ACADEMO
Revista de Investigación en Ciencias Sociales y Humanidades
ISSN 2414-8938. Vol. 12 Nro. 1, 2025.

ORIGINAL ARTICLE

https://doi.org/10.30545/academo.2025.n1.1108

Factors influencing the academic performance of Students in the Mechanical Engineering Program at FIUNA during the pandemic

Factores que influyen en el rendimiento académico de los estudiantes de la carrera Ingeniería Mecánica de la FIUNA durante la pandemia

Aida Ayala [1], Cecilia Domínguez[1], Dirse Martínez[1], Pablo Ramírez[1], Diego Villar[1]

[1] Universidad Nihon Gakko, Programa de Doctorado en Ciencias de la Educación. Asunción, Paraguay.

Abstract

This study analyzes the factors affecting the academic performance of Mechanical Engineering students at FIUNA during the pandemic in 2020. The methodology used is observational, quantitative, and retrospective, with a sample of 66 students from the program. It focused on various aspects related to the virtual mode of classes, such as characteristics, challenges, and experiences. The results of the institutional survey conducted with students through a 5-dimensional questionnaire reveal formal aspects associated with learning, teaching for learning, assessment for learning, communication, and technological tools. The research highlights that university students face challenges such as academic pressure, time management, and financial limitations, especially in a pandemic context. The results reveal weak correlations between academic performance and the dimensions analyzed; however, there are other factors influencing students' individual skills and capabilities in their evaluative process. Likewise, teacher preparation in the use of technological tools for virtual learning is fundamental. Understanding the intricacies of students is crucial for developing effective strategies that support their academic journey and future success.

Keywords: *University students, academic performance, pandemic, COVID-19.*

Resumen

Este estudio analiza los factores que afectan el rendimiento académico de los estudiantes de Ingeniería Mecánica de la FIUNA durante la pandemia, 2020. La metodología utilizada es observacional, cuantitativa y retrospectiva, con una muestra de 66 estudiantes de la carrera. Se enfoca en diversos aspectos relacionados con la modalidad virtual de clases, como características, retos y experiencias. Los resultados de la encuesta institucional realizada a los estudiantes mediante un cuestionario de 5 dimensiones revelan aspectos formales asociados al aprendizaje, enseñanza para el aprendizaje, evaluación para el aprendizaje, comunicación y herramientas tecnológicas. La investigación destaca que los estudiantes universitarios enfrentan desafíos como la presión académica, la gestión del tiempo y las limitaciones financieras, especialmente en un contexto de pandemia. Los resultados revelan correlaciones débiles entre el rendimiento académico y las dimensiones analizadas; sin embargo, existen otros factores que afectan a las habilidades y capacidades individuales de los estudiantes en su proceso evaluativo. Así mismo, es fundamental la preparación del docente en el uso de herramientas tecnológicas para el aprendizaje virtual. Comprender las complejidades de los estudiantes es crucial para desarrollar estrategias efectivas que apoyen su trayectoria académica y éxito futuro.

Palabras clave: *Estudiante universitario, rendimiento académico, pandemia, COVID-19.*

Correspondence: Diego Villar (diegofvillar@gmail.com)
Article received: May 31, 2024; accepted for publication: September 23, 2024; published: January 8, 2025.
Conflicts of Interest: None.
Funding Source: Self-funded.

Responsible Editor: Herib Caballero Campos. Universidad Americana. Asunción, Paraguay.

Website: http://revistacientifica.uamericana.edu.py/index.php/academo/

Introduction

Advances in information and communication technologies (ICT) have had a remarkable impact on the educational field. These advances have led to the emergence of new approaches in teaching and learning processes, such as online learning, blended learning, and distance learning, among others (Eryilmaz, 2015, as cited in Ferrer Dávalos, 2021).

Learning through technology has gained popularity and is seen as a valuable complement to modern teaching. However, studies should evaluate the benefits of using technology in enhancing students' knowledge and skills, rather than focusing solely on student satisfaction with the use of technology as a learning supplement (Back et al., 2014, as cited in Ferrer Dávalos, 2021).

