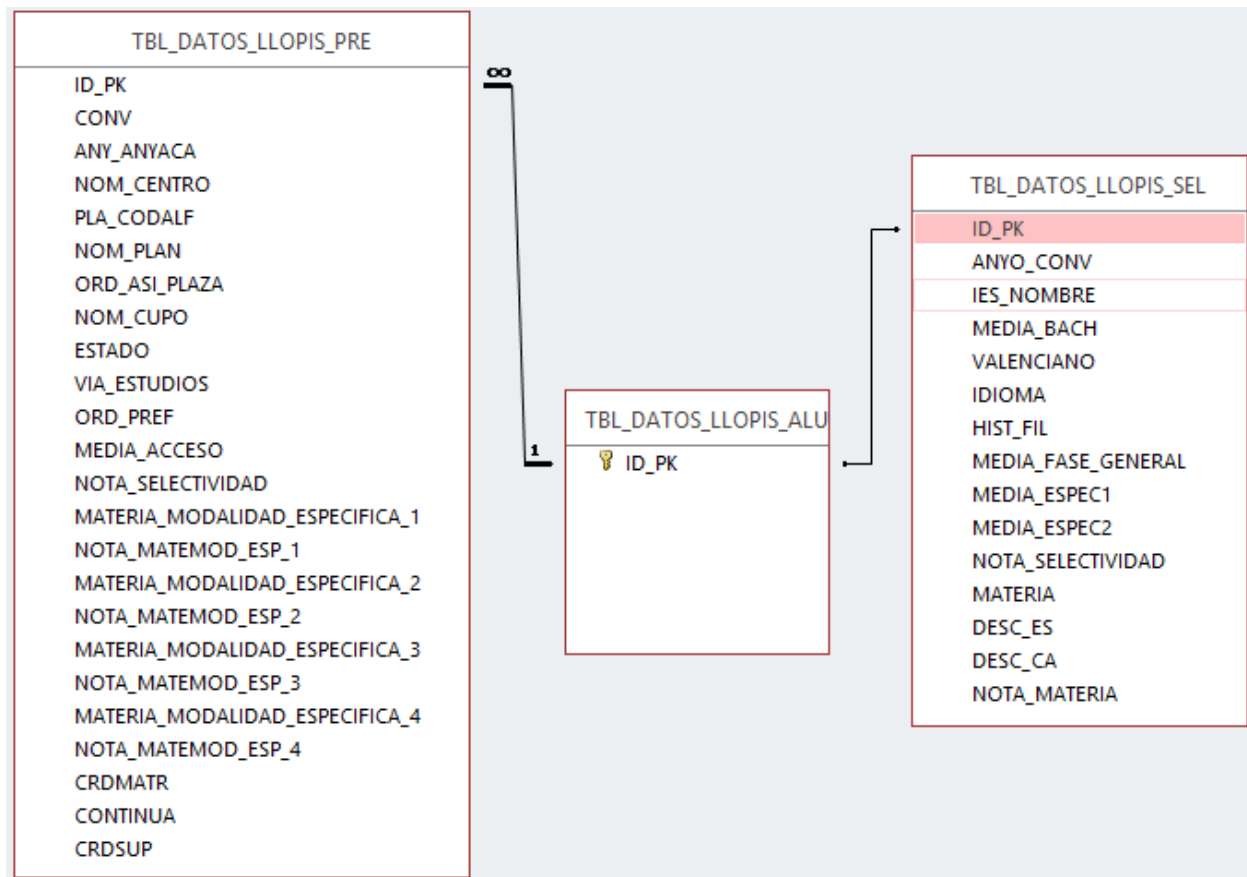


Fig. 1. Entity relationship model of the refined data to be analysed

For statistical purposes the following fields were made use of:

ID\_PK – Student’s unique identification number.

ANYO\_CONV – Entrance year.

ANY\_ANYACO – Academic year.

NOM\_CENTRO – University faculty name.

MEDIA\_ACCESO – Entrance grade (average).

CRDMATR – Credits taken.

CRDSUP – Credits passed.

MEDIA\_BACH – High school graduate grade (average).

DESC\_ES – Entrance exam discipline name (in Spanish).

NOTA\_MATERIA – Entrance exam discipline grade.

The information obtained was sufficient to assess the results of all university entrants in terms of the percentage of the credits passed as to the credits taken. Academic Success and Retention Indices allow early identification of students at risk [15] so the Pass Rates were taken as an important indicator of students’ achievements and can be calculated as follows:

$$\text{Pass Rate} = \frac{\text{Credits passed}}{\text{Credits taken}}$$

$$\text{Average Pass Rate} = \frac{1}{n} \sum_{i=1}^n a_i,$$

where  $a$  is a pass rate.

