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ORIGINAL ARTICLE

Externalities generated by virtual education in the academic performance of students of the faculty of economics (UNSAAC – 2022)

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Abstract
The general objective of this research is to determine how the externalities generated by virtual education are related to the academic performance of the students of the Faculty of Economics (Universidad Nacional de San Antonio Abad del Cusco) in the year 2022, using a quantitative approach as methodology, based on a non-experimental design and with a descriptive correlational scope. The subjects of the study were 252 economics students, and the sampling was simple random. The data collection techniques were the virtual survey by Google Forms. To identify how the externalities generated by virtual education are related to academic performance and whether they have a significant effect on the academic performance of students, the Kolmogorov-Smirnov normality test was applied, since the study sample is greater than 50 and the significance results are 0.000 < 0.05 for each indicator, therefore, we worked with the Rho-Spearman statistic, using SPSS version 26, a p-value of 0.001 lower than 0.05 was obtained. Concluding that there is a significant relationship between the externalities generated by virtual education and the academic performance of the students of Economics - UNSAAC in the year 2022. In addition, it was identified that the social and economic externalities generated by virtual education that are significant in academic performance are the study environment, mental health, resilience, quality of internet connection, time savings, electricity costs, student internet service and investment in computer equipment.

Keywords: Higher education, external effects, social and economic externalities, Internet, computer equipment.

1. Introduction

Education is a right for all with access to quality education (UNESCO, 2021); however, this right was violated, since, at the end of 2019, the appearance of the new corona virus COVID 19, shocked the world, causing changes in the behavior of society, mainly in the educational field, this disease originated in Wuhan-China and was subsequently declared as a pandemic. (Gestión, 2020).

As a result, the Peruvian government ordered the country to enter a state of Sanitary Emergency with COVID-19 prevention and control measures, suspending the start of classes and teaching activities in public and private universities. On March 15, mandatory confinement began for the entire population.

After the confinement, educational institutions that taught face-to-face classes switched to working in an online format, with measures adjusted to the urgency and without any planning (García et al., 2020). After the migration to virtual education, shortcomings were seen in the institutions in terms of infrastructure and academic training for successful online education, exhibiting inequalities among the student population with respect to the digital divide and learning (Alcántara, 2020).

In Latin America, several countries took measures for the management of digital technologies, such as Brazil, Chile, Colombia, Panama, Ecuador, Mexico and Argentina. In Brazil, resources and scholarships for refugee students were increased, financial resilience was promoted and loans were granted for equipment and access to internet use, as well as psychological support and consultations; in Chile, workshops were held on virtual education strategies, the design of a portal with updated information, where medical support is offered; in Colombia, the reduction of tuition fees was promoted and studies in digital environments were strengthened, raising donations to finance students who need it most (Paredes et al., 2020).

At the level of Public University Higher Education in Peru, the teaching-learning process was undergoing serious difficulties because for years there was no investment in a virtual campus, institutional websites, teachers and students had minimal training in the management of ICTs (Ríos , 2020).

At the "Universidad Nacional de San Antonio Abad del Cusco", UNSAAC, the vice rector Edilberto Zela Vera, indicated that 300 students dropped out of their studies due to problems of access to virtual education, increasing the university dropout rate by 5% in the semester 2020-2 (Salcedo, 2020). It is known that UNSAAC hosts students from the provinces and from a low and middle socioeconomic level, with technological limitations without computers, internet service and physical spaces available for studying (Suaste et al., 2020).

Thus, one of the provisions of the Ministry of Education was the implementation of virtual education with the objective of online university teaching or virtual academic training, generating externalities in academic performance. However, it is not perceived how these externalities are related to academic performance.

For this reason, it is proposed how the externalities generated by virtual education are related to the academic performance of university students, both socially and economically, and what is the level of academic performance in the face of the externalities generated by virtual education.