During the COVID-19 pandemic, university classes were primarily conducted virtually. A study by the United Nations Children's Fund (UNICEF) supported this trend and also highlighted the existence of inequalities in access to the tools and technologies required for adequate remote education (UNICEF, 2020; Minaya, 2022).

In Europe, technological advances have impacted pedagogical processes in higher education, particularly student performance. However, the rise of ICT and virtual environments has posed challenges for traditional universities in delivering their content during the teaching-learning process (López et al., 2013, as cited in Minaya, 2022). A study in Spain highlights the importance given to virtual education, as seen in initiatives such as the e-Europe Plan. Within the framework of the European Higher Education Area (EHEA), requirements emphasize centering teaching and learning processes on fostering competencies and strategies aimed at developing students' study skills and autonomous learning abilities (Cano & Hernández, 2018, as cited in Minaya, 2022).

The Ministry of Education (MINEDU, 2020, as cited in Minaya, 2022) of Peru issued guidelines regarding virtual education during the COVID-19 pandemic. A non-presential or remote educational service was implemented. As a result, the Educational Quality Statistics program (ESCALE) of MINEDU's statistics unit estimated that around 1,200,000 indigenous students could not access nearly 27,000 educational centers offering intercultural bilingual programs. Moreover, advantages and challenges were observed in virtual education due to errors in the execution of platforms and technological tools that affected academic performance. Consequently, Peru ranked 64th out of 67 countries in the Programme for International Student Assessment (PISA) evaluation (La República, 2021, as cited in Minaya, 2022).

Gutiérrez Monsalve et al. (2021) presented a methodology to identify variables related to university academic performance (AP) in a cohort of students from 2014 at a private university in northwestern Colombia. Canonical discriminant analysis and logistic regression were employed using only information from the university's administrative systems to determine the association between pedagogical, institutional, and sociodemographic variables and low AP. The discriminant analysis successfully classified 100% of students with low AP based on institutional and sociodemographic variables, whereas pedagogical variables only showed adequate discrimination in the Faculty of Law. Logistic regression revealed significant associations between low AP and students' academic trajectory, receipt of scholarships, repetition of courses, and the number of canceled subjects. In conclusion, discriminant analysis and logistic regression proved effective in classifying and explaining factors related to low university academic performance.

García et al. (2022) conducted a study to analyze digital academic factors influencing increased academic performance during the COVID-19 period in Mexico.Technological factors related to improvements in online class grades were identified using a multiple linear regression model. The results revealed that certain digital factors were significant in the coefficients of the predictive model, including email-based classes, development of case studies, digital presentations, and internet resources suggested by instructors. Other digital factors contributing to better academic performance included subjects taught via platforms such as Teams, computer use, access to information technologies (IT), video-based explanations, evaluation methods, and note-taking. In

conclusion, students' academic performance during the COVID-19 pandemic depended on the digital tools they used in the learning process.

In Paraguay, Ferrer Dávalos (2021) states that advances in ICT have generated new approaches in educational processes. The arrival of COVID-19 forced educational institutions in Paraguay to abruptly shift from face-to-face to virtual modalities without prior experience.Comparisons of student academic performance before and during the pandemic show mixed results. In one subject, no significant changes in performance were observed, but participation and engagement in virtual classes increased. In another subject, performance varied, but no major differences were seen in platform usage. These results suggest that, under suitable conditions, virtual classes can be as effective as face-to-face classes, although larger studies are needed to draw definitive conclusions.

The COVID-19 outbreak caused significant changes in higher education, particularly in teaching and learning modalities, leading to the widespread implementation of remote learning. Mechanical Engineering students at the Faculty of Engineering of the National University of Asunción (FIUNA) were directly affected by this shift. The abrupt transition to virtual learning, which included the adoption of online platforms and the suspension of in-person activities, created various challenges and obstacles for their academic performance.

Concept of Academic Performance

According to Bonilla (2015, cited by Chasco et al., 2017), academic performance is defined as the level of knowledge expressed as a numerical grade obtained by a student as a result of an evaluation measuring the outcome of the teaching-learning process in which they participate.

