FACTORS INVOLVED IN THE ACADEMIC PERFORMANCE OF STUDENTS OF TECHNICAL ARCHITECTURE DEGREE FROM THE UNIVERSITY OF ALICANTE

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Abstract

The academic performance of university students is influenced by a wide variety of factors and is one of the main elements which influence students' leaving their university studies. Knowing which factors and, to what extent they may be taking part in students' academic performance, would be of the utmost importance in improving the teaching-learning process, the university excellence and the students' academic performance. It is the aim of this study to identify the potential factors which influence in the academic performance of the students of the degree in Technical Architecture. The study focuses on determining the explanatory and predictive power of seven variables so as to predict the students' academic performance throughout three academic courses. We used the statistical technique of multiple linear regression, in which statistically significant variables and the relative importance each of them has upon the academic performance of students have been identified.

Keywords: academic performance, multiple linear regression, Technical Architecture, construction, building.

1 INTRODUCTION

1.1 Literature review

One of the causes that determine the dropout in university or school teaching is due to poor academic performance [1]. It is not the only one cause since there may be other internal and external conditions affecting equally, such as the personal factor, family, economic, work, etc.

Currently there are many studies and documentation on the factors influencing academic performance of students, being able to have this information would provide an added value to the personalization of education, it could reduce dropout rates, the level of stress among students, improve performance, etc.

Tourón [2] proposes two major factors which affect the academic performance:

- The first refers to the student's (personal) characteristics: previous academic performance or admission tests, aptitude variables (intelligence, reasoning), personality variables, professional interests, personal self-concept, motivation, etc.
- The second focuses on the teaching-learning process: the quality of teachers, teaching methods used, the characteristics of the institution, etc.

Following Montero-Rojas et. al [1] and supplemented by other authors [3] [4], it is possible to expand the list of possible issues or factors which can influence the performance of students:

- Institutional factors: structural and functional characteristics of each institution, academic schedules, the size of groups, library services, institutional environment, etc. may be aspects that influence academic performance.
- Pedagogical factors: the role of the teacher is vital, the methodology or teaching strategy used, the teacher's communication capability, teacher-student relations, interest and motivation of the teacher in teaching, etc.
- Psychosocial factors: student's personal characteristics such as motivation, anxiety, self-esteem in the academic context, interest and aspiration level, intellectual ability, social and study skills, interests of professional projection, attendance and participation in class, etc.

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- Sociodemographic factors: the gender of the student, family economic status, type of school of origin (state or private), parents education level, employment status, etc.

As it is evident, academic performance consists of a large number of multidimensional factors, it is a construct not only made up by the skills and motivation of students, but also influenced by other extrinsic aspects such as teachers, institutional aspects, family, etc.[4].

The concept of academic performance is complex and multidimensional, being closely associated with the result of learning. Normally the indicators to determine the academic performance were the marks obtained by students in specific objective tests. [1] [4]. This criterion may be biased due to the fact that different teachers, subjects, degrees, schools and even universities have very different criteria for the qualification and evaluation of their students. This can significantly affect the calculation of what would be the academic performance.

For this research, it has been adopted as an indicator of academic performance, a measure of achievement in the studies, i.e., the relations between the credits the students have obtained in their studies and those the students had enrolled in. Obtaining a 100% of registered credits means overcoming an important goal, leaving in a second background the average score obtained during the course. On the other hand a low percentage of credits obtained implies poor academic performance, but the marks obtained could have been very high. It is due to this circumstance that the alternative of using academic qualification as an indicator of the academic performance has been ruled out.

This research aims to focus on identifying possible factors which influence academic performance of university students in Technical Architecture degree from the University of Alicante.

1.2 Degree studies in Technical Architecture from the University of Alicante

Technical Architecture Studies are being transformed to current degrees in Building Engineering adapted to European Higher Education Area (EHEA), which means that we face a new system of accumulation and transfer of credits in order to create a standard system of transferable credits at European level, with a more focused approach to student training, measuring the effort they spend promoting their self-learning and encouraging a more active participation thereof.

Through the Resolution published on 17 December 2007 [5] and Order ECI/3855/2007 of 27 December [6] the specific regulations for graduate studies in Building Engineering were published, establishing a syllabus of 240 European credits with 60 credits per academic year. The studies in Building Engineering, as they give access to the regulated profession of Technical Architect should enable the acquisition of those skills necessary for professional practice. This should be done through the acquisition of the knowledge, abilities and skills covered in the syllabus.

