What Happened to Academic Achievement in Chemical Engineering?: A Study in the Days of COVID-19[a]

¿Qué pasó con el rendimiento académico en Ingeniería Química?: un estudio en tiempos de COVID-19

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Sulma Paola Vera-Monroy*
Universidad de La Sabana, Chía, Colombia
ORCID: https://orcid.org/0000-0002-7573-4151

Santiago Monsalve-Silva
Universidad de La Sabana, Chía, Colombia
ORCID: https://orcid.org/0000-0002-4242-1773

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* Corresponding author. E-mail: sulmavemo@unisabana.edu.co

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Abstract

COVID-19 forced higher education institutions to change the learning environment from face-to-face to computer-assisted to continue and ensure educational quality. *Objective:* This study was conducted to evaluate the effect of environmental change on the academic performance of chemical engineering students. Students of General Chemistry I and Engineering of Transport Phenomena participated and were recognized as apprentices and connoisseurs, respectively. *Materials and methods:* Two Likert-type instruments were designed and validated to evaluate the perception of academic and social variables at two moments, the beginning of isolation and the end of the semester; in addition, the grades of the first and sixth semester students who participated in the study, called apprentices and connoisseurs, respectively, were compared with the grades of students who took the subjects in other periods. *Results and discussion:* Experiencing a new learning context that strongly affected the social component decreased apprentices' performance, while connoisseurs improved their performance through school adaptation, a product of their experience and mental maturity. Communication and formative well-being were recognized as the variables that make face-to-face attendance more favorable for the acquisition of knowledge and the development of skills. The remote modality conditions the methodology affecting learning, and finally, the evaluation process does not change when the environment is modified, since, being an institutional requirement, it does not depend on the learning space. *Conclusions:* The learning environment affects the performance of students, negatively for learners and positively for connoisseurs, who by having university experience manifest a capacity for adaptation. On the other hand, face-to-face attendance favors well-being by improving assertive communication and the development of transversal competencies.

Keywords: School adjustment; learning environment; education; computer-assisted instruction; academic achievement.

Resumen

El COVID-19 obligó a que las Instituciones de Educación Superior tuvieran que cambiar el ambiente de aprendizaje de presencial a asistido por ordenador, para poder continuar y asegurar la calidad educativa. *Objetivo:* Este estudio se evaluó el efecto del cambio de ambiente sobre el rendimiento académico de estudiantes de Ingeniería Química. Participaron estudiantes de Química General I e Ingeniería de Fenómenos de Transporte, reconocidos como aprendices y conocedores, respectivamente. *Materiales y métodos:* Se diseñaron y validaron dos instrumentos tipo likert para evaluar la percepción en términos de variables académicas y sociales, en dos momentos, iniciando el aislamiento y al finalizar el semestre, además se compararon las notas de los estudiantes que participaron en el estudio, llamados aprendices y conocedores, de primero y sexto semestre, respectivamente, con las notas de estudiantes que vieron las asignaturas en otros periodos. *Resultados y discusión:* Aprendices disminuyeron su rendimiento al experimentar un nuevo contexto de aprendizaje que afectó fuertemente el componente social, mientras que conocedores mejoraron su rendimiento por tener una adaptación escolar, producto de su experiencia y madurez mental. La comunicación y el bienestar formativo fueron reconocidas como las variables que identifican la presencialidad, favoreciendo la apropiación del conocimiento y el desarrollo de competencias. La modalidad remota, condiciona la metodología afectando el aprendizaje, y finalmente, la evaluación no cambia al modificar el entorno, ya que, por ser una declaración institucional, no depende del espacio de aprendizaje. *Conclusiones:* El ambiente de aprendizaje incide en el rendimiento de los estudiantes, negativamente a los aprendices y positivamente a los conocedores, quienes por tener experiencia universitaria manifiestan capacidad de adaptación. De otro lado, la presencialidad favorece el bienestar mejorando la comunicación asertiva y el desarrollo de competencias transversales.

Palabras Clave: Adaptación escolar; contexto de aprendizaje; educación; enseñanza asistida por ordenador; rendimiento académico.