We started with a correlation research between the high school scores and the first year pass rate in the university irrespective of the study programmes. The correlation was calculated in accordance with the Pearson correlation coefficient as most appropriate instrument [16] to set up direct relationship between absolute values of the variables. For calculation of the correlation coefficient we used the formula below:

$$\text{Correlation} = \frac{\text{Cov}(x, y)}{\sigma_x \cdot \sigma_y}$$

In order to make the information on the university and high school study programmes useful for statistical analysis and comparison we grouped all (42) the Undergraduate Courses at the University of Alicante [17] in three main knowledge/career areas (Table 1):

Table 1

Knowledge/ career area	Department	Undergraduate Courses	Undergraduate Courses
Engineering and Sciences <i>ScienceUA</i>	Escuela Politécnica Superior	GRADO EN ARQUITECTURA	GRADO EN INGENIERÍA MULTI-MEDIA
		GRADO EN ARQUITECTURA TÉCNICA	GRADO EN INGENIERÍA QUÍMICA
		GRADO EN FUNDAMENTOS DE LA ARQUITECTURA	GRADO EN INGENIERÍA ROBÓTICA
		GRADO EN INGENIERÍA CIVIL	GRADO EN TECNOLOGÍAS DE LA INFORMACIÓN PARA LA SALUD
	Facultad de Ciencias	GRADO EN INGENIERÍA INFORMÁTICA	Ingeniería Técnica en Obras Públicas
		GRADO EN MATEMÁTICAS	GRADO EN BIOLOGÍA
		GRADO EN ÓPTICA Y OPTOMETRÍA	GRADO EN CIENCIAS DEL MAR
		GRADO EN QUÍMICA	GRADO EN FÍSICA
	Facultad de Ciencias de la Salud	GRADO EN ENFERMERÍA	GRADO EN GEOLOGÍA
		GRADO EN NUTRICIÓN HUMANA Y DIETÉTICA	
Social Sciences <i>SocialUA</i>	Facultad de Filosofía y Letras	GRADO EN GEOGRAFÍA Y ORDENACIÓN DEL TERRITORIO	GRADO EN HUMANIDADES
		GRADO EN HISTORIA	GRADO EN TURISMO
	Facultad de Derecho	DOBLE GRADO EN DERECHO Y CRIMINOLOGÍA	DOBLE GRADO DADE
		GRADO EN GESTIÓN Y ADMINISTRACIÓN PÚBLICA	GRADO EN DERECHO
		GRADO EN RELACIONES LABORALES Y RECURSOS HUMANOS	GRADO EN CRIMINOLOGÍA
	Facultad de Ciencias Económicas y Empresariales	GRADO EN ADMINISTRACIÓN Y DIRECCIÓN DE EMPRESAS	GRADO EN SOCIOLOGÍA
		GRADO EN PUBLICIDAD Y RELACIONES PÚBLICAS	DOBLE GRADO DIIADE
		GRADO EN TRABAJO SOCIAL	DOBLE GRADO TADE
		GRADO EN ECONOMÍA	
	Facultad de Educación	GRADO EN CIENCIAS DE LA ACTIVIDAD FÍSICA Y DEL DEPORTE	GRADO EN MAESTRO EN EDUCACIÓN INFANTIL
		GRADO EN MAESTRO EN EDUCACIÓN PRIMARIA	
	Humanitarian and languages <i>LinguisticsUA</i>	Facultad de Filosofía y Letras	GRADO EN ESPAÑOL: LENGUA Y LITERATURAS
GRADO EN ESTUDIOS INGLESES			GRADO EN ESTUDIOS FRANCESES
GRADO EN TRADUCCIÓN E INTERPRETACIÓN			GRADO EN FILOLOGIA CATALANA

- The entrants taking career in Natural Sciences (ScienceUA, where UA stands for University of Alicante).

- The entrants taking career in Social Sciences (SocialUA where UA stands for University of Alicante).

- The entrants taking career in Humanities and Languages (LinguisticUA where UA stands for University of Alicante).

We also grouped all high school subjects in three main high school study programmes which mainly

coincide with LOMCE classification [18], although we had to break down Humanitarian and Social Sciences into Social Studies and Humanitarian Studies and Languages which in their turn merged with a few students of Arts (Table 2):

- Engineering and Sciences (ScienceHS where HS stands for high school).
- Social Sciences (SocialHS where HS stands for high school).
- Humanitarian and Languages (LinguisticHS where HS stands for high school).

