

Analysis of the academic performance of students from a higher education institution in Ecuador, before and during the pandemic

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Abstract- The coronavirus SARS-CoV-2 pandemic dramatically changed daily activities globally. In the field of higher education, many universities had to carry out their functions in virtual mode. The National Polytechnic School is an Ecuadorian university, the study modality of which stayed face-to-face in more than 150 years of history. However, since the pandemic, said university had to adapt all its classes to the virtual modality. In this study, we conducted a comparative analysis of academic performance between students who entered to the university leveling course during the pandemic and those who did so before the pandemic. To do this, we analyzed the information of 9,267 students who entered the institution for the first time between 2017 and 2020. We carried out a Variance Analysis the factor of which was the study modality, and then we carried out a Tukey post hoc test to identify homogeneous groups. The results showed that the students who entered the leveling course in virtual mode presented an academic performance significantly higher than the historical academic performance of the students who had face-to-face classes. Nevertheless, results do not necessarily indicate that the students of that period and modality have obtained more knowledge. These findings coincide with some authors who establish that the academic performance of university students is not a reference for cognitive evaluation in all its magnitude, since this process causes the labeling of them, the subjects, and the teachers themselves, placing them in a range evaluation that can determine the capacity, effectiveness, and quality of the teaching-learning process.

Keywords: *Academic performance, Covid -19, Data Analysis*

1. INTRODUCTION

On January 30, 2020, the World Health Organization declared the COVID-19 pandemic a Public Health emergency, which to date has affected many people worldwide (World Health Organization, 2020). The new coronavirus SARS-CoV-2, responsible for the COVID-19 disease, has spread throughout the planet, adding more than 3 million deaths and about 146.4 million infected, registered until May 25, 2021 (Johns Hopkins University, 2021). The aggressiveness of the virus and its easy transmission has forced the activities that take place in society to move to a space that minimizes face-to-face interaction. In the case of education, according to data from the United Nations Educational, Scientific and Cultural Organization (UNESCO),

in mid-May 2020, in the Latin American and Caribbean region, more than 160 million students of all educational levels, had stopped having face-to-face classes at school (ECLAC-UNESCO, 2020).

The Economic Commission for Latin America and the Caribbean (ECLAC) (2020) indicated that, even before facing the pandemic, the social situation in the region was deteriorating, due to the increase in poverty and extreme poverty rates, the persistence of inequalities, and social growth. In this sense, the impact of the pandemic has had significant negative effects on different social sectors, particularly health and education, as well as on employment and the fight against poverty.

In this context, the education system is going through a critical situation, a product of the COVID-19 pandemic, which has particularly affected students in the face-to-face study modality. Even so, educational institutions have developed strategies to give continuity to academic programs through a change of modality towards virtual education, which, in parallel, has presented drawbacks such as the lack of resources, especially technological, on the part of students, reflecting the economic constraints they face that limit their access to connectivity and digital media to their homes. This, together with mandatory social isolation as a preventive measure, directly influences the performance of students in virtual environments, in the emotional sphere, and in the student's family environment (D'Amelio et al., 2020).

However, it is remarkable that in many cases the virtual teaching-learning offered by most Higher Education Institutions (IES) has allowed students to improve their academic skills and competencies, creating the basis for constant personal growth, allowing students to at the same time, promote self-management, critical reflection and the autonomy of the student in pursuit of their integral development, preparing them to face life, with constructive and positive thinking, tending to success in their professional, personal and family training (Parada & Pérez, 2014).

A similar investigation in (Benítez & Cabrera, 2021) determined that the averages of the marks obtained from the cohort May 2020 - 2021 with virtual modality due to the pandemic, were better by 52.52% compared to the previous cohort, which was in person. However, the perception of the students showed that the conferences, collaborative works, workshops, laboratories, and clinical cases were better oriented and with greater participation of the students in person, so an advantage is the saving of time when receiving the classes at home and the disadvantage is that there were shortcomings at the practical level as mentioned.

The increase in the use of digital technologies was fundamental in virtual education, which was intervened by strategies based on systems programmed to face complex realities such as academic evaluations, but which should be strengthened especially those that correspond to the institutional technological environment, with accessibility. And use of the Internet by students (Paredes Chacín et al., 2020).

Thus, the work carried out by IES is part of one of the six guiding principles to face the crisis of COVID-19 in higher education, as indicated by UNESCO and the International Institute of Higher Education in Latin America and the Caribbean (IESALC), which refers to the fact that "the resumption of face-to-face activities in IES should be seen as an opportunity to rethink and, as far as possible, redesign the teaching and learning processes, taking advantage of the lessons that the intensive use of technology may have meant, paying special attention to equity and inclusion "(Ordorika Imanol, 2020).