Introduction

In 2020, the emergence of COVID-19 (coronavirus disease 2019, caused by the SARS-CoV-2 virus) forced a change in the lifestyle of all people, being an event that tested the adaptation processes in all areas. In the chemical engineering (IQ) program at the University of La Sabana, students who were developing their training in a face-to-face learning environment were forcibly migrated to computer-aided teaching educational environments. Students and teachers had to modify their practices to guarantee educational quality, which should result in the acquisition of knowledge and the development of the program's competencies related to problem solving, engineering design, conducting experiments, project management, teamwork, ethics, innovation, effective communication, acquisition of new knowledge and research. One way to estimate the impact of the change brought about by COVID-19 is to evaluate what happened to the academic performance of students. Does modifying the learning environment, referring to the situational, mental, and linguistic contexts, affect academic performance, and if so, is it favorable or not?

Before studying the impact of COVID-19 on the academic performance of IQ students, it is worth investigating what has happened in education during other pandemics.

While history has witnessed pandemics since before Christ, such as the plagues of the Hittites (1300 BC) and that of Azoth (fifth and fourth centuries), plagues of the first centuries of modern times, such as the Antonine and Cyprian plagues (second and third centuries) [1] and more recent epidemics, such as the black (1300) and Persian (1800) plagues, cholera (1900), the Spanish flu (1920), SARS (2002), Ebola (2014), among others [2]; the records do not refer to the effect on education, perhaps because, on the one hand, the concept of school is relatively new, and on the other, the effect of pandemics is visualized in terms of health, mortality, economy and society. However, [3] in his book "The Black Death, 1346-1353: The Complete History," Jørgen Benedictow states that classes were suspended, and during their return home, many students died, indirectly evidencing a problem for education. Regarding the recent pandemic (21st century), countries such as Guinea and Sierra Leone had to close their classrooms for 9 months while acknowledging the consequences of this inactivity, especially for low-income students who after the period could not return, increasing dropout rates [4].

COVID-19 has popularized words such as quarantine, contagion, and isolation, which are not new and that condition the actions taken by governments to mitigate their effects. The concept of quarantine references 1374 in Italy; there was talk of contagion in 1659 when Kircher showed that to preserve life, it was necessary to avoid the sick and burn the dead, which led to the idea of isolation during the plague of 1665, when some people, following the characters of Bocaccio in the Decameron (1353), took shelter in ships anchored at sea [5].

Now that people live in isolation and quarantine to avoid contagion, it is a good time to recognize what is happening with education.

To date, many authors have published analyses, studies and reviews related to education in the times of COVID-19, such as [6], who affirmed that the crisis has been an opportunity to highlight the deficiencies at the educational level in terms of infrastructure and training, which will help to improve online education by developing innovations that take advantage of all the technological resources available in society and to facilitate learning processes, findings that were identified in 2019 by UNESCO [7].

In turn, [8] designed a guide of recommendations for university professors to build methodologies that guarantee equity and transparency. On the other hand, [9] conducts an in-depth reflection on the future of medical education and how COVID-19 will positively impact the development of new strategies that involve technology. [10], for their part, published a comparative study on the actions taken by three Latin American governments regarding education to avoid the loss of the school year, seeking to improve the development of virtual environments.

Consequently, an interesting reflection was made by [11], who illustrated that well-oriented online activities can replace face-to-face activities. In another context, [12] demonstrated through a survey that the accelerated use of ICT in education is not a response to the pandemic but to the technological revolution and its constant change; however, the virus is responsible for its widespread growth. In sharp contrast to this argument, [13] showed that the government measures taken against COVID-19 affect education, generating a psychological impact on students that results in anxiety and uncertainty.

Based on the above results, it is worth recognizing the following aspects:

First, in the educational field, the learning context is developed according to the proposal of [14], who divides it into three contexts: situational, mental and linguistic. The situational context refers to the social, cultural, and institutional system in which educational agents (teachers and students) live. It is structured within learning environments, which are recognized as interactive, face-to-face, online or hybrid spaces, where the exchange of knowledge with a pedagogical approach is defined by the area or discipline [15].