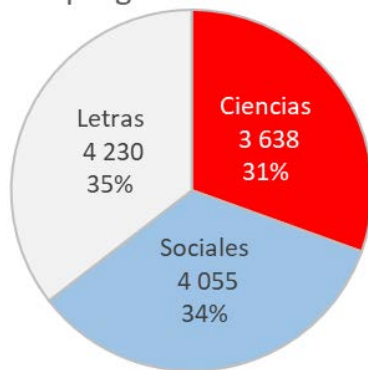
Table 2

Study programm	School subjects		
<b>Natural Ciencias</b> <i>ScienceHS</i>	Matemáticas II	Química	
	Biología	Dibujo Técnico II	
	Ciencias de la Tierra y Medioambientales	Electrotecnia	
	Geología	Física	
<b>Ciencias Sociales</b> <i>SocialHS</i>	Lenguaje y Práctica Musical	Artes Escénicas	Diseño
	Historia de la Música y la Danza	Análisis Musical II	Historia de España
	Técnicas de Expresión Gráfico-Plástica	Dibujo Artístico II	Historia del Arte
	Fundamentos del Arte II	Economía de la Empresa	Geografía
	Cultura Audiovisual II	Tecnología Industrial II	
	Matemáticas aplicadas a las Ciencias Sociales	Historia de la Filosofía	
<b>Humanitarian and Languages</b> <i>LinguisticHS</i>	Inglés	Italiano	
	Valenciano: Lengua y Literatura II	Alemán	
	Castellano: Lengua y Literatura II	Portugués	
	Literatura Universal	Francés	
	Griego II	Latín II	

### ANALYSIS AND RESULTS

Our preliminary analysis demonstrated the distribution of the group of the entrants according to the

HS programme distribution



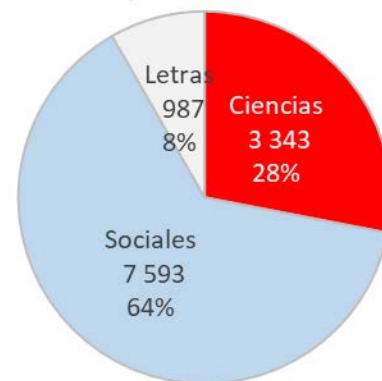
**Fig. 2.** Average High school background share by academic years 2010/11-2016/17

Fig. 2 reveals the fact that the three main high school study programmes are equally presented by the full-time first year undergraduate entrants:

- 34% – (4.055 entrants) Social Sciences (SocialsHS);
- 31% – (3.638 entrants) Natural Sciences (ScienceHS);
- 35% – (4.230 entrants) Humanitarian and Languages (LinguisticsHS).

study courses taken at high school and at the university. Fig. 2 exposes the share of the entrants according to the high school study programmes taken between 2010/11 and 2016/17 academic years.

UA study areas distribution



**Fig. 3.** Average University Career Area share by academic years 2010/11-2016/17

Fig. 3 demonstrates that nearly 2/3 of all entrants enrolled in Social Sciences, the second largest career area is Engineering and Natural Science, while languages represents less than 10% of all the full-time first degree starters:

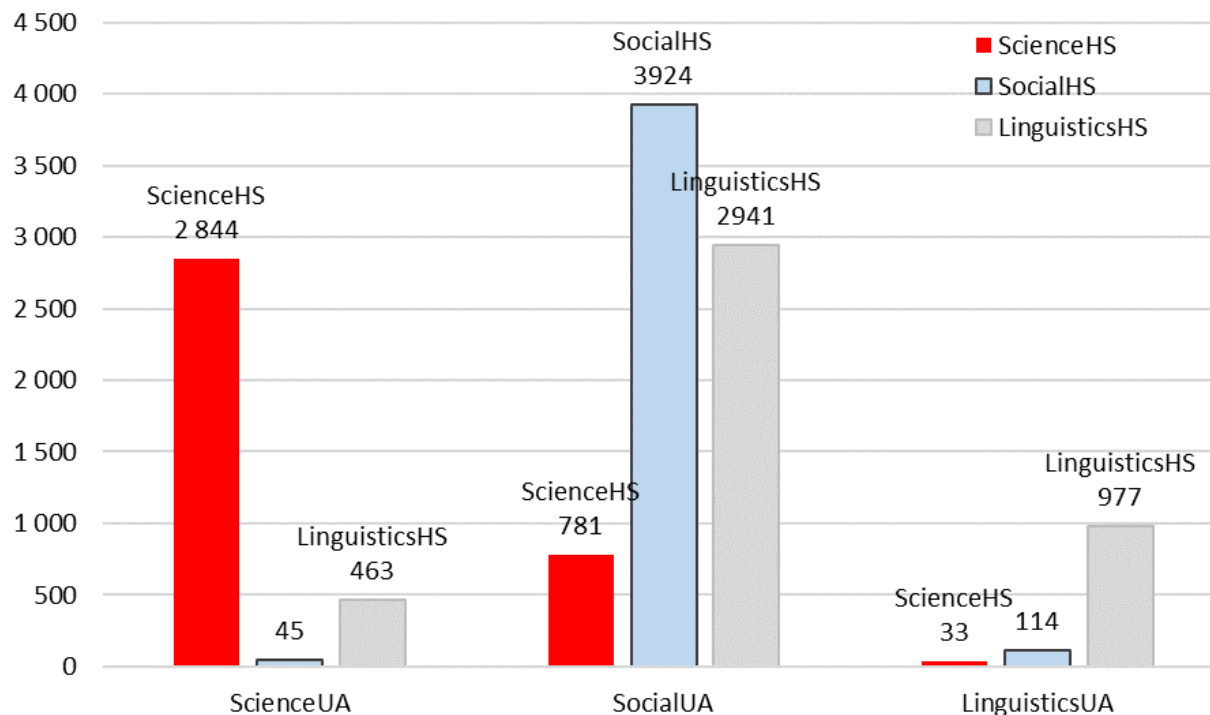
- 64% – (7.593 entrants) Social Sciences (SocialsUA);
- 28% – (3.343 entrants) Natural Sciences and Engineering (ScienceUA);