In the 2010-11 academic year, the University of Alicante started the first course tailored as grade for Building Engineering studies (later renamed grade in Technical Architecture). During the academic year 2013-14 the four courses, which form the grade, were taught, as the implementation done was progressive. Thus, in this course 2013-14 the first students who began their studies in Technical Architecture grade have graduated.

At this point it is necessary to take stock of the academic performance obtained by students in the degree. Currently, there are already enough enrolment data and evaluation data which allow to characterize the performance of the students and evaluate which aspects may be influential so as to propose solutions of improvement.

1.3 Statement of the problem and objectives

Knowing the factors that may be influencing the academic performance of students of Technical Architecture degree from the University of Alicante can be of vital importance for improving the teaching-learning process. This will help to determine the extent to which the different elements involved in the educational process influence students' learning.

The aim is to study the factors that may influence academic performance of students of Technical Architecture degree from the University of Alicante. Once the factors have been determined, the relevance of each one will be specified in order to establish a predictive model that helps decision making for continuous improvement of the education system.

2 METHODOLOGY

The methodology used is descriptive, correlational and quasi-experimental. Through a survey type instrument for collection of information, the relevant data from the study sample information has been compiled. Sociodemographic and academic data, such as the number of credits registered per course, credits submitted and obtained, the qualifications obtained per subject in each course, etc. (independent variables) have been collected.

After gathering the relevant information, the data were processed using the statistical tool of multiple linear regression to identify which variables and in which way they influence students' performance (dependent variable). Among the statistical techniques used by other authors to determine the academic performance of students, we can mention multiple linear regression, logistic regression, discriminant analysis, or multilevel analysis, etc. [1] [2] [3] [4].

2.1 Description of the context and participants

The population under study corresponds to the students enrolled in the degree of Technical Architecture grade from the University of Alicante during the academic years 2010-11, 2011-12 and 2012-13. The initial sample was filtered to remove students who completed the course of adaptation during those years, as well as students who do not have reliable data for some reason (unsubscribe at midterm, students enrolled who do not attend any subject, etc.). The sample is formed by a total of N = 479 students enrolled in the three courses, 289 men and 190 women. (See Table 1).

Table 1. Distribution of the sample under study

		Academic year		
		2010-11	2011-12	2012-13
Total students		227	129	123
Gender	Males	125	94	70
	Females	102	35	53
Access type	PAU or COU	170	90	97
	FP, FP2 or Module III	50	33	23
	Over 25 years	3	3	2
	Foreign educational systems	3	2	0
	With university degree, or equivalent	1	1	1
Provenance	National	208	121	109
	Foreign	19	8	14

As for the age of the sample, there are outliers, as evidenced in figure 1. In general, the age of women (M = 24.0, SD = 3.8) is lower than that of males (M = 25.7; SD = 5.7) and has lower dispersion. Assuming unequal variances, a test t of Student for differences in means reveals that there are statistically significant differences between the average age of males and females (t = 3.715, df. = 476.85; p < 0.001). During the academic year 2012-13 we can see a wider amplitude than in previous years in age, both of men and women.

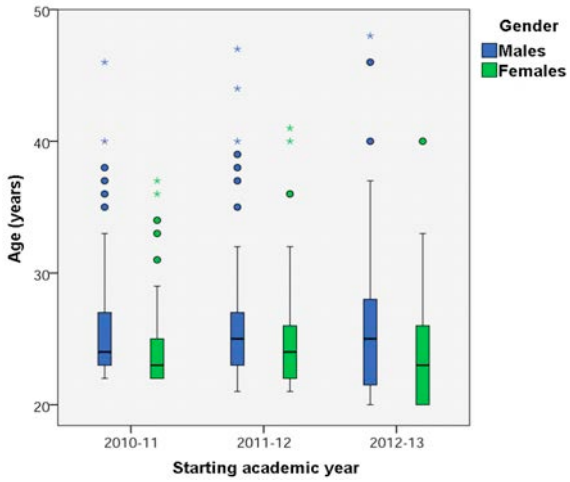

Fig. 1. Box plot as course and gender

2.2 Materials

A database consisting of different information, which has been treated in order to unify and extract the variables under study, has been used. Statistical confidentiality of individuals has been kept at all moments. The original source is divided into several tables, one containing information related to sociodemographic and personal information of students attending the studies of Technical Architecture degree, such as gender, date and place of birth, age, nationality and address. Another table contains general academic information of students, syllabus, course of first registration, type of access to university studies, numerical rating of the grade of access, registered and obtained credits in each academic course, etc. Finally, another table contains the scores obtained by each student in all subjects studied, passed or failed, indicating in which course and period the qualification is obtained, the number of credits of the subjects and whether acknowledgement of the same has been applied for.