On the other hand, the mental context takes into account observable aspects such as attitudes, knowledge and procedures, which are activated by the demand of thought, and nonobservable aspects such as conceptions, meanings, semantic networks, frames of reference and affective roots [14]. In addition to the conceptual framework, the acquisition and application of knowledge, the mental context has a close relationship with biological maturity and brain

plasticity, where neuronal characteristics are identified [16]. Finally, the linguistic context represents the channel of dialog used in education, that is, the codes with which the messages are expressed, and the processes of emission and reception that are carried out.

Based on the above observations, teachers must promote students' comprehensive vision of the environment, strengthening the development of competencies that allow for global training, including all dimensions of the human being.

Second, learning environments can be face-to-face, virtual, or remote. In the face-to-face modality, teachers and students are in a specific physical space, where they interact face-to-face and in doing so can be better understood with verbal and nonverbal language [17]. The virtual modality is characterized by having low social interaction, since it has an independent and autonomous process where all the contents are on a digital platform [18]; on the other hand, the computer-assisted modality, known as remote or online, is synchronous and allows the members to connect at the same time and interact to develop the class; the contents are not available but are oriented and built in the community [19].

Finally, the evaluation of the impact of a training process can be carried out from two perspectives, the subjective, which depends on the perception of the student, and the objective, which corresponds to academic performance; the latter is understood as the assessment that the student obtains from his formative performance [20]. For others, academic performance represents the measure of the educational experience in which attributes of quality and quantity are synthesized as a result of the articulation of cognitive processes [21]. Both perspectives, as demonstrated by various authors, are affected by the environment, particularly variables such as family, self-esteem, gender, marital status, and study habits, among others [22], [23].

Materials and Methods

Design

The study was carried out following a nonexperimental or ex post facto research to evaluate the effect of the change in the learning environment due to COVID-19 on the academic performance of IQ students, so it is longitudinal in a descriptive trend; in addition to being of a mixed type, this study analyzed data of the students' perceptions that were related to the academic performance expressed in terms of grade from 0.00 to 5.00 [24].

Participants

The population was made up of 97 CE students. It was divided into two groups, the study subpopulation (S) of 31 students who took the subject General Chemistry I (GC) in the period 2020-1 (GCS) and 16 who studied Transport Phenomena Engineering (TP) in 2020-1 (TPS) and the control subpopulation (C) made up of 16 students who took GC in 2019-2 (GCC) and 34 who studied TP in 2019-2 (TPC).

GC is a subject that is taught in the first semester and has a theoretical nature, and TP is taught in the sixth semester and has a theoretical-practical nature. The two subjects were included in the study to compare whether there are changes between the perception of students in the first semester (apprentices) and the sixth semester (connoisseurs).

Apprentices, recent graduates of middle basic education (baccalaureate), molded by a type of school learning that has a high degree of accompaniment in a protective environment, are usually students with great expectations of university life, seen from the social and academic dimensions, and are considered novices for having a partial vision of the environment. On the other hand, connoisseurs are students who have embarked on an undergraduate experience, faced different challenges, and acquired information that defines their vision of the world.

Instruments

The information was collected through self-developed surveys, which were constructed from a consistency matrix, as recommended [25], based on information proposed by different authors, with which the degree of the coherence and connection of the items were evaluated, including questions about elements of face-to-face and remote learning environments reviewed by [26] and the items on the situational characteristics of the students' social environment proposed by [27]. Two instruments were developed with a Likert-type scale constructed from completely disagree to completely agree; the first was to evaluate face-to-face, composed of 13 items, and the second was for remote learning, with 18 items. The questionnaires were validated with Cronbach's alpha values of 0.802 and 0.909, respectively, as proof of their internal consistency.

