



Analysis of the Factors Affecting Academic Performance of Students in Two Portuguese High Schools: School, Family, and Individual Factors

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Abstract. Students' academic performance not only mirrors their learning attainment and learning capability but is also influenced by numerous factors. This paper will concentrate on the analysis of the factors affecting students' academic performance, encompassing external factors such as family background, social environment, etc., and personal factors like commitment of learning time, personal pursuit and aspiration. The aim of this study is to disclose how these factors independently and jointly impact students' mathematical performance, to analyze the factors influencing students' performance through the method of multiple linear regression, and to endeavor to propose targeted improvement strategies based on the findings. These results will offer valuable indirect influences to the normal education decision-makers and teaching practitioners, and provide effective approaches to enhance student achievement.

Keywords: Pedagogy, Education, Academic performance, School support, Parents' Level of Education, Academic failures, Students' academic pursuit, Regression Analysis, Intersection term

1 Introduction

Education is the foundation and pillar for nurturing and developing a country, which can promote an entire nation's social, economic, and political development. Considerable international research focused on the academic achievement of students. Indeed, academic performance has always been a top priority for all sections of society. Schools rely on high-quality students' academic performance to gain prestige and expand enrollment further. Students bring back a report to themselves, their families, and society by achieving excellent educational achievement and acquiring the right to choose their work and studies [1]. What is more, teenagers who have academic obstacles are at greater risk of suffering from unemployment, substance abuse, and even crime [2]. Academic failure is, therefore, among the most unwelcome results. Academic failure commonly manifests as low grades or frequent past class failures. Failure among students is potentially viewed as a 'fault,' in 'deficit, and unsuitable for schooling [3].

In addition to the massive psychological pressure on the students, educational expenditure and resource consumption are significant concerns. For example, Governments often set up designated funding in education to assist students with underachievement. Funds are used to provide supplementary instructional materials, counseling services, and extracurricular programs. The schools establish learning support centers, after-school tutoring, individual education plans, and teacher training. Some figures even indicate that households withstand substantial educational expenditures to improve students' academic achievement or support those experiencing difficulties in learning. In 2021, parents in Japan with kids enrolled in private elementary schools paid the highest annual expenditures for extra tutoring out of the school. The households allocated an average of around 273.6 thousand Japanese yen to cram institution [4]. In 2023, a South Korean high school student budgeted an average of 461,000 South Korean won monthly for private educational expenses. Secondary school students' standard expenditure on private education has steadily risen in recent years[5]. In the same year, private spending on remediation in Singapore totaled 8.91 billion Singapore dollars. Tuition classes are widely available in Singapore, as most parents and kids consider them essential in the intensely competitive educational atmosphere [6].

Over the past decade, a few studies have focused on identifying the variables that lead to differences in academic achievement [7]. The evidence from previous research shows that the contributing elements of failure in school are different and complex. Learning motivation, family atmosphere, government support, and school spirit have all been recognized as influential factors [8]. This study was carried out in two stages. Initially, this writer investigated students' education aspirants, romantic relationships, absenteeism, tutoring expenditure, early childhood education, family structure, and school support and summarized the main factors affecting student performance. Secondly, the author used a regression model to analyze the impact of the following interaction items: extra paid classes, parents' education level, school support, and the number of past course failures.

2 Data

2.1 Data Source and Reliability

The data set is from the UCL Machine Learning Repository. The source of this data is Paulo Cortez, University of Minho, Portugal.

2.2 Interpretation of Variables

The research involved 395 students, aged between 15 and 22, from two Portuguese secondary schools: Gabriel Pereira and Mousinho da Silveira. Data was gathered using school records and questionnaires, with a restriction on collecting personal details such as names. The database contains 30 items that may affect a student's academic performance, measuring three dimensions: internal triggers, familial factors, and school-related features. The variables and their explanations are demonstrated in Table 1.

Those questioned were asked to use a 5-point Likert-type scale to describe their status on the following items: parents' education, commuting time, study time, quality of family relationships, after-school leisure, hanging out with friends, alcohol consumption, and current health status. With regard to the quality of family relationships and health, the meaning of the number 5 is excellent and number 1 means terrible. The remaining items, such as describing time or drinking, on a 5-point Likert-type scale from "highest frequency" (coded 5) to "lowest frequency" (coded 1) (or a rating of 5 reflects the highest frequency, while 1 refers to the lowest frequency.) Noticeably, response options for parental education have been combined to classify and to simplify statistical assessment: higher education (code number: 4), secondary education (code number:3), lower secondary education (code number:2), elementary education (code number:1), and no schooling (code number:0).