Although universities and students are clear about the importance of virtual training, the facilities and flexibility that this modality allows, we must be aware that not all fields and careers can transfer all their subjects to the virtual world. These careers that present disadvantages with the virtual are mainly technical, scientific, or health careers, in which practical learning is the pillar of teaching and the key to being able to exercise them. Perhaps, in the first two years of these careers, it is possible to work virtually, since in technical careers specialization practices are minimal. It is possible that the student can have online material to know how to carry out different procedures, but in the end, it takes practice to learn how to do it and perfect it. It is also true that there are still some details to be clarified in virtual training, especially about the student's experience and the interaction with other participants, at this time it is difficult to transfer the practical learning experience to virtual classrooms (Universia.net, 2020). In this context, in the case of the National Polytechnic School (EPN), in Quito-Ecuador, the study modality has always been face-to-face, until the moment when the pandemic began, where drastically the semester of the first period of 2020 was developed virtually. The EPN offers degrees in physical and mathematical sciences, economics, technical and technological engineering, the virtual transformation of which had not been fully implemented. To access the mentioned careers, new students must pass the regular leveling course developed by the Basic Formation Department of the same university. The EPN leveling course includes in its academic program the subjects: Mathematics, Geometry, Physics, Chemistry, Language and Communication, which must be fully approved by students, to be promoted to the first level of the career they have selected for their professional training, as established in the Regulations of the Academic Regime (CES., 2019). The virtual modality

represented a risk, but at the same time a challenge, for the authorities, teachers, and students of the institution, since there was no previous, adequate, and timely intervention for the virtual learning environments, having to adapt, suddenly and strategic, content and activities that can fit into virtual classrooms, providing the virtual spaces necessary for interaction between teachers and students.

2. CONTEXT

The information analysis is carried out on a total of 9,267 who entered the EPN leveling course, between 2017 and 2020. During each school year, the institution opens two quarters called A and B, with the 2020-A quarter being the first that was fully developed online, due to the health emergency caused by COVID-19. Table 1 shows the distribution of study participants.

The method used was an exploratory and descriptive analysis of the data obtained before the pandemic (2017-A to 2019-B), to which the ANOVA analysis of variance was performed and then the Tukey post hoc test to identify homogeneous groups and compare them with the academic performance of students enrolled by subject in the academic period 2020-A in virtual mode. In which, the Tukey test provides a global significance level of α when the sample sizes are equal and of α at most, when they are not equal.

Table 1: Distribution of the study participants.

Period	Modality	Number of students
2017-A	Face-to-face	1505
2017-B	Face-to-face	1373
2018-A	Face-to-face	1344
2018-B	Face-to-face	1413
2019-A	Face-to-face	1237
2019-B	Face-to-face	1071
2020-A	Virtual	1324
	Total	9267

A. Measurements

The final score of 40 points was determined, obtained by the students in each of the leveling subjects - Mathematics, Geometry, Physics, Chemistry and Language and Communication - in each of the academic semesters; The grade reflects the results of the students' work during the semester, through the delivery of assignments and assignments, as well as the completion of tests and exams.

Likewise, the students who passed the leveling course were identified based on their final grade of 40 points, in accordance with the provisions of the EPN Academic Regime Regulations and will include the number of necessary subsections in each section.

B. Procedure

The information used in this study was obtained from the databases of the Directorate of Information Management and Processes of the EPN. The data of all the students considered in

the research was managed based on institutional confidentiality agreements, which contemplate the processing of information for purely investigative purposes. In this study, only aggregated and anonymous information is presented.

3. DESCRIPTION

A descriptive analysis of the percentage of approval of the leveling course was carried out, depending on the face-to-face and virtual modality, as well as an independence test between the period of admission to the leveling course and approval. In addition, an analysis of the variance of a factor of the final grade was carried out, of each one of the subjects of the leveling course, between each academic semester. Finally, a post hoc Tukey test was performed to identify homogeneous groups. All analyzes were performed with a significance level of 5% and were performed in SPSS V22.

4. RESULTS

Figure 1 shows the percentage of students who passed and failed the remedial course, according to the type of study. It is appreciated that the percentage of approval in the virtual modality is practically double that in the face-to-face modality.