Each individual has an associated unique code (academic record) that remains anonymous and that relates data from different tables. In this way, it was possible to calculate the grade for each student in each subject and academic year; enrolled, presented and obtained credits; the rate of performance per course and in all of the studies; and the average grade for all university academic period.

2.3 Instruments

Table 2 defines the eight variables used. The variables gender and nationality are fictitious (dummies), they describe whether or not the individual has a property. For example, the nationality variable has adopted the code 0 for spanish and 1 for foreigners, no matter the country they are from, so it is possible to identify those individuals that have the property of “foreigner” versus those who do not. The gender variable is set to 0 for male and 1 for female.

Table 2. Definition of variables and coding

Variables	Variable name	Measure
Gender: Male (0); Female (1) [var. dummy]	GENDER	Nominal
Nationality: Spanish (0); Foreigner (1) [var. dummy]	FOREIGNER	Nominal
Age (years):	AGE	Interval
Access grade:	ACCESS_GRADE	Interval
University studies average grade:	AVERAGE _GRADE	Interval
Average enrolled credits per course:	ENROLLED_CREDITS	Interval
Percentage of attended credits over total:	PER CENT_ATTENDED	Interval
Performance rate in credits of the studies (%):	STUDIES_PERFORMANCE	Interval

Note: The numbers in brackets show the code; var.= variable; dummy= fictitious variable.

Access grade refers to the numerical score on the entrance examination or average grade of vocational studies. The university average grade is the average of the scores of all subjects passed in any university courses (with scores ≥5 over 10). For its calculation the specifications of Royal Decree 1125/2003 [7] have been considered, that is, the sum of the credits earned by the student multiplied each by the value of the relevant qualifications, and divided by the total number of credits obtained by the student.

The average registered credits per course correspond to the total sum of credits enrolled in each course divided by the number of courses. The percentage of credits presented refers to the relationship between the credits of the subjects to which the student has been submitted to examination, divided by the total number of credits enrolled, as a percentage.

The variable named performance rate in credits (%) refers to the percentage of credits obtained by the student in relation to the number of credits registered by the student for all courses taken (it could also be calculated per academic year). This will be the dependent variable in the regression model and to be referred in the text as “academic performance”.

2.4 Procedures

After preparing the database and calculating the variables under study, using a statistical package we proceed to its descriptive and correlational analysis, calculating the necessary statistics to describe the variables and calculate the Pearson correlation coefficient *r* among those which are measured as interval.

Then we proceeded to conduct a multiple linear regression analysis, identifying those statistically significant variables and establishing the equations of the most interesting models. As dependent variable it was chosen the “rate of performance in credits of the studies” (academic performance), expressed as a percentage, and the other variables will be the independent from the model or predictor models.

3 RESULTS

Table 3 shows the descriptive statistics of the variables under study, with a sample size of $N = 479$ individuals. As to the grade of access, the maximum is greater than 10 points since in selectivity tests it can overcome such status, but the average is 6.76 points, counting the cut-off of 5 for the access to the university studies in this degree. It is to point out the percentage value of the credits that the student takes, reaching an 81%, which is considered positive by the authors. The average of credits registered per academic year is 54.5 credits, a value very close to the 60 credits of each academic year in the curriculum. In terms of performance a low value (in the opinion of the authors) stands out as students pass on average about half of the credits enrolled (56.6% of the total obtained credits).

Table 3. Descriptive statistics for variables of type interval

	N	**Mean**	***SD***	**Min.**	**Max.**	**Skewness**	**Kurtosis**
Age(years)	479	25.01	5.07	20	72	3.15	18.02
Access Grade	479	6.76	1.22	5	11.5	1.02	0.84
Studies Average	479	6.06	0.53	5	8.2	0.62	0.87
Average enrolled credits	479	54.49	8.97	21	75	-1.41	1.91
Percentage credits attended	479	81.18	18.41	20	100	-1.05	0.46
Studies Performance (%)	479	56.59	24.07	7.1	100	-0.11	-0.85

Note: N number of subjects, SD standard deviation, min. and max., minimum and maximum respectively.