For Soza Mora (2021), academic performance results from a combination of diverse and complex factors influencing an individual's learning process. It is defined by a numerical assessment attributed to the student's achievement in academic tasks, reflected in the grades obtained. These grades indicate passed or failed subjects, dropout rates, and the level of academic success achieved.

Factors Associated with Academic Performance in Higher Education

According to Soza Mora (2021), the study of factors influencing students' academic performance is of great importance due to societal demands for producing highly competent and academically excellent professionals. Academic performance is a complex, multi-causal phenomenon influenced by various factors and temporal contexts within the learning process. There are different aspects related to academic performance, both internal and external to the individual, encompassing categories such as personal determinants, social determinants, and institutional determinants.

Over time, students' performance has been impacted by diverse factors, and it is recognized that the causes of academic success or failure are varied, involving personal, social, and cultural aspects. The quality of student academic performance can vary depending on the circumstances and environment in which they are situated, encompassing socioeconomic, pedagogical, and institutional factors, among others (Soza Mora, 2021).

The transition from secondary to higher education represents a critical period that can affect academic performance. By the end of the first or second year at university, it is possible to evaluate the successful or problematic resolution of this transition, and it is common for obstacles or changes to arise in the educational process (Soza Mora, 2021).

It is important to consider demographic, social, and economic factors, as well as the student's adaptation to new teaching-learning methods in higher education. Not only academic skills, but also non-academic elements such as socialization, engagement, and social and cultural capital, can influence academic performance (Soza Mora, 2021).

Personal determinants include individual aspects and interactions that may condition academic success or failure, such as study habits, class attendance, participation, and interpersonal relationships. Internal variables related to academic performance can be grouped into three distinct categories (Soza Mora, 2021):

1. Personal factors**:** include conditions and cognitive competence, motivation, academic self-concept, perceived self-efficacy, psychological well-being, class attendance, aptitudes, and pre-university academic training.
2. Social elements**:** consider social differences, family environment, parents' educational level, and demographic variables.
3. Institutional elements**:** encompass students' choice of study programs, the complexity of their studies, institutional conditions, the student environment, and the student-teacher relationship.

Educational quality must take academic performance into account, as it is an essential component for evaluating whether an institution meets its educational objectives. Academic performance is a complex variable influenced by factors such as psychological characteristics, self-esteem, efficacy, focus on learning comprehension, socio-familial elements, and pedagogical aspects. Students' academic performance is a crucial indicator of the academic work of educational institutions at all levels. It has been emphasized that academic performance is the combination of multiple factors, including sociodemographic, psychosocial, pedagogical, institutional, and socioeconomic elements, such as motivation, anxiety, perceived academic climate, enthusiasm, the teacher's role, and sense of purpose. Given the diversity of factors related to academic performance, continuous research and accurate data are required to make institutional decisions (Soza Mora, 2021).

Dimensions in the Study of Academic Performance

For a better understanding, the concepts of the dimensions under study related to the educational performance of university students are developed as follows:

1. Formal aspects associated with learning**:** These aspects focus on the structure and organization of learning activities, compliance with academic requirements, and adaptation to the rules and regulations established within the educational environment (Maldonado Fuentes et al., 2020).
2. Teaching for learning**:** This relates to the quality of instruction provided by teachers, the teaching strategies employed, and the ability of instructors to facilitate student learning.
3. Assessment for learning**:** This dimension concentrates on how students' learning is evaluated, including the variety of assessment methods used and how feedback is provided to help students improve their performance (Gómez & Salinas, 2020).
4. Communication**:** Refers to the interaction between teachers and students, the clarity of communication, and the availability of resources and support to facilitate effective communication (Moscoso Valarezo & Iglesias León, 2019).
5. Tools**:** Relates to the use and access to information and communication technologies in the learning process, including online platforms, digital resources, and technological tools that enhance the educational experience (Tapia Cortes, 2020).

From this perspective, the objective of this study is to analyze the factors that may have affected the academic performance of students in the Mechanical Engineering program at FIUNA during the 2020 pandemic, focusing on aspects related to virtual learning modalities, such as their characteristics, challenges, and experiences.