Along with responding to the above variables, participants were obligated to provide information to the researchers about their familial structure, reason for choosing this school, school support, romantic relationships, Internet access at home, number of past class failures, attendance rate, and more by answering an additional 20 items. Some questions are dichotomized for experimental purposes into being "yes" (Binary coding 1) or "no" (Binary coding 0).

Table 1. Data Description

Factors	Indicators	Explanations
Family	famsize	family size
	Pstatus	the cohabitation status of parents
	Medu	mother's education level
	Fedu	father's education level
	Mjob	mother's occupation
	Fjob	father's occupation
	famsup	family educational support
	famrel	quality of family relationships (from 1 to 5)
	guardian	student's guardian
Individual	sex	gender of the student
	age	age of the student
	address	home address type
	traveltime	home to school travel time
	studytime	study time per week
	higher	the idea of pursuing an advanced degree
	internet	internet access at home
	romantic	in a romantic relationship or not
	freetime	leisure time after school (from 1 to 5)

	goout	play time with friends (from 1 to 5)
	Dalc	workday alcohol consumption (from 1 to 5)
	Walc	weekend alcohol consumption (from 1 to 5)
	health	health status(from 1 to 5)
School	school	student's school
	reason	reason to choose this school
	failures	number of past class failures
	schoolsup	extra educational support
	paid	extra paid classes within the course subject
	activities	extra-curricular activities
	nursery	attended nursery school
	absences	number of school absences (from 0 to 93)

3 Data Analysis

3.1 Statistics Analysis

The school sample comprised 187 males (47.3%) and 208 females (52.7%). More than half of the students (52.9%) got final grades above average, with a mean of about 10.42. Then, the researcher calculated the means of the learners’ academic achievement in different settings, which are shown in Table 2. Statistical means are presented in Table 2. The average score of higher education aspirants (Higher) in final grades is higher than the overall mean, which is significantly greater than the corresponding figures of those who lack the desire in a college education. Students engaged in a love relationship (Romantic) are also in a disadvantageous position in terms of academic performance. Students participating in extracurricular tutoring (Paid) find it easier to get higher grades, and the same thing happened for children who attended kindergarten (Nursery).

Table 2. Statistical means of the academic achievement in different settings

	Higher	Romantic	Paid	Nursery
Yes	10.61	7.62	10.92	10.54
No	6.80	10.87	9.99	9.95

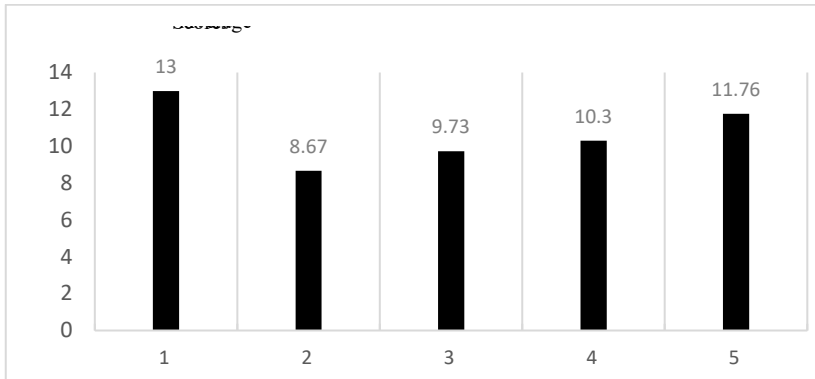


Fig. 1. Average scores of students grouped according to their father's education level

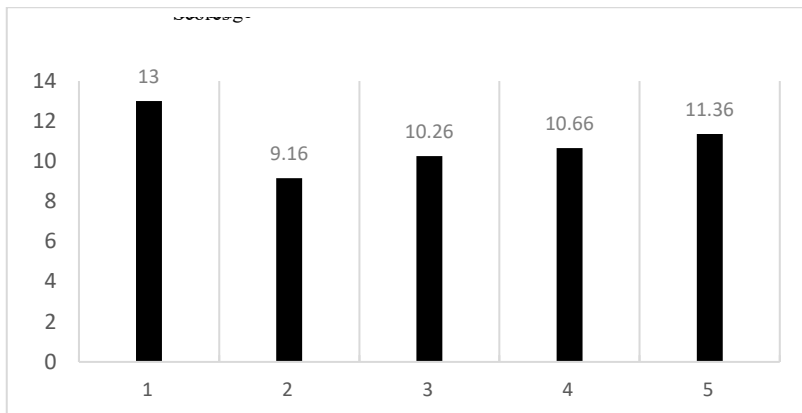


Fig. 2. Average scores of students grouped according to their mother's education level

As demonstrated by Figure 1 & 2. The author found that student achievement was not always positively correlated with parental education. It is noteworthy that when parents have the lowest level of education, their children's academic performance shows the highest peak instead.