In view of the above, this study is of great importance for public institutions that include students with similar academic background and socioeconomic level, in order to formulate policies, promotion strategies, educational and technological planning. In addition to contributing to the analysis of the performance of university students who are a key factor of economic and social development, taking into account the theories of Higher Education, Human Capital, Economics of Education, Economics of Knowledge, Virtual Education and Externalities; which explain the study to know the relationship of externalities in the academic performance of university students.

2. Materials and methods

A basic type of research was conducted that aims to contribute knowledge to the problem (Hernandéz and Mendoza, 2018), with descriptive scope, non-experimental design and cross-sectional type since the data are collected in a single moment, on the externalities of virtual education in the academic performance of students of the Professional School of Economics of the National University of San Antonio Abad del Cusco in the year 2022.

The study population of this research are the university students of the professional school of Economics, of which a simple random sampling was performed, obtaining as a result 252 university students, the data collection technique was the survey through forms in Google Forms to obtain an adequate record of data, this carried out during the year 2022 . Finally, the processing, analysis and interpretation of the information was carried out with SPSS version 26 statistical software.

3. Results.

After the inferential tests were performed in order to examine the correlations between variables and dimensions, the normality test of the data was analyzed using the Kolmogórov-Smirnov test, since the study sample is greater than 50, with this result the appropriate statistical model was determined and chosen for the inferential analysis of the study.

There are two methods for this test, the Kolmogorov-Smirnov method for large samples (>30) and the Chapiro-Wilk method for small samples (<30).

Then, it is evident that, the database presents a normal distribution or not, when:

a) Significance is 5%, or 0.05
b) If the "p" value is greater than 0.05 ($p > 0.05$), because the data have a normal distribution, Pearson's correlation is used.
c) If the "p" value is less than 0.05 ($p < 0.05$), the data have a nonparametric distribution, Spearman's Rho is used.

Table 1. Kolmogórov-Smirnov normality test, Social Aspects

	Statistician	gl	Sig.
Internal migration	0,454	252	0,000
Study environment	0,239	252	0,000
Household members studying and/or working remotely	0,259	252	0,000
Mental health	0,261	252	0,000
Resilience with respect to virtual classrooms.	0,343	252	0,000
University dropouts	0,535	252	0,000
Student employment	0,341	252	0,000
Opportunity cost between work and study	0,342	252	0,000
Internet access in your study environment	0,525	252	0,000
Internet connection quality	0,296	252	0,000
Level of income received	0,174	252	0,000
Government financial assistance	0,402	252	0,000
Form of government assistance:	0,379	252	0,000
Electric power expenses	0,474	252	0,000
Internet service expenses	0,464	252	0,000
Time savings	0,281	252	0,000
Savings on mobility tickets	0,311	252	0,000
Investment in computer equipment	0,227	252	0,000
Academic Performance (Grouped)	0,318	252	0,000

Source: Own elaboration according to Lilliefors significance correlation.

Table 1 shows the normality test in the indicators of the externalities of virtual education and academic performance, with a degree of freedom greater than 50, therefore, the Kolmogorov-Smirnova statistic is used, consequently, the significance results are $0.000 < 0.05$ for each indicator respectively, therefore, we worked with the Rho-Spearman statistic, because it does not have a normal distribution, to determine the hypothesis test and verify the relationship between the research variables.

Table 2. Rho-Spearman coefficient values

Spearman's Rho coefficient values	Meaning
-1	Perfect and large negative correlation
From -0.90 to -0.99	Very high negative correlation
From -0.70 to -0.89	High negative correlation
From -0.40 to -0.69	Moderate negative correlation
From -0.20 to -0.39	Low negative correlation
From -0.01 to -0.19	Very low negative correlation
0,00	Null correlation
From 0.01 to 0.19	Very low positive correlation
From 0.20 to 0.39	Low positive correlation
From 0.40 to 0.69	Moderate positive correlation
From 0.70 to 0.89	High positive correlation
From 0.90 to 0.99	Very high positive correlation
1,00	Perfect and large positive correlation

Source: Own elaboration according to SPSS Version 26.