- 8% – (987 entrants) Humanitarian and Languages (LinguisticsUA).

This result raised a question of how happened that a large number of the former high school students eventually changed their mind and enrolled in

a study course very different from that of the high school.

In order to understand such a phenomenon, a diagram was built of the entrants' choice between the three career areas of the University of Alicante (Fig. 4).



**Fig. 4.** UA study areas formed by the entrants with different high school study programmes

Although this diagram gives us objective information based on the real data provided by the higher education provider we must keep in mind the effect of the individual internal structure as well as the general specialization of the latter which in our case might have influenced the results of the career distribution.

Fig. 4 visualizes the distribution of entrants' types which form the main three UA career areas. More than 96% of the former Social Studies High school students end up within the UA social study area, also significantly pumped up by the entrants from linguistic (2941) and not so much from science (781) high school programmes.

Having identified the groups of the undergraduate entrants as for their high school origin as well as their university study courses we moved on to apply specific indicators. The purpose of the indicators is to provide an objective measure of how the undergraduate entrants pass rates are associated with the assessment score and profile of the high school education.

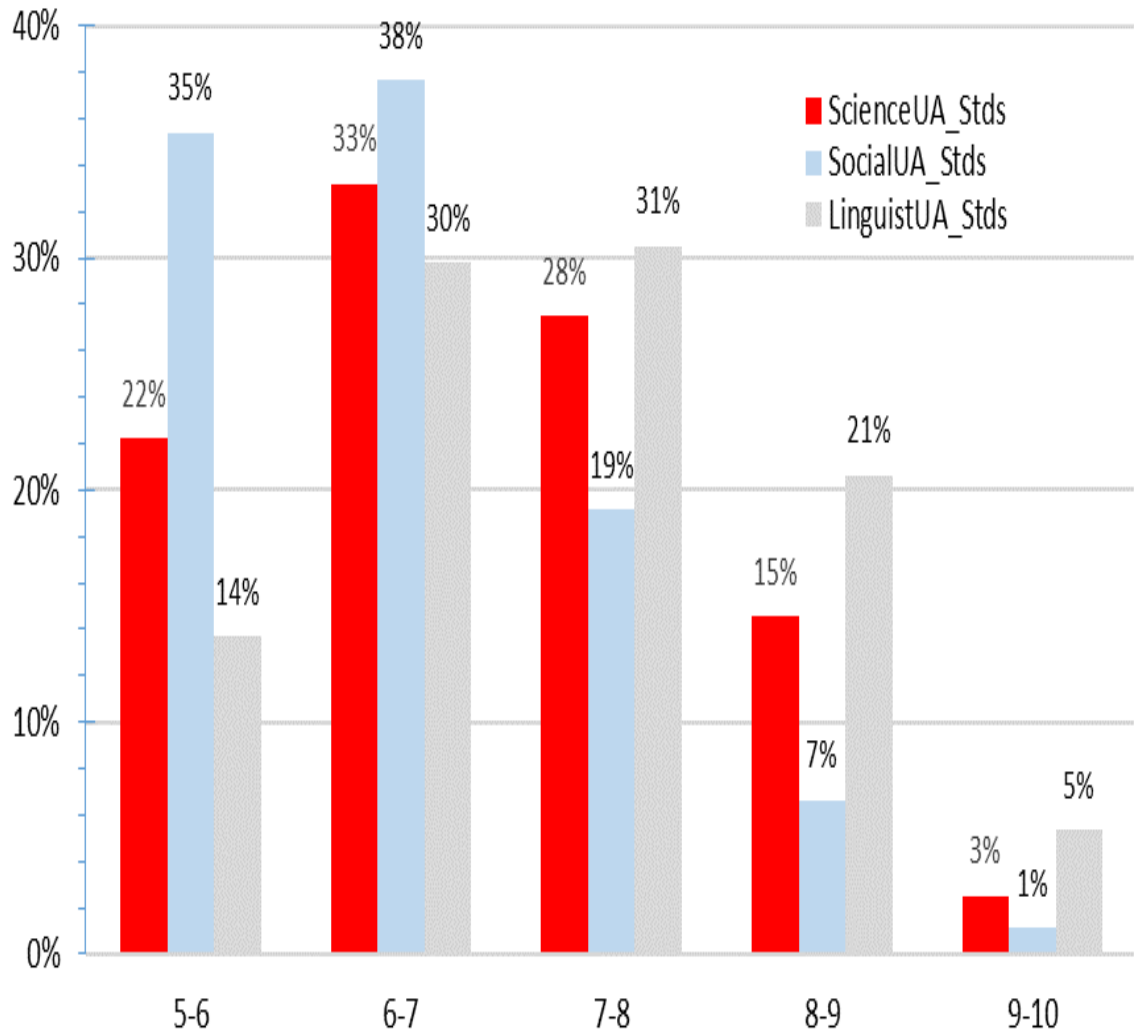
The first key indicator for the rules in a decision making process is the entry score (results). Fig. 5 reveals the number of the entrants enrolled in each of