3.2 Correlation Analysis

Upon conducting a Spearman's rank correlation analysis, it was observed that certain variables exhibit a significant negative association with G3 academic performance. These include age, travel time to school, and the number of previous academic failures. Conversely, a positive correlation was noted with variables such as the educational attainment of parents, the amount of time dedicated to studying, and the quality of family relationships.

Furthermore, an examination of the correlation matrix among the independent variables(shown in Figure 3) indicated that none of the absolute magnitudes of the correlation coefficients surpass the threshold of 0.7. This finding suggests that multicollinearity is not a concern when formulating a multivariate regression model for further analysis.

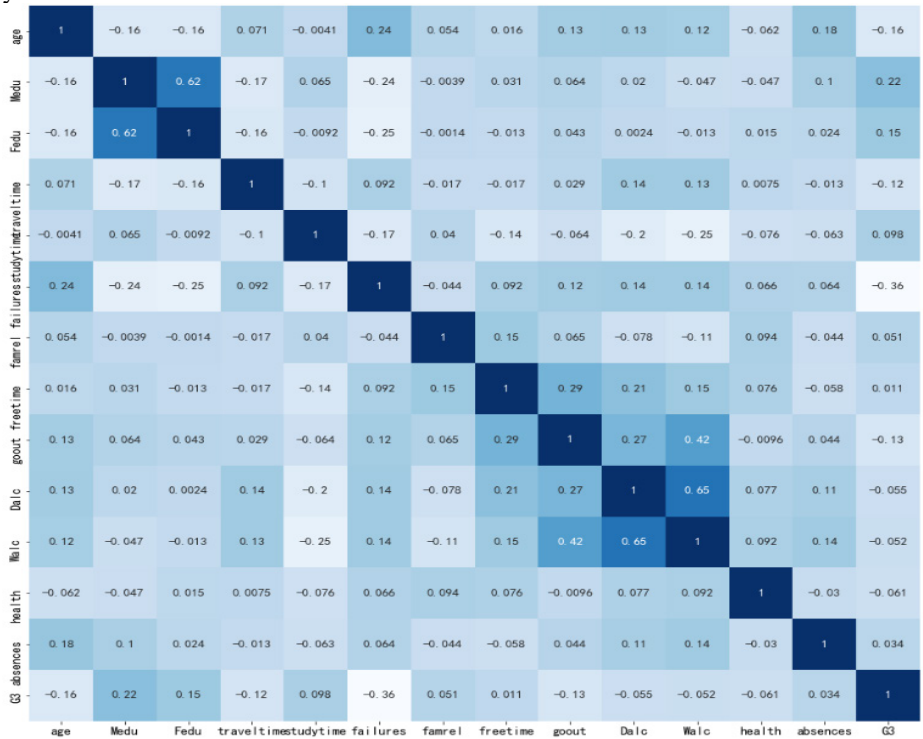


Fig. 3. Heat map of correlation between variables

3.3 OLS Regression Analysis

The regression model is first trained using all available parameters. The Significance of Variables results below show that only the following five variables were shown to be significant (shown in Table 3). Significant effects were found: the number of past class failures (failures) $P=0.000$, going out with friends (go out) $P=0.009$, student's sex (sex_M) $P=0.011$, extra educational support (schoolsup_yes) $P=0.044$, with a romantic relationship (romantic_yes) $P=0.019$. The figures demonstrate that the above factors significantly affect academic success.