3.1 Comparison of means between different genders

It has been carried out an analysis of mean comparison with the variables studied to see if there are differences between groups of men and women (with a confidence level of 95%). There has been a hypothesis test for each variable considering as null hypothesis that the mean scores in males is

greater than or equal to that of females, H_0: $\mu_F \leq \mu_M$. As an alternative hypothesis it is proposed that the mean scores in females are higher than that of males, H_a: $\mu_F > \mu_M$.

As seen in Table 4, the mean scores are higher in females than in males, by Student *t* test it was observed that unilateral meanings are less than 0.05. Consequently, it can be inferred that there are statistically significant differences between males and females, with higher scores on the variables in the latter group.

Although it can be interpreted that the differences are apparently low, they are significant, see grade access variables and average grade of studies. The differences between registered credits per course and the percentage of credits attended are higher in females than in males. In terms of academic performance, females pass nearly 8% more credits enrolled than males.

Table 4. Descriptive statistics for variables of type interval

Variable	Gender	*N*	Mean	*SD*	Test *t*	*df*.	Sig. (1-tailed)
Access Grade	Male	289	6.68	1.13	-1.773 [a]	353,3	0.033
	Female	190	6.89	1.35			
Studies average	Male	289	6.02	0.54	-2.156	477	0.016
	Female	190	6.13	0.49			
Average registered credits per course	Male	289	53.58	9.51	-2.739	477	0.003
	Female	190	55.86	7.90			
Percentage of credits attended	Male	289	79.47	18.37	-2.520	477	0.006
	Female	190	83.78	18.21			
Studies performance	Male	289	54.86	23.71	-1.944	477	0.026
	Female	190	59.22	24.44			

Note: [a] Not assuming equal variances, N number of subjects, SD standard deviation, df. degrees of freedom of the t statistic.

3.2 Correlation coefficients

From the correlational study of the variables (of the 479 individuals) it is drawn that the variables most correlated with performance at university are: the percentage of credits attended ($r = 0.709$; $p < 0.001$) and the average score obtained in the studies ($r = 0.428$; $p < 0.001$). The remaining variables have low correlations near $r = 0.20$ or lower values.

Table 5. Pearson correlation coefficients *r* (*N* = 479)

	Age (years)	Access grade	Studies average grade	Average credits enrolled	Percentage credits attended	Studies performance
Age (years)	1					
Access grade	-0.090*	1				
Studies average grade	0.260**	0.206**	1			
Average credits enrolled	-0.418**	0.115**	-0.135**	1		
Percentage credits attended	-0.213**	0.140**	0.185**	0.091**	1	
Studies performance	-0.060	0.217**	0.428**	-0.098*	0.709**	1

**. Correlation is significant at the 0.05 level (2-tailed).*

***. Correlation is significant at the 0.01 level (2-tailed).*

3.3 Multiple linear regression

Using multiple linear regression by the ordinary least squares method we try to create a mathematical model to predict academic performance from other independent variables. The general equation used is:

$$y = \beta_0 + \beta_1 \bullet X_{1i} + \beta_2 \bullet X_{2i} + \ldots + \beta_k \bullet X_{ki} + \varepsilon$$

where y represents the dependent variable to be predicted, X_{Ki} the score of each individual i in each predictor variable k, β_k are the regression coefficients and ε terms of waste or errors [8] [9].

It was decided to explore the regression with all variables to identify how they relate to each other, besides checking the statistical significance of each variable. It was decided to create a model with all variables regardless of significance (noting the variation in adjusted R^2) and another eliminating those variables that are not statistically significant (criterion $p > 0.05$).

The first model has seven independent variables, including two fictitious type or dummies, and a total of 479 individuals with complete data. The statistical goodness of fit adjusted R^2 gives a value of 0.619, indicating that 62% of the variability of the dependent variable is explained by the independent variables of the model. The statistical F ($F_{0.05\ (7,471)} = 111.75$; $p < 0.001$) allows us to reject the null hypothesis that the regression coefficients are zero, so that at least one of the regressor variables contributes significantly to the model.