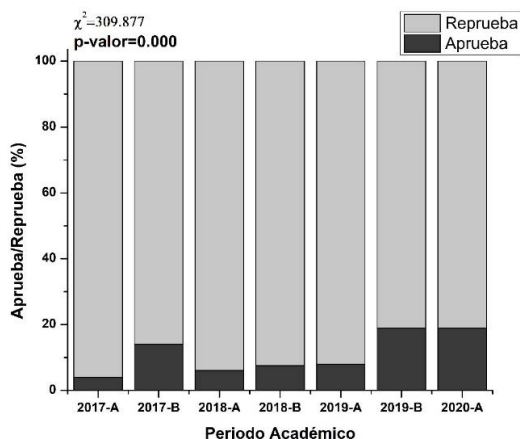


Figure 1. Percentage of approval and failure of the leveling course, according to the type of study.

On the other hand, Figure 2. Shows the results of the independence test carried out between the period of admission to the leveling course and approval. At a significance level of 5%, approval is not independent of the starting period of the leveling course, and it is observed that the highest historical approval percentage, corresponding to 25.2%, occurred in the 2020-A semester, which was carried out in virtual mode due to the health emergency caused by COVID-19.

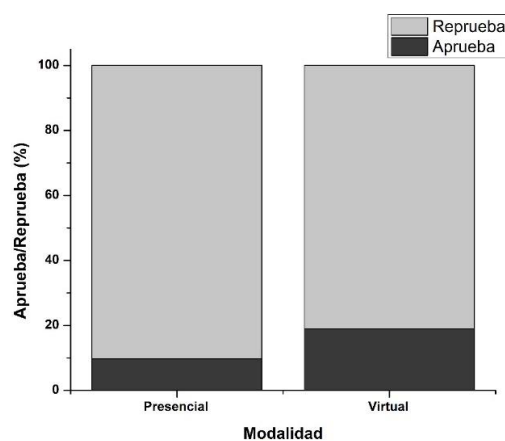


Figure 2. Pass and fail percentages in the leveling course.

Figure 3 shows the graph of means of the final grades in the subjects of the leveling subject, for each academic period.

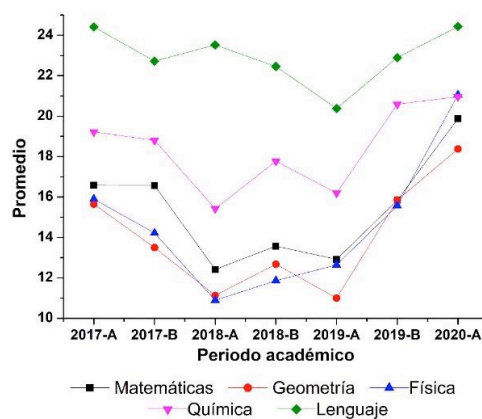


Figure 3. Graph of means of the marks of the subjects of the leveling subject, in each academic period.

It is observed that in the period 2020-A the highest value of the mean was obtained for each of the subjects.

These findings are compared with the information presented in Table 2, where it is shown that, indeed, there are significant differences between the performance of the students in each of the academic periods.

Table 2. Results of the ANOVA of a factor of the final grade of each one of the subjects of the leveling course

		F	Next
Mathematics	Between groups	87.935	.000
	Inside the groups		
	Total		
Geometry	Between groups	100.843	.000
	Inside the groups		
	Total		
Physics	Between groups	196.320	.000

Chemistry	Inside the groups		
	Total		
	Between groups	47.970	.000
Language	Inside the groups		
	Total		
	Between groups	22.395	.000

To determine between which academic periods there were significant differences in final grades, a Tukey test was performed, the results of which are presented in tables 3 to 7.

Table 3. Results of Tukey's test of the final grade in Mathematics.

Start of the Semester	N	Subset for alpha = 0.05		
		1	2	3
2018-A	1343	12.4208		
2019-A	1237	12.9224		
2018-B	1411	13.5714		
2019-B	1071		15.8381	
2017-B	1369		16.5733	
2017-A	1341		16.5955	
2020-A	1324			19.8835
Next		0.063	0.489	1.000

Table 4. Results of the Tukey test of the final grade in Geometry

Start of the Semester	N	Subset for alpha = 0.05			
		1	2	3	4
2019-A	1237	11.001			
2018-A	1343	12.130			
2018-B	1413	12.677			
2017-B	1373	13.499			
2017-A	1413		15.648		
2019-B	1071		15.848		
2020-A	1324			18.379	
Next		1.000	.327	0.999	1.000

Table 5. Results of the Tukey test of the final grade in Physics

Start of the Semester	N	Subset for alpha = 0.05				
		1	2	3	4	5
2018-A	1343	10.892				
Next		6				

2018-B	1413	11.860	11.860			
2019-A	1237		12.645			
2017-B	1373			14.220		
2019-B	1071				15.568	
2017-A	1433				15.899	
2020-A	1324				21.052	
Next		.078	.264	1.000	.964	1.000