the three main University study areas divided according to the entry score level. For the qualitative analysis the entry scores (entrance examinations results) were divided into five categories:

- 5-6 – below average;
- 6-7 – average;
- 7-8 – good;
- 8-9 – very good;
- 9-10 – excellent.

Fig. 6 shows the entrance exams score distribution as follows:

- the majority (35%+38%=73%) of the undergraduate entrants in Social Studies scored between 5 and 7;
- a bit more than a half (22%+33%=55%) of the natural sciences/engineering entrants had the entrance score between 5 and 7 and 45% of the entrants scored between 8 and 10;
- nearly a half (14%+30%=44%) of the humanitarian and languages entrants had the entrance score between 5 and 7 and 56% of the entrants scored between 8 and 10.



**Fig. 5.** The entrance exams score distribution

The second key indicator shall reveal which of the university career areas is the most sensible to the high school study programmes? For that purpose, we use the undergraduate entrants pass rates in connection with the entry scores.

In order to quantify the results, we performed a correlation analysis between the high school results (entry scores) and the 1st year pass rate at the university. A correlation of 0.39 has been detected which means that generally speaking the university performance has a very weak correlation with the entry scores and there might be another factor which makes a contribution in the university 1st year pass rate.

Breaking these figures down to high school study programmes level a much stronger positive correlation (0.52) has been detected for sciences and engineering study area which demonstrates its sensibility in terms of the entrants' level of the high school education (based on the entry scores).

Our research has made it obvious that choosing science and engineering turns out to be the most challenging option where the students with a low entry score (between 5 and 6) would pass less than a half (44.30%) of credits taken. The pass rate will also be very low for other two academic areas: social studies (average pass rate 68%) and humanitarian / languages (average pass rate 63%).