Table 3. OLS regression results of the variables

Variables	Coefficients	P-values
Goout	-0.5909	0.009

Failures	-1.7327	0.000
Sex_M	1.2747	0.011
Schoolsup_yes	-1.3488	0.044
Romantic_yes	-1.1060	0.019
Medu	0.4522	0.163
Fedu	-0.1128	0.686
Famsup_yes	-0.8623	0.073
Higher_yes	1.3850	0.200
Internet_yes	0.5125	0.410

Table 4. The regression results of the interaction terms

Variables	Coefficients	P-values
Failures*Medu	-0.5831	0.0400
Failures*Fedu	-1.1074	0.0000
Failures*schoolsup	2.1287	0.0170
Internet*Failures	-1.4522	0.0480
Internet*higher	-1.8178	0.0350

As is evident from Table 4, the regression results of failures*Medu and failures*Fedu indicate that the cross-term of parents' education level and the number of failures exhibits a significantly negative correlation with "student achievement". This might imply that a higher level of parental education has an inhibitory effect on alleviating the negative influence of failing grades. That is, a higher level of parental education negatively affects helping students with more frequent failures to enhance their grades. Secondly, the regression results of failures*schoolsup reveal that the cross-term of school counseling and the number of failures has a significantly positive correlation with student achievement (with a coefficient of 2.1287), suggesting that there exists a positive interaction between the two variables. This might suggest that school counseling has a positive impact on reducing the negative effect of failing grades. Additionally, there is a significantly negative correlation between Internet*Failures and Internet*higher, indicating that having home access to the network negatively impacts the academic performance of students who often fail or those who aim to attain higher education degrees.

4 Result Analysis & Discussion

The majority of prior research into student academic performance has concentrated on variables including socio-economic status, classroom dynamics, gender disparities, parental education levels, and preferences for teaching and learning methodologies [9]. In this study, the researcher maintains that subjective initiative may strongly influence students' academic achievement by comparing average grades. Meanwhile, we should not overestimate the impact of subjective initiative. The author believes three external aspects are worth considering when it comes to academic success. Such factors as romantic relationships, private tuition, and attending nursery have been recognized as potential risks to students' academic success. The uniqueness of this study is that the writer used an interaction experiment to generate new findings on the impact of parental education level, school support, and available internet on the academic performance of young children who frequently pass subjects' failures.

4.1 Parental Education

Many variables, such as learning environment and family environment, have been shown in research to have positive and negative correlations with their learning outcomes. Although Idris M., Hussain S., Nasir A. and others (2020) [10] proposed that children of educated parents outperform their less-educated counterparts since they could do better in their instructional activities and motivate them to study, the author accidentally found that parents with higher education levels have a negative effect on helping students with more failed subjects improve their grades. Parents with high academic qualifications are unsuitable for educating children with low academic levels. Highly educated parents may not be able to really stand in the shoes of underachieving children, resulting in inaccurate parental guidance methods. Thus, the writer suggests that these students should be offered supplemental school support or private instruction.

4.2 School Support

Research shows that school engagement offers the potential to address poor school performance and high dropout rates. School engagement negatively correlates with dropout rates and positively correlates with academic success [11]. The final results of this study reaffirm the above argument, uncovering that supporting student with more failed subjects will be more beneficial to their academic improvement.

4.3 Available Internet

It has been found that social media networks often directly or indirectly necessitate access to information and knowledge attainment, while these networks influence student academic achievement [12]. There is widespread disagreement about whether the

Internet positively or negatively affects academic achievement. From the perspective of this research, what matters most is the student's desire for academic success. Students utilize the Internet to obtain information related to their studies, such as engaging in online classes and browsing scholarly websites, which helps improve their academic performance. However, this depends on the individual's ability to grasp the opportunity to cope with academic-related problems. This study shows that students with more past class failures will experience a more significant decline in their final grades if they have the Internet available at home. Nonetheless, youngsters aspiring to pursue further education have higher grades within the same domestic internet circumstances.

5 Conclusion

The value of students' intrinsic motivation in achieving academic success deserves greater attention, as this learning motivation promotes self-discipline and inspires learners to pursue educational objectives. It is suggested that parents and teachers motivate youngsters to improve their self-agency of studying. Additionally, this study has some implications for educational policies: the government and educational institutions are obliged to prevent earlier romantic relationships and promote accepting early childhood education by formulating regulations.

There are some limitations to this study. Firstly, the study used a questionnaire to investigate students' family situation, learning motivation, and school involvement. Indeed, a more precise comprehension of their surroundings should be achieved by applying more techniques like interviews. Besides, students' responses may be subjective. Hence, it would be more appropriate to incorporate evaluations from parents and educational institutions. Finally, the sample size is relatively small, which may slightly affect the results.

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