General Hypothesis Test

H1: The externalities generated by virtual education are significantly related to the academic performance of the students of the Professional School of Economics - UNSAAC in the year 2022.

H0: The externalities generated by virtual education are not significantly related to the academic performance of the students of the Professional School of Economics - UNSAAC in the year 2022.

Decision rule

If $p \geq 0.05, H_0 is$ accepted

If $p < 0.05$, H_0 *is* rejected

In order to verify the designed hypothesis at a significance level $\alpha < 0.05$, the statistical program (SPSS 26) was used to demonstrate the rho-Spearman hypothesis:

Table 3. Rho-Spearman correlation of the general hypothesis

Correlations				
			(V1)	(V2)
			Externalities generated by virtual education	Academic performance
Spearman's Rho	(V1) Externalities generated by virtual education	Correlation coefficient	1,000	0,579**
		Sig. (bilateral)		0,001
		N	30	30
	(V2) Academic performance	Correlation coefficient	0,579**	1,000
		Sig. (bilateral)	0,001	
		N	30	30

Source: Own elaboration according to SPSS Version 26.

Interpretation:

Note that the "p" value of 3 is 0.001, which is lower than 0.05, so we must reject H0 and accept H1, which indicates a significant relationship between the externalities generated by virtual education and the academic performance of students of Economics - UNSAAC in the year 2022. Similarly, in the Rho-Spearman correlation analysis a result of 0.579 was obtained, indicating a moderate positive correlation, which led to the conclusion that there is a moderate positive correlation and significant between the externalities generated by virtual education and the academic performance of the students of the professional school of Economics- UNSAAC, 2022.

Table 4. Social externalities

			Academic Performance (Grouped)
Spearman 's Rho	Internal migration	Correlation coefficient	0,029
		Sig. (bilateral)	0,642
		N	252
	Study environment	Correlation coefficient	0,188**
		Sig. (bilateral)	0,003
		N	252
	Household members studying and/or working remotely	Correlation coefficient	-0,040
		Sig. (bilateral)	0,526
		N	252
	Mental health	Correlation coefficient	-0,249**
		Sig. (bilateral)	0,000
		N	252
	Resilience with respect to virtual classrooms.	Correlation coefficient	0,315**
		Sig. (bilateral)	0,000
		N	252
	University dropouts	Correlation coefficient	0,118
		Sig. (bilateral)	0,062
		N	252
	Student employment	Correlation coefficient	0,007
		Sig. (bilateral)	0,916
		N	252
	Opportunity cost between work and study	Correlation coefficient	-0,022
		Sig. (bilateral)	0,733
		N	252
	Internet access in your study environment	Correlation coefficient	0,027
		Sig. (bilateral)	0,667
		N	252
	Internet connection quality	Correlation coefficient	0,139*
		Sig. (bilateral)	0,027
		N	252
	Academic performance (Grouped)g	Correlation coefficient	1,000
		Sig. (bilateral)	0.000
		N	252

Source: Own elaboration

Table 4 shows the level of significance of social externalities on academic performance:

- With respect to the internal migration of economics students; in the question if during virtual classes the student returns to his/her place of origin, a significance level of 0.642> 0.05 was obtained, so the variable is not relevant or does not influence academic performance. Similarly, in the Rho-Spearman correlation analysis, a result of 0.029 was obtained, indicating a very low positive correlation between internal migration generated by virtual education and the academic performance of the students of the professional school of Economics- UNSAAC, 2022.
- In the level of accessibility to an adequate study environment, a significance level of 0.003 < 0.05 was obtained, so the variable is relevant and does influence academic performance, according to the Rho Spearman Correlation Coefficient, the value is 0.188, that is, the level of correlation is very low positive, which means that the higher the level of accessibility to an adequate study environment, the higher the level of performance.
- According to the number of members who study and/or work in the student's home remotely, a significance level of 0.526> 0.05 was obtained, so the variable is not relevant or does not influence academic performance, likewise, in the Rho-Spearman correlation analysis a result of -0.040 was obtained, indicating a very low negative correlation.
- With respect to the level of student mental health, which includes problems of motivation, stress,

worry and mental exhaustion, a significance level of 0.000 < 0.05 was obtained, so the variable is relevant and does influence academic performance; likewise, in the Rho-Spearman correlation analysis a result of -0.249 was obtained, indicating a low negative correlation; therefore, the greater the student's mental health problems, the lower the academic performance.