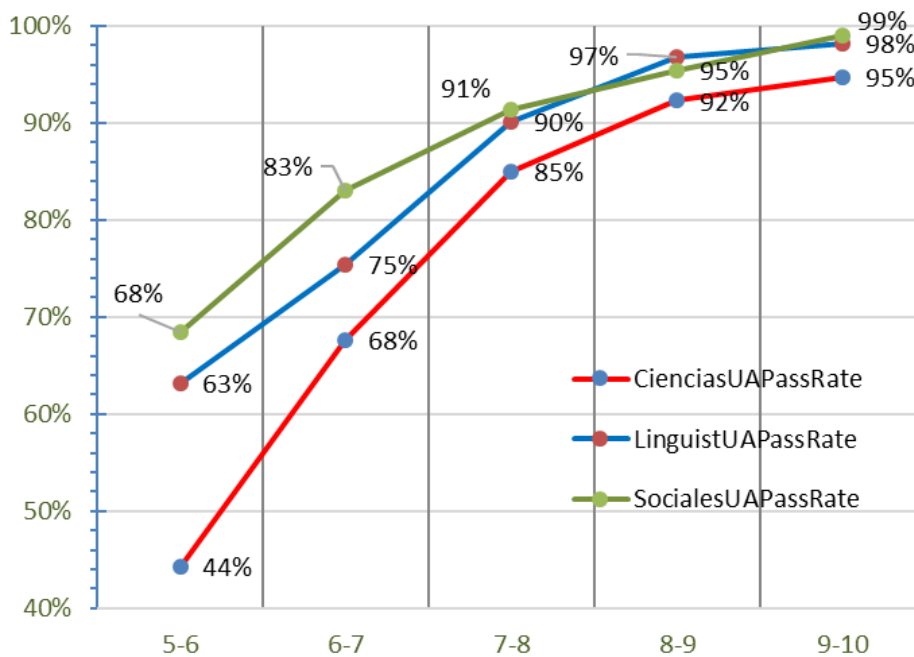


Fig. 6. Pass rate according to the entrance exams score

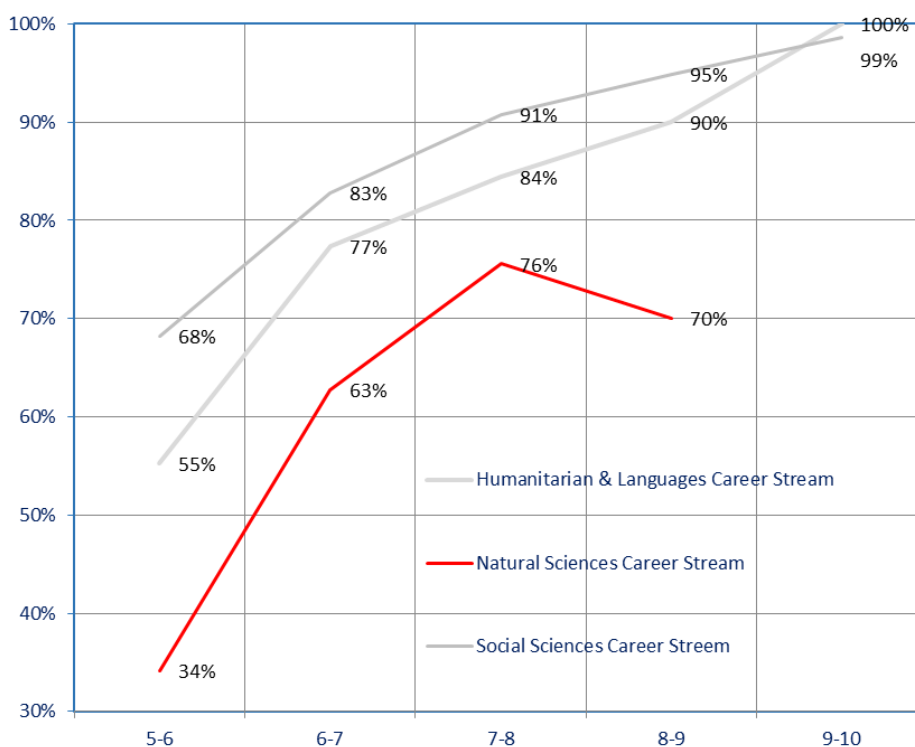
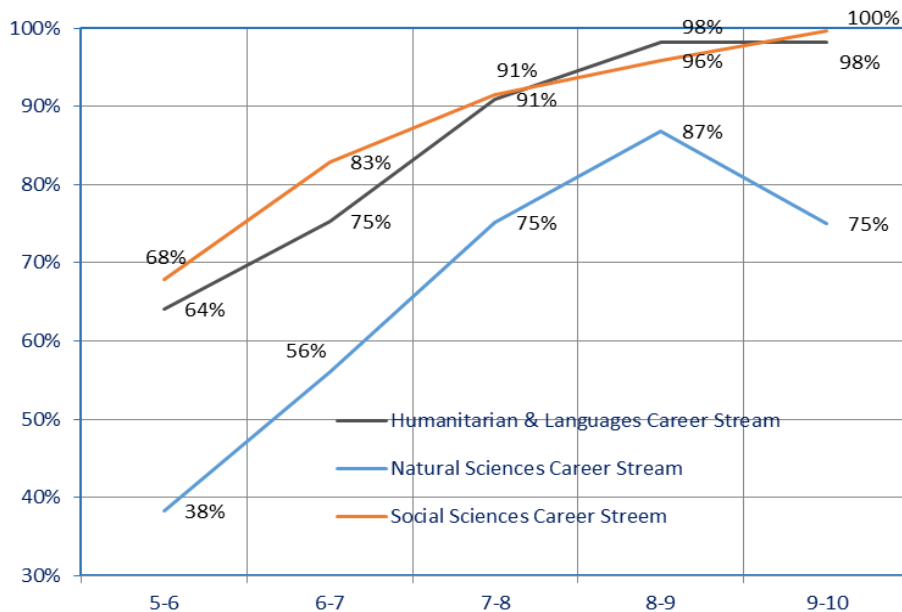


Fig. 7. 1<sup>st</sup> year pass rates according to the three main university study areas for those graduated from High School study programme in Social Studies

Fig. 7 demonstrates the university pass rates according to the entry scores for the entrants with the Social Sciences High School background.