This research aims to provide an in-depth understanding of the factors that influenced the academic performance of these students during the pandemic. Based on the analysis of these factors, measures can be taken, and strategies can be designed to improve the quality of education in similar crisis situations in the future.

Furthermore, the results of this study will provide relevant information for the faculty and instructors, enabling them to adapt and optimize their teaching methods to address potential emergency situations.

Methodology

The research followed a quantitative approach, aiming to collect, process, and analyze quantitative data on previously determined variables through a survey process (Campoy Aranda, 2019). The design *was ex post facto* observational, which implies a systematic approach in which the researcher has no control over the variable under study, since the events had already occurred in the past or were inherently unmanipulable. It is important to note that no variable was manipulated, nor were measurements taken before the events occurred.

The study had a descriptive scope, in which the characteristics of the variable under study were described, organized, tabulated, and presented statistically (Campoy Aranda, 2019). It was also retrospective, based exclusively on information from past events (Miranda de Alvarenga, 2020). The operationalization of the study variable is detailed in table 1.

Table 1. Definition and Operationalization of the variable

Variable	Definition of the variable	Dimensions
Academic Performance	Academic performance refers to the achievements attained by students during the teaching-learning process. Teaching initiates the formative process and is expressed through the evaluation and assessment of the student's academic performance (Garcia, 2019)	Formal aspects associated with learning. Teaching for learning Assessment for learning Communication Tools

The population consisted of 66 university students enrolled in the Mechanical Engineering program at the Faculty of Engineering, National University of Asunción, in 2020, corresponding to 28 courses and a total of 181 questionnaires administered. These students responded to the research objectives and represented 86% of the program's total student body.

Data were obtained through a survey administered to the students using a semi-structured questionnaire covering five dimensions: Formal aspects associated with learning (5 items), Teaching for learning (6 items), Assessment for learning (10 items), Communication (4 items), and Tools (8 items). The survey was self-administered and included 33 questions on a 5-point Likert scale (1: Strongly disagree, 2: Disagree, 3: Neither agree nor disagree, 4: Agree, 5: Strongly agree). The reliability of the instrument was measured using Cronbach's Alpha coefficient, which was 0.982 for the entire sample. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.946, indicating that the instrument was appropriate for use, and Bartlett's test of sphericity yielded $\mathcal{X}^2 = 7956.731$; $p < 0.001$. Data collection was conducted through the faculty's proprietary information system.

For data analysis, a student performance spreadsheet corresponding to the year 2020 was used. This spreadsheet contained detailed information on students' past academic performance, including final grades and other relevant indicators such as process evaluations for scores obtained in the first, second, third, and fourth midterms, as well as practical assignments. Attendance was not considered, as it was not required due to the health emergency.

To conduct the analysis, data were extracted from the spreadsheet and statistical techniques were applied to examine trends, correlations, and patterns in student performance. Tables were also employed to visualize the results and facilitate interpretation.

The performance spreadsheet allowed the researchers to obtain a comprehensive retrospective view of students' academic progress and provided a solid basis for identifying factors that may have influenced their past performance.

Microsoft Excel (MSO 365), the statistical package PSPP (GNU pspp 1.6.2-g78a33a), and R Studio (version 2022.02.3) were used to carry out these analyses.

Results

The sample consisted of 66 students from the program. Data were collected from 28 professional courses and 181 administered survey questionnaires. Table 2 presents the data in frequencies and percentages for the variables "Students per semester" and "Questionnaires administered per course."

Table 2. Students per semester and questionnaires administered per course.

Students per Professional Semester	f	%
6	101	55,8
7	4	2,2
8	40	22,1
10	16	8,8
13 - Electives	20	11,0
Questionnaires Administered per Course		
Air Conditioning and Refrigeration	11	6,1
Accounting and Finance	2	1,1
Basic Industrial Electronics	11	6,1
Machine Elements	15	8,3
Metal Structures	3	1,7
Project Formulation and Management	1	,6
Quality and Environmental Management	1	,6
Maintenance Engineering	2	1,1
Industrial Installations	1	,6
Introduction to Photovoltaic Energy	3	1,7
Introduction to Asset Management	1	,6
Introduction to Research	2	1,1
Operations Research	12	6,6
Mechanical Laboratory 1	10	5,5
Legislation	3	1,7
Fluid Machines	6	3,3
Materials 2	14	7,7
Metrology	15	8,3
Automotive Engines and Components	3	1,7
Business Organization	5	2,8
Internship	1	,6
Manufacturing Processes 1	16	8,8
Integrated Project	2	1,1
Metal Coating by Galvanization	8	4,4
Workplace Safety	1	,6
Alternative Energy Technology	8	4,4
Thermotechnics 2	9	5,0
Heat Transfer	15	8,3