- According to the resilience scale with respect to the virtual classes, a significance level of 0.000 < 0.05 was obtained, so the variable is relevant and does influence academic performance, in addition, the Rho Spearman Correlation Coefficient has a value of 0.315, i.e. the correlation level is low positive, so the higher the student's resilience, the higher the academic performance.
- With respect to university dropout of economics students, a significance level of 0.118> 0.05 was obtained, so the variable is not relevant or does not influence academic performance, likewise, in the Rho-Spearman correlation analysis a result of 0.118 was obtained, indicating a very low positive correlation.
- According to the level of employment of economics students during virtual classes, a significance level of 0.916> 0.05 was obtained, so the variable is not relevant or does not influence academic performance, likewise, in the Rho-Spearman correlation analysis a result of 0.007 was obtained, indicating a very low positive correlation between the level of employment during virtual education and academic performance.
- In reference to the opportunity cost during virtual classes, if the student preferred: work, study or work and study at the same time, a significance level of 0.733> 0.05 was obtained, indicating that the variable is not relevant or does not influence academic performance, likewise, in the Rho-Spearman correlation analysis a result of -0.022 was obtained, indicating a very low negative correlation.
- With respect to Internet access, a significance level of 0.667> 0.05 was obtained, indicating that the variable is not relevant or does not influence academic performance. Similarly, in the Rho-Spearman correlation analysis, a result of 0.027 was obtained, indicating a very low positive correlation between the degree of Internet access in virtual education and the academic performance of the students.
- According to the quality of Internet connection, a significance level of 0.027 < 0.05 was obtained, so the variable is relevant and does influence academic performance. Similarly, in the Rho-Spearman correlation analysis, a result of 0.139 was obtained, indicating a very low positive correlation, that is, the higher the quality of Internet connection, the higher the academic performance of the students.

Table 5. Economic externalities

			Academic Performance (Grouped)
Spearman's Rho	Level of income received	Correlation coefficient	-0,078
		Sig. (bilateral)	0,218
		N	252
	Government financial assistance	Correlation coefficient	0,024
		Sig. (bilateral)	0,704
		N	252
	Electric power expenses	Correlation coefficient	-0,215**
		Sig. (bilateral)	0,001
		N	252
	Internet service expenses	Correlation coefficient	-0,155*
		Sig. (bilateral)	0,014
		N	252
	Time savings	Correlation coefficient	0,159*
		Sig. (bilateral)	0,012
		N	252
	Savings on mobility tickets	Correlation coefficient	0,076
		Sig. (bilateral)	0,229
		N	252
	Investment in computer equipment	Correlation coefficient	-0,188**
		Sig. (bilateral)	0,003
		N	252
	Academic Performance (Grouped)	Correlation coefficient	1,000
		Sig. (bilateral)	0,000
		N	252

Source: Own elaboration.

Table 5 shows the level of significance of economic externalities on academic performance:

- With respect to the level of income that the student perceives, a significance level of 0.218 > 0.05 was obtained, so the variable is not relevant or does not influence academic performance. Similarly, in the Rho-Spearman correlation analysis, a result of –0.078 was obtained, indicating a very low negative correlation between the level of income perceived by the student and academic performance.
- In reference to whether the student received any governmental financial aid, a significance level of 0.704 > 0.05 was obtained, so the variable is not relevant or does not influence academic performance; furthermore, in the Rho-Spearman correlation analysis a result of 0.024 was obtained, indicating a very low positive correlation.
- According to the behavior of the electric energy expenditure, a significance level of 0.001 < 0.05, so the variable is relevant and does influence academic performance, likewise, in the Rho-Spearman correlation analysis a result of –0.215 was obtained, indicating a low negative correlation, which means that the higher the expenditure on electricity, the lower the academic performance, which could be due to several factors, since increasing the expenditure decreases the family income, causing a greater pressure on the student who would have to work.
- According to the behavior of the expenditure on Internet service, a significance level of 0.014 < 0.05 was obtained, so the variable is relevant and does influence academic performance. Similarly, in the Rho-Spearman correlation analysis, a result of–0.155 was obtained, indicating a very low negative correlation which means that the higher the expenditure on Internet service, the lower the academic performance, which means that the income of the student's family could decrease and cause greater pressure on the student who would have to work.
- With respect to time savings during virtual classes, a significance level of 0.012 < 0.05 was obtained,

so the variable is relevant and does influence academic performance. Similarly, in the Rho-Spearman correlation analysis, a result of 0.159 was obtained, indicating a very low positive correlation, which means that the greater the time savings, the greater the academic performance, since students could take advantage of this extra time to study and research.

- With respect to savings in mobility tickets, a significance level of 0.229 > 0.05 was obtained, so the variable is not relevant or does not influence academic performance; likewise, in the Rho-Spearman correlation analysis, a result of 0.076 was obtained, indicating a very low positive correlation.
- In reference to the investment in computer equipment to participate in virtual teaching, a level of significance of 0.003 < 0.05 was obtained.05, then the variable is relevant and if it influences academic performance, likewise, in the Rho-Spearman correlation analysis a result of –0.188 was obtained, indicating a very low negative correlation, which means that the higher the student's investment in computer equipment, the lower the academic performance, since by investing more money students could feel pressure and would have to work, since being a student of a public university, probably the family income is not so high, so the state could intervene through subsidies, bonuses, programs, etc.

4. Conclusions

In the research, it was determined that the most relevant externalities in the social sphere that influence academic performance are: accessibility to the study environment, level of mental health of the student, level of resilience, quality of internet connection; which have a significance value of 0.003, 0.000, 0.000, 0.027 and a low positive correlation level for accessibility to the study environment (0.188), level of resilience (0.315) and Internet connection quality (0.139), with the exception of mental health which had a low negative correlation (-0.249). Likewise, the most relevant externalities in the economic sphere are: expenditure on electricity, expenditure on internet service, time savings and investment in computer equipment; with a significance value of 0.001, 0.014, 0.012, 0.003 and a very low level of negative correlation: expenditure on electricity (-0.215), expenditure on internet service (-0.155), investment in computer equipment (-0.188), with the exception of time savings, which had a very low positive correlation (0.159).

The externalities in the social sphere that virtual education generates in the students of the Professional School of Economics - UNSAAC in the year 2022 were identified, the most outstanding is the accessibility to the study environment, 42.9% have a good study environment; likewise, 44.4% indicated that virtual education influenced their mental health regularly, resilience where 62.7% of students consider themselves to be resilient regularly, the quality of internet connection 57.5% indicated having a regular quality of connection.

Regarding the economic externalities generated by virtual education in the students of the Professional School of Economics - UNSAAC in the year 2022, the most relevant is the expenditure on electricity, 78.2% indicated that they increased their expenses, 75.8% of students indicated that they increased their expenses, with respect to time savings 43.7% of students indicated that they decreased their time savings and according to the investment in computer equipment 34.5% indicated that on average they invested between s/.500 and s/.1500.

In relation to the level of academic performance in virtual education in the students of the Professional School of Economics - UNSAAC in the year 2022, 62.3% have a regular or average level of performance, according to the feeling of technological mastery, satisfaction with virtual education and participation and interaction in classes. Likewise, there is a significant relationship between the externalities generated by virtual education and the academic performance of students with a moderate positive correlation of 0.579.

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