Fig. 8 demonstrates the university pass rates according to the entrance exam score for the entrants with the Humanitarian and Languages High School background.

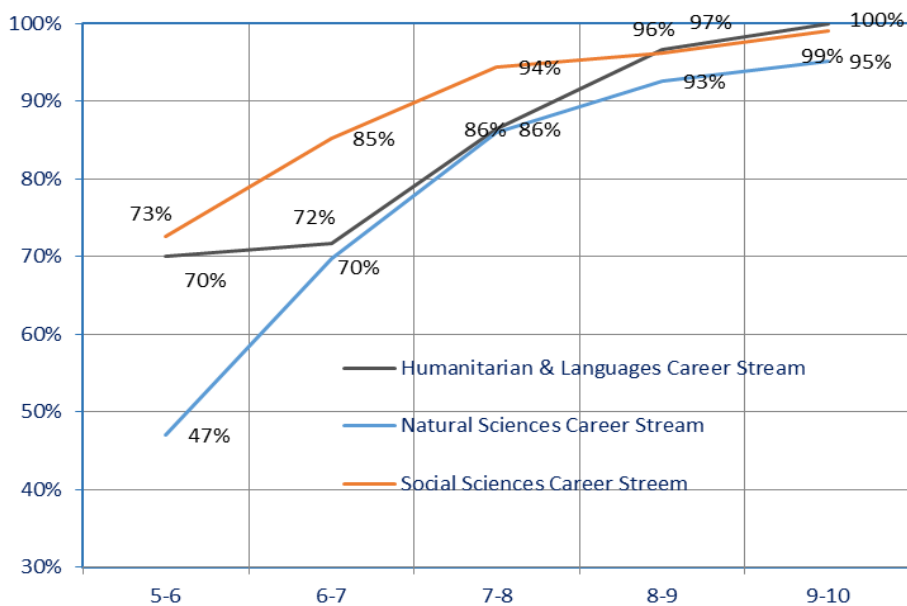




**Fig. 8.** 1<sup>st</sup> year pass rates according to the three main university study areas for those graduated from High School study programme in Humanitarian and Languages Studies

Fig. 9 demonstrates the university pass rates according to the entrance exam score for the entrants with the Sciences High School background. The diagram shows that although this high school study programme is the most universal of all, the enginry

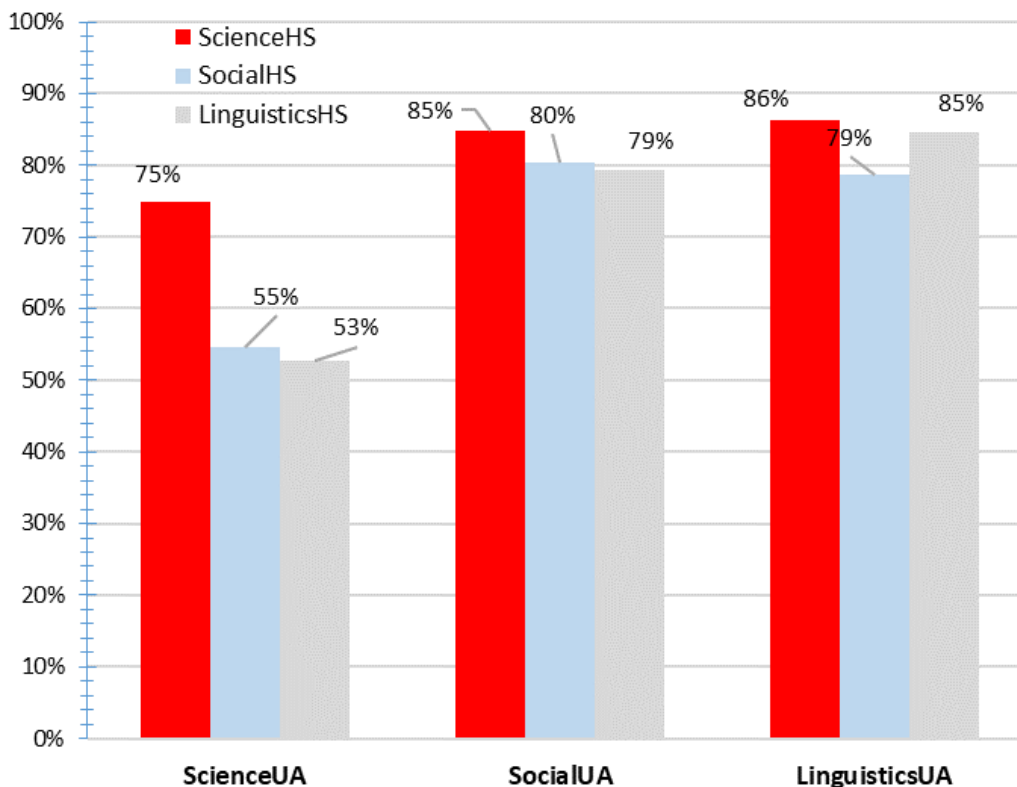
and science might be a very risky career choice even for the students specialized in science with the entry score below 6 - with only half (48%) of the credits passed.