Regarding students' academic performance, institutional authorities implemented specific regulations in response to the COVID-19 health emergency. Table 3 presents a homogeneous average performance in accordance with the evaluative processes at each stage.

Table 3. Process Evaluation Variables and Academic Performance.

Item	Minimum	Maximum	Mean	Standard Deviation
First Midterm	-1	12	7,08	3,651
Second Midterm	-1	12	8,28	3,902
Third Midterm	-1	12	6,31	4,753
Fourth Midterm	-1	36	26,17	7,419
Practical Assignments & Others	0	10	8,75	2,293
Passing Grade	1	5	4,52	0,860

For the analysis of the dimensions, the scores of their indicators were considered, including the mean (M), standard deviation (SD), and responses on the Likert scale (SD: Strongly Disagree, D: Disagree, N: Neither Agree nor Disagree, A: Agree, SA: Strongly Agree). In this regard, Table 4 presents the weighted means for each of the dimensions, highlighting Dimension 1 and Dimension 4 as the most significant.

Table 4. Weighted means by analyzed dimension.

Dimension 1 Formal aspects associated with learning	**Dimension 2** Teaching for learning	**Dimension 3** Assessmentr for learning	**Dimension 4** Communication	**Dimension 5** Tools
4,4	**4,2**	**4,3**	**4,4**	**4,3**

From this perspective, table 5 summarizes the analysis by dimension of those indicators with the highest averages in the administered survey. Regarding Dimension 1 – Formal Aspects Associated with Learning, the item that showed a significant impact was "I have the technological resources to follow online classes," which obtained a mean of 4.39 on the scale.

For Dimension 2 – Teaching for Learning, the item "I have applied autonomous learning techniques" presented a mean of 4.31, with 50.8% of students selecting "Strongly Agree" on the Likert scale.

Regarding compliance with evaluation processes from the perspective of Dimension 3 – Assessment for

Learning, the item "The teacher demonstrated openness to any issues arising during the evaluation" was significant, with a mean of 4.19 and 50.8% of students responding "Strongly Agree."

Similarly, Dimension 4 – Communication showed a high impact in the item "The videoconference link was available at the scheduled time," which had a mean of 4.34, with 51.4% of students selecting "Strongly Agree."

Finally, it was observed that teaching materials were sufficient and accessible in a timely manner. The item "Reading materials were available before the synchronous session" within Dimension 5 – Tools was significant, with a mean of 4.24 on the scale.

Table 5. Indicators with the Highest Mean by Dimension.

ítems	M	SD	SD %	D %	N %	A %	SA %
Dimension 1. Formal Aspects Associated with Learning							
I have the technological resources to follow online classes	4,39	,846	,6	4,4	7,2	31,5	56,4
Dimension 2. Teaching for Learning							
I have applied autonomous learning techniques	4,31	,827	1,1	0,6	14,9	32,6	50,8
Dimension 3. Assessment for Learning							
The teacher demonstrated openness to any issues arising during the evaluation	4,19	1,076	5,5	1,7	11,6	30,4	50,8
Dimension 4. Communication							
The videoconference link was available at the scheduled time	4,34	,839	1,1	3,3	7,2	37	51,4
Dimension 5. Tools							
Reading materials were available before the synchronous session	4,24	,929	2,2	3,3	10,5	35,9	48,1

Note. M = Mean; SD = Standard Deviation; SD = Strongly Disagree; D = Disagree; N = Neither Agree nor Disagree; A = Agree; SA = Strongly Agree.

Table 6 shows that the results regarding academic performance during the analyzed period revealed a homogeneous average performance between the first and second midterm exams, and a relatively moderate level compared to the maximum score defined for the exams.