The change in learning environment (LE) was the independent variable, and dependent variables included in the study characteristics were grouped into two components: *Academic component* was formed by grade (academic achievement), methodology (Metd), learning (Lear), participation (Part), evaluation (Eval), feedback (Fedb), communication (Comm) and use of technologies (Tecn). *Social component* was formed by interest in the class (Icls), liking the class (Lcls), comfort with space (Cspa) and formative well-being (Forb).

Data analysis

Data processing was performed with IBM SPSS Statistics V25.0, obtaining p values of Kolmogorov–Smirnov to evaluate the distribution of the data, Wilcoxon, and Mann–Whitney tests for comparisons between groups and Spearman coefficients for correlations between variables.

Procedure

The study began with the evaluation of the knowledge gained in the first term of the period 2020-1 of the GC and TP subjects, which was conducted in person. At the beginning of the second term, preventive isolation was ordered, and the environment changed to remote, during which time the first instrument was applied, which collected information on the student's perception of face-to-face attendance (Moment 1). The second term was considered the transition period, while the third term was completely remote. At the end of this period, the learning was evaluated, and the second instrument was applied, with which the information on the students' perception of the remote activity was collected (Moment 2).

Results

Effect of changing the learning environment

To analyze the effect of the change in LE from face-to-face to remote on students, the distribution of the data was evaluated (Table 1), and it was found that most were nonparametric.

Table 1. Distribution of data, Kolmogorov–Smirnov test.

Groups	LE	Grade	Metd	Lear	Part	Eval	Fedb	Comm	Tecn	Icls	Lcls	Cspa	Forb
TPS1	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TPS2	0.105	0.201	0.048	0.000	0.011	0.000	0.000	0.014	0.000	0.003	0.006	0.012	0.016
GCS1	0.000	0.202	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
GCS2	0.000	0.125	0.000	0.000	0.013	0.000	0.000	0.100	0.000	0.000	0.000	0.082	0.006

Source: authors creation

The first analysis that was carried out was to determine if there was a significant difference in the perceptions of the students belonging to the control group, the learners, and the connoisseurs regarding the assessment of the different variables with the change in LE. The results are shown in Table 2.

Table 2. Comparison between TPS1 vs. TPS2 and GCS1 vs. GCS2, Wilcoxon test.

Groups	LE	Metd	Lear	Part	Eval	Fedb	Comm	Tecn	Icls	Lcls	Cspa	Forb
TPS	0.008	0.053	0.003	0.018	0.317	0.480	0.001	0.623	0.031	0.010	0.002	0.003
GCS	0.000	0.002	0.001	0.000	0.697	0.032	0.000	0.004	0.001	0.001	0.000	0.000

Source: authors creation

As shown in Table 2, it was observed that both learners and connoisseurs recognized that variables such as learning, participation, communication, interest in the class, pleasure in the class, comfort with the space and formative well-being changed when the LE was modified, perceived as the characteristics that defined each modality and that were typical of them. On the other hand, connoisseurs' perceptions of methodology, feedback, and use of technologies were not modified when the LE was changed, since they had already identified various methodological strategies, with different types of monitoring and inclusion of ICT, in several of their classes. It is important to clarify that the evaluation was not recognized by the students as a variable that was modified with the LE, perhaps because its rigor and purpose were maintained.

The second analysis was carried out to determine the correlation between the variables of the academic component, concerning the achievement of the students, for which they were established as variables of comparison LE, grade, and learning (Table 3).

Table 3. Correlation of academic variables with achievement, Spearman test.