**Fig. 9.** 1<sup>st</sup> year pass rates according to the three main university study areas for those graduated from High School study programme in Sciences

Obviously it will not be too difficult for the university entrants with the sciences high school background to succeed in languages or social sciences starting with the entry score above 5 (with the pass rate above 70%). On the bases of those diagrams above (7-9) we have clearly detected the second key indicator (performance factor) which states that irrespective of the entry score or university study area

an entrant with the High School Study Programme in Science find himself in a better position than any other entrant. Now we would like to demonstrate it on a diagram which does not take into consideration the entry scores so that we could highlight the decisive role of the High School Study Programme (Fig. 10).



**Fig. 10.** The pass rate for each of the UA study area disclosing the pass rate for each high school study programme

Fig. 10 demonstrates that the students with a scientific high school background are better off in all University study areas. The low number (33 students for 6 years - see Fig. 4) of the science students in Humanitarian and Languages area is not enough to formulate a substantial rule. Although it's absolutely clear that the students with a scientific high school background have a noticeable advantage in two core career areas.

### CONCLUSION

The obtained results (Fig. 2, Fig. 3) demonstrate a big share disproportion where the former high school study programme was replaced by a different university career area.

Nowadays there's a growing literature on this topic in higher education where it is commonly referred to as "mismatch". Eventually it may take the forms of a mismatch between expected and real grades, a mismatch between expected and real levels of interest in studying [19] and mismatch between the university skills and the job requirements.

Looking into the greater detail of that phenomenon we discovered that the former Social Studies High school students in their absolute majority had stayed with their high school choice and opted for the UA social study area (Fig. 4). Which was also increased by the entrants from the other two High School study programmes.

A very weak correlation between university pass rates and the entry scores calculated for the whole sample data means that the university performance (pass rates) doesn't depend much on the entry scores but rather on which high school study programme the entrants had.

Social Studies are mainly formed by entrants with the lowest entry score (Fig. 5).

Engineering and natural sciences areas at the university without taking into consideration the high school study programmes of the entrants tends to be most demanding and sophisticated for the 1st year entrants demonstrating the lowest pass rate for all entry scores groups (Fig. 6).

The enginery and sciences area is very risky for the students with that Social Studies high school study programmes. Irrespective of the entry scores results the pass rate doesn't exceed 76%. For those with the entrance score between 5 and 6 and with the pass rate of 38% there's very little chance to successfully end the first year at the university (Fig. 7). It will also be difficult to success in languages passing around a half of all the credits.

The enginery & science is a very risky career for the students with the Humanitarian high school background and with the entrance score below 7. For those with the entrance score between 5 and 6 with the pass rate of 38% there's very little chance to successfully end the first year at the university (Fig. 8).

At the same time the pass rate line for the Humanities & Languages practically coincide with that of the Social Studies.

Even for the entrants with a scientific high school background and a low entrance score (between 5-6) it's very problematic to succeed in the university engineering and science studies, also in all other career areas that shall not cause significant difficulties (Fig. 9).

The university applicants having opted for a 2-years High school study programme in Sciences will have better chances and will be better and universally prepared because of the highest pass rate after the first year at the University irrespective of the entry score or what university study area they have chosen (Fig. 10).

It is also true that the Sciences career area happen to be the utterly complicated for the students without a two years Sciences study programme at school.

Thus, the research has revealed the objective key indicators based on the statistical analysis of the cohort of more than 12 thousand first year university entrants over the last 7 years, which in their turn has made it possible to formulate consistent rules for decisions taking both for the secondary school graduates as well as for the applicants and students of the higher education institution.

This research has demonstrated the utter importance of the High School Study Programme in Sciences irrespective of the future university career choice. We expect that results of the investigation let young people make a weighed and adequate decision at choosing their future career in order to match the individual aspirations and capacities of each person.

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#### METADATA

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**Abstract:** A purpose of this research was to identify the most relevant educational factors for decision making process by applicants for an undergraduate university course. This work is based on the results of the analysis of cohort of 13.487 students of the first year full-time undergraduate entrants' in the University of Alicante taking into consideration the university study areas, the high school study programmes as well as the entrance exams results and credit pass rate of each student. The research proved the scientific high school education to be such a key indicator with the highest relevant school/university performance correlation and securing higher retention rate in the university study areas.

**Key words:** pass rate, drop rate, entrants, study programme, high school background, career choice, decision support system.

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