To analyze the distribution of the data, the Kolmogorov-Smirnov test was applied with a 95% confidence level and a 5% significance level. The result of the test indicated that the variables and dimensions analyzed do not follow a normal distribution; therefore, the null hypothesis of normality was rejected. This outcome required the use of non-parametric techniques for the analysis.

A correlation analysis was applied to verify the potential relationship between the dimensions and academic performance as represented by the final grade obtained. Likewise, the analysis examined whether the dimensions had any effect on the performance in process evaluations.

Table 6. Average results of scores and grades obtained.

Academic performance variables	N	Maximum	Mean	Standar deviation
First midterm	181	12	7,08	3,651
Second midterm	181	12	8,28	3,902
Third midterm	181	12	6,31	4,753
Fourth midterm	181	36	26,17	7,419
Practical work	181	10	8,75	2,293
Final grade obtained	**181**	**5**	**4,52**	**0,860**

For the interpretation of the values, the scale proposed by Hernández-Sampieri & Mendoza Torres (2018) was considered. According to this scale, table 7 shows that the process evaluation variables presented positive correlations. However, the values of the analyzed Dimensions showed very weak correlations. The low p-value for the process evaluation variables implies a significant relationship between these and the final grade, as expected. Nevertheless, the high p-value for the Dimensions

indicated the absence of a significant correlation with academic performance.

Table 7. Correlation between Final Grade and the Analyzed Variables and Dimensions.

Variables and Dimensions	r	p-value
First midterm	0,250**	0,001
Second midterm	0,336**	0,000
Third midterm	0,250**	0,001
Fourth midterm	0,600**	0,000
Practical work and others	0,332**	0,000
Formal aspects associated with learning	0,072	0,335
Teaching for learning	-0,08	0,286
Assessment for learning	-0,055	0,46
Communication	-0,035	0,636
Tools	-0,043	0,565

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

When analyzing the performance variables in the process evaluations (First Midterm, Second Midterm, Third Midterm, Fourth Midterm, and Practical Work) in relation to the Dimensions, these showed very weak correlations with the process evaluations. On the other hand, the Practical Work variable presented very weak positive correlations with Formal Aspects Associated with Learning ($r = 0.21$; $p = 0.004$), Assessment for Learning ($r = 0.177$; $p = 0.017$), and Communication ($r = 0.158$; $p = 0.034$). Likewise, a weak inverse relationship was found between the use of Tools and the Second Midterm ($r = -0.110$; $p = 0.046$), and a very weak inverse relationship with the Fourth Midterm ($r = -0.090$; $p = 0.229$).

Regarding the First Midterm, statistically significant correlations were found with the analyzed Dimensions. This may suggest that the subsequent adjustments made in the regulations could have influenced the performance in the process evaluations, as shown in table 8.

Table 8. Correlation of Performance Variables and Analyzed Dimensions

		Formal aspects associated with learning	Teaching for learning	Assessment for learning	Comunication	Tools
First term	r	0,155*	0,193**	0,173*	0,181*	0,148*
	p-value	0,037	0,009	0,020	0,015	0,046
Second terml	r	0,050	-0,021	-0,006	0,036	-0,110
	p-value	0,505	0,781	0,939	0,627	0,141
Third term	r	0,130	0,117	0,105	0,083	0,080
	p-value	0,081	0,117	0,160	0,268	0,284
Fouth term	r	0,063	-0,124	-0,043	-0,007	-0,090
	p-value	0,402	0,097	0,568	0,922	0,229
Practical Tasks	r	0,211**	0,136	0,177*	0,158*	0,113
	p-value	0,004	0,067	0,017	0,034	0,128

Note. *Correlation is significant at the 0.05 level (two-tailed). **Correlation is significant at the 0.01 level (two-tailed).

Table 9. Model summary.

R	R squared	Adjusted R squared	Standard error of the estimate	Durbin-Watson
0,531 [a]	0,282	0,239	0,750	1,878

In table 9, the model is summarized. This model suggests that the process evaluation variables and analyzed Dimensions can explain only 28.2% of the variability in final grades, which reinforces the pattern of correlations observed in table 8.