Table 6. Results of the Tukey test of the final grade in Chemistry

Start of the Semester	N	Subset for alpha = 0.05			
		1	2	3	4
2018-A	1344	15.424			
2019-A	1237	16.196			
2018-B	1413		17.774		
2017-B	1373		18.802	18.802	
2017-A	1193			19.227	
2019-B	1071				20.592
2020-A	1323				20.961
Next		.542	.196	.955	.978

Table 7. Results of Tukey's test of the final grade in Language

Start of the Semester	N	Subset for alpha = 0.05		
		1	2	3
2019-A	1237	20.3832		
2018-B	1381		22.4627	
2017-B	1371		22.7225	
2019-B	1071		22.8960	
2018-A	1343		23.5252	23.5252
2017-A	960			24.4170
2020-A	1321			24.4344
Next		1.000	.134	.295

5. CONCLUSIONS

Among the measures adopted by universities, worldwide, it is observed that many have adopted mechanisms to promote virtual education, as is the case of the Pedagogical and Technological University of Colombia (UPTC), which promoted academic connectivity from the homes of students. The students, allowing the communication to interact more easily and thus improving the assimilation of the knowledge imparted by the teachers, who used tools according to the need. Therefore, this institution considers that social confinement

meant a change in the students' lifestyle, which should be studied to determine the influence that isolation had on their academic performance and their family environment (Valdivieso et al., 2020).

Regarding the results of the first case with undergraduate students, 50% of the competencies have been enhanced in the face-to-face and virtual modalities. In the second case with undergraduate students, the learning activities developed virtually received a good weighting, after incorporating good learning practices in the writing of these activities. The results of the two cases confirm the hypothesis that virtual education is a means to improve both skills and learning in university students (Durán, 2015).

Another study shows results of the effectiveness of virtual teaching delivered in the three modalities: online, offline and in the medium (distance, face-to-face, and blended), where students had a similar performance, which means that learning can have the same success in any of the three modalities, provided that the techniques and methodologies used by teachers are of quality, added to a process of adequate and timely academic accompaniment (Yen et al., 2018).

Likewise, other research shows that a sequential, well-structured, and organized teaching methodology, in addition to the appropriate technology for the development of virtual classrooms, gives rise to the construction of knowledge with new content during workspaces. To achieve this, technological tools were used that encouraged the active participation of students, with a broader thought that allowed them to solve problems originating within their virtual classes. In fact, it is shown that the academic performance had high achievements and this is attributed to the interaction carried out in the virtual spaces that the students were able to experience, where they also had the opportunity to develop interpretive skills of texts and contents, of each of the subjects, which implies the continuity of autonomous and collaborative methods in the new teaching-learning model, using the precise technological tools for the correct functioning of the system during the time of transition in health that the world is going through (Durso et al., 2020).

According to the results of the research, regarding the homogeneity of the grades obtained in the subject of Language and communication, in the students of the leveling courses in the period 2017-2020; Due to the nature of the subject, it belongs to the social sciences and therefore does not correspond to the exact sciences group, which allows students to have more response options to an assessment, expressing more fluently the concepts related to the subject, to develop logical thinking and skills that contribute to the strengthening of memory, verbal expression, attitudes and behavior.

This is based on some data that shows that students achieve important competencies within the learning process since it allows the development of both cognitive and linguistic skills, which are expressed within a space of consensus to achieve the objectivity of science, being able to interpret and argue the contents and texts with greater freedom, through oral and written language. Likewise, from the logical theory of research, the products of the human mind are influenced by language, since the human being can reach high levels of understanding for subjective and objective knowledge, which means that to keep knowledge alive, the use of language in its two forms is important (Martínes et al., 2013).

Although the results of the academic performance for the period 2020-A, of the virtual education, show higher grades compared to the previous periods where the education was face-to-face, this does not necessarily indicate that the students of that period and modality have obtained more knowledge. Some authors agree that the academic performance of university students is not a reference for cognitive evaluation in all its magnitude, since this process causes the labeling of them, the subjects, and the teachers themselves, placing them in an evaluation range that can determine the capacity, effectiveness, and quality of the teaching-learning process. However, criteria of difficulty of the subjects can also be presented, observing in the opposite case that a student with a low performance fails and a subject with a low average may be more important in the study plan. For this reason, they mention that the rating is an evaluation mechanism that requires verification of the personal capacities of the students and that in reality, a value does not express their cognitive level, since the application of a traditional evaluation system contrasts with the true capacity of students (Rojas Betancur & González, 2009).

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