In the second model two variables not statistically significant ($p > 0.05$), namely Gender variables ($t = 0.285$; $p = 0.775$) and Foreign ($t = -0.223$; $p = 0.824$) have been eliminated. The statistical goodness of fit adjusted R^2 (0.620) has not been altered by the deletion of the model of these two variables, so one would think that the simplest model is the most appropriate. Statistical F ($F_{0.05\ (5,473)} = 157.05$; $p < 0.001$) equally allows us to say that at least one of the regressor variables contributes significantly to the model.

Table 6. Summary of statistical models ($N = 479$)

Model	R	R squared	Adjusted R Square	Standard error of the estimate
1	0.790	0.624	0.619	14.867
2	0.790	0.624	0.620	14.837

The regression results are shown in Table 7. The standardized Beta coefficients measure the change in the dependent variable (in standard deviation units) produced by a unit change in the independent variable that it accompanies (in standard deviation units) keeping other variables constant. From the analysis of the standardized Beta coefficients, one could say that the most important variables are the percentage of credits attended in the studies ($B = 0.68$) and the average grade of university studies ($B = 0.24$).

If we analyse in detail the model equation 1, it can be seen that the variables with coefficients B positive favourably affect performance (gender, age, access grade, average grade in studies and % of credits attended). That is, being female, older, having obtained high scores on the grade of access or at university and a high percentage of credits attended, predict an increase in academic performance. The variables with negative coefficients (foreign and average registered credits per course) indicate that foreign students have lower performance than national, and that enrolling in too many credits also adversely affects performance.

Model 2 behaves like 1, but excluding the variables of gender or foreign. However, the interpretation of the regression coefficients is the same. As it has fewer variables and maintains the same percentage of explained variability, model 2 is preferred.

The regression equation is expressed as follows, where i is the individual; X_{1i} the age; X_{2i} university access grade; X_{3i} average grade of university studies; X_{4i} average of credits enrolled in university courses; X_{5i} percentage of credits submitted for consideration in their studies.

$$\textbf{\textit{Studies performance} = -95.438 + 0.538} \bullet X_{1i} + 1.825 \bullet X_{2i} + 11.033 \bullet X_{3i} - 0.244 \bullet X_{4i} + 0.894 \bullet X_{5i} + \varepsilon$$

Table 7. Result of regression in models 1 y 2 (*N* = 479)

Model		Unstandardized coefficients		Standardized Coefficients		
		B	Std. Error	Beta	*t*	*Sig.*
1	(Constant)	-95.206	10.531		-9.040	0.000
	Gender	0.407	1.427	0.008	0.285	0.775
	Foreigner	-0.544	2.444	-0.006	-0.223	0.824
	Age (years)	0.543	0.158	0.115	3.435	0.001
	Access Grade	1.813	0.580	0.092	3.127	0.002
	Studies average grade	10.976	1.433	0.240	7.662	0.000
	Average of credits enrolled per course	-0.244	0.084	-0.091	-2.889	0.004
	Percentage of credits attended in studies	0.894	0.039	0.683	22.781	0.000
2	(Constant)	-95.438	10.490		-9.098	0.000
	Age (years)	0.538	0.157	0.113	3.434	0.001
	Access Grade	1.825	0.577	0.093	3.160	0.002
	Studies average grade	11.033	1.419	0.241	7.778	0.000
	Average of credits enrolled per course	-0.244	0.084	-0.091	-2.909	0.004
	Percentage of credits attended in studies	0.894	0.039	0.684	22.869	0.000

Note: Dependent variable: Performance studies. In red variables eliminated in blue the most relevant.

4 CONCLUSIONS

Being able to determine which variables can affect the academic performance of students has great difficulty due to the lack of data to adequately characterize all dimensions that could influence. The family, economic, work, health, social environment data are not usually available on this type of study, but it would be interesting to have them.

That is why we will always be investigating a small part of reality, but one, which will allow us to draw conclusions that could facilitate decision-making in the academic environment.

In relation to the data analysed, it can be concluded that there are statistically significant differences between male and female students at the Technical Architecture degree from the University of Alicante. The group of women have better access grades as well as in university studies, in addition to better academic performance (percentage of credits obtained for those enrolled).

As for academic variables that may be associated with academic performance, it is evident that the most influential are the percentage of credits submitted for consideration in their studies and the average mark obtained in previous university studies. This conclusion is consistent with other studies such as [4]. On the negative side, we emphasize that the greater the number of credits registered for the course the poorer academic performance, which is reasonable, considering that the burden of study and work is very high on technical degrees.

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