Predictors: (Constant), Practical Work, Tools, Third Midterm, Fourth Midterm, First Midterm, Second

Midterm, Teaching for Learning, Formal Aspects Associated with Learning, Communication, Assessment for Learning. Dependent variable: Final Grade.

Discussion

Regarding the results obtained, students reported that the measures implemented by the institution to adapt to the situation and provide resources were considered appropriate. However, the virtual modality did not sufficiently motivate them to maximize their educational process. In addition, the lack of feedback and review in assessments had negative consequences, hindering understanding of the subjects and the quality of study materials.

Concerning academic performance, the analysis showed a weak correlation between the different dimensions analyzed and the final grades. Although these dimensions had little impact on final assessments, it was observed that as students became more familiar with the virtual environment, their process performance improved. Effective communication and proper use of technological tools emerged as key elements for enhancing academic performance.

The results have important pedagogical implications within the context of the Mechanical Engineering program at FIUNA. Therefore, it is essential for educators to understand the relevance of technology in their teaching approach, adjusting strategies and methodologies accordingly. Likewise, the fundamental role of feedback as a formative resource is emphasized. This understanding will positively influence interaction with students, improving their educational experience.

In a study conducted by Hernández Flores et al. (2021), the influence of virtual education on the academic performance of higher education students in Tlaxcala during the 2020 pandemic in Brazil was explored. This research observed that the predominant actions to continue the teaching-learning process in an isolation context included the use of educational platforms and support from tools available through various social networks, both free and paid. While these aspects relate to technology, few or no educational centers considered social, emotional, and family aspects during isolation. This approach resulted in a decrease in students' academic performance, highlighting the influence of emotional and academic factors on outcomes.

Another study by Ferrer Dávalos (2021) evaluated the performance of university students in two modalities, before and during the COVID-19 pandemic in Paraguay. The results revealed that, despite the sudden shift in class modality, in one of the subjects analyzed, no significant changes in overall academic performance were observed. However, a marked difference was detected in students' level of participation and engagement in virtual classes. In contrast, in the other subject analyzed, a significant difference in student performance was observed, while no notable differences occurred in the use of the virtual learning platform. The results suggest that, under adequate conditions, including technological resources and appropriate methodology, virtual classes could be as effective as face-to-face classes.

Conclusion

Regarding the results, students indicated that institutional actions for normative adaptation and resource provision were timely. Nonetheless, the virtual environment did not sufficiently motivate them to fully leverage the teaching-learning process. Additionally, the lack of feedback and assessment review resulted in negative aspects that hindered comprehension of the topics and the quality of didactic materials.

Concerning academic performance, the analysis showed a weak correlation between the dimensions and final grades. Although these dimensions influenced ongoing evaluations, it can be concluded that as students became familiar with the environment, their performance in the processes improved. Communication and technological tools were identified as pillars for improving performance.

Finally, the results have relevant implications for teaching in the Mechanical Engineering program at FIUNA. Therefore, it is crucial that faculty in this program understand the relevance of technology in their educational approach, enhancing strategies and

teaching methodologies, as well as assigning importance to feedback as a formative tool. This understanding will impact student interaction, enriching their educational experience.

Author Contributions

Idea: C.D.; Project development: all authors; Literature review (state of the art): A.A., P.R.; Methodology: all authors; Data collection: C.D., D.V.; Data analysis: D.V.; Presentation of results: C.D., D.V.; Discussion and conclusions: all authors; Draft writing: all authors; Final revisions: D.V.; Approval for publication: all authors.

References

Campoy Aranda, T. J. (2019). *Metodología de la Investigación Científica*. Editorial Marben

Chasco, C., Pumarada, M., & Contreras, J. (2017). Papel de las TIC en el Rendimiento académico: una aplicación con modelos de ecuaciones estructurales. *Investigaciones de Economía de la Educación*, *12*, 449-471. https://www.researchgate.net/profile/Coro-Chasco/publication/323542738_Papel_de_las_TIC_en_el_rendimiento_academico_una_aplicacion_con_modelos_de_ecuaciones_estructurales/links/5a9b18eea6fdcc3cbacb5640/Papel-de-las-TIC-en-el-rendimiento-academico-una-aplicacion-con-modelos-de-ecuaciones-estructurales.pdf

Ferrer Dávalos, R. M. (2021) Rendimiento de estudiantes universitarios en dos modalidades antes y durante la pandemia del covid-19. *Revista Paraguaya de Educación a Distancia* https://revistascientificas.una.py/index.php/REPED/article/view/2251

García, M. J., Miranda, P. G., & Romero, J. A. (2022). Análisis de tecnologías de información y estrategias en el rendimiento académico durante la pandemia por COVID-19. *Formación Universitaria*, *15*(2), 139-150. https://dx.doi.org/10.4067/S0718-50062022000200139

García, Z. G. (2019). Hábitos de estudio y rendimiento académico. *Boletín Redipe*, *8*(10), 75-88. https://dialnet.unirioja.es/servlet/articulo?codigo=7528325

Gómez, H. M. R., & Salinas, M. L. (2020). La evaluación para el aprendizaje en la educación superior: Retos de la alfabetización del profesorado. *Revista Iberoamericana de Evaluación Educativa*, *13*(1), 111-137. https://dialnet.unirioja.es/servlet/articulo?codigo=7408495

Gutiérrez Monsalve, J. A., Garzón, J., & Segura Cardona, A. M. (2021). Factores asociados al rendimiento académico en estudiantes universitarios. *Formación Universitaria*, *14*(1), 13-24. https://dx.doi.org/10.4067/S0718-50062021000100013

Hernández Flores, G., Paredes Cuahquentzi, V. J., & Martín Rivera, M. H. (2021). Factores que influyen en el rendimiento académico de los estudiantes de nivel superior en Tlaxcala derivado de la educación virtual durante la pandemia 2020. *Brazilian Journals of Business*. https://doi.org/10.34140/bjbv3n2-011

Hernández Sampieri, R., & Mendoza Torres, C. P. (2018). *Metodología de la Investigación. Las rutas cuantitativa, cualitativa y mixta*. McGraw-Hill Interamericana.

Maldonado Fuentes, A., Rodríguez Alveal, F., & Sandoval Rubilar, P. (2020). Evaluación de la incidencia de los componentes formales del lenguaje visual en la elaboración de ilustraciones: un estudio con estudiantes en formación inicial docente. *Educación*, *29*(56), 95-115. https://dx.doi.org/10.18800/educacion.202001.005

Minaya, J. C. L. (2022). Educación virtual y rendimiento académico en estudiantes de la Universidad Nacional de Cañete. *Horizontes Revista de Investigación en Ciencias de la Educación*, *6*(24), 1153-1161.https://doi.org/10.33996/revistahorizontes.v6i24.404

Miranda de Alvarenga, E. (2020). *Metodología de la investigación social cuantitativa y cualitativa*. Editorial Grafisol.

Moscoso Valarezo, A. I., & Iglesias León, M. (2019). La formación del docente en comunicación educativa afectiva en la clase. *Conrado*, *15*(66), 45-49. http://scielo.sld.cu/scielo.php?pid=S1990-86442019000100045&script=sci_arttext

Soza Mora, S. E. (2021). Factores asociados a la calidad del rendimiento académico de estudiantes en la educación superior. *Revista Ciencias de la Salud y Educación Médica*, *3*(3). https://revistacienciasmedicas.unan.edu.ni/index.php/rcsem/article/view/79

Tapia Cortes, C. (2020). Tipologías de uso educativo de las Tecnologías de la Información y Comunicación: una revisión sistemática de la literatura. *Edutec. Revista Electrónica De Tecnología Educativa*, (71), 16-34. https://doi.org/10.21556/edutec.2020.71.1489

UNICEF. (2020). *La falta de igualdad en el acceso a la educación a distancia en el contexto de la COVID-19 podría agravar la crisis mundial del aprendizaje*. UNICEF. https://www.unicef.org/es/comunicados-prensa/la-falta-de-igualdad-en-el-acceso-la-educaci%C3%B3n-distancia-en-el-contexto-de-la