Group	Variables		LE	Grade	Metd	Lear	Part	Eval	Fedb	Comm	Tecn
TPS1	LE	Correlation cf.	1.000	0.312	0.232	0.108	0.018	0.290	0.069	0.709	0.706
		p value	.	0.239	0.387	0.690	0.947	0.276	0.800	0.002	0.002
	Grade	Correlation cf.	0.312	1.000	0.120	0.329	0.553	0.156	0.400	0.042	0.382
		p value	0.239	.	0.658	0.214	0.026	0.563	0.124	0.876	0.144
	Lear	Correlation cf.	0.108	0.329	0.857	1.000	0.424	0.752	0.545	0.428	0.662
		p value	0.690	0.214	0.000	.	0.102	0.001	0.029	0.098	0.005
TPS2	LE	Correlation cf.	1.000	-0.315	0.696	0.299	0.322	0.376	0.304	0.028	0.360
		p value	.	0.234	0.003	0.261	0.223	0.151	0.252	0.917	0.171
	Grade	Correlation cf.	-0.315	1.000	0.108	0.560	0.360	0.295	0.034	0.082	-0.043
		p value	0.234	.	0.691	0.024	0.170	0.268	0.900	0.764	0.874
	Lear	Correlation cf.	0.299	0.560	0.483	1.000	0.660	0.327	0.003	0.494	0.102
		p value	0.261	0.024	0.058	.	0.005	0.216	0.990	0.052	0.707
GCS1	LE	Correlation cf.	1.000	0.282	0.606	0.374	0.246	0.136	0.355	-0.086	-0.118
		p value	.	0.124	0.000	0.038	0.183	0.467	0.050	0.646	0.527
	Grade	Correlation cf.	0.282	1.000	0.251	0.353	-0.051	-0.104	-0.233	0.206	-0.437
		p value	0.124	.	0.173	0.051	0.786	0.577	0.208	0.265	0.014
	Lear	Correlation cf.	0.374	0.353	0.668	1.000	0.223	0.271	0.159	0.204	0.010
		p value	0.038	0.051	0.000	.	0.228	0.141	0.391	0.272	0.959
GCS2	LE	Correlation cf.	1.000	0.186	0.491	0.622	0.493	0.434	0.541	581	0.466
		p value	.	0.316	0.005	0.000	0.005	0.015	0.002	0.001	0.008
	Grade	Correlation cf.		1.000	0.526	0.401	0.408	0.210	0.037	0.320	0.266
		p value	0.316	.	0.002	0.025	0.023	0.256	0.843	0.080	0.147
	Lear	Correlation cf.	0.622	0.401	0.692	1.000	0.605	0.466	0.335	0.631	0.346
		p value	0.000	0.025	0.000	.	0.000	0.008	0.065	0.000	0.057

Source: authors creation

Spearman's statistics (Table 3) revealed that for all students, the remote environment correlated with the methodology, while in the face-to-face, a correlation existed between methodology and learning, perhaps because they recognized the face-to-face environment as natural, that is, a constant in the formative process. The above is in line with the statements of [17], [28], who report that face-to-face environments favor social aspects that facilitate formative processes.

In addition, it was observed that, for apprentices, in the two learning environments, there was a relationship with methodology, a result that is consistent with the idea that the learning environment defines the methodological strategies that are implemented [6]. On the other hand, the results also showed that, in remote conditions, there were relationships between a) the LE and learning, participation, feedback, communication and the use of technologies; (b) grades and methodology; and (c) learning and methodology, participation, communication and evaluation, demonstrating that changing the learning environment influenced different variables related to socio-affective competencies, thus affecting the formative process.

On the other hand, the results for connoisseurs on the face-to-face classes indicated that a) the LE was related to communication and the use of technologies and b) learning was related to evaluation and the use of technologies. The results of apprentices and connoisseurs showed that during face-to-face attendance, an effective and dynamic communication channel, which favored learning and ultimately resulted in academic performance, was developed [17]. Additionally, it is clear that for the participants of the study, technology was a fundamental tool in the development of the training process, and they considered it a necessary resource to respond to academic demands, as stated by [12], who considers that the use of technology in education is a response to social needs.

The third analysis was to determine the correlation between the variables of the social component for performance, for which the LE, grade and learning were established as comparison variables (Table 4).

Table 4. Correlation of social variables with achievement, Spearman test.

Group	Variables		Icls	Lcls	Cspa	Bfor
TPS1	LE	Correlation cf.	-0.166	0.069	0.413	.
		p value	0.538	0.801	0.112	.
	Grade	Correlation cf.	0.225	0.214	0.244	.
		p value	0.403	0.426	0.363	.
	Lear	Correlation cf.	0.618	0.747	-0.101	.
		p value	0.011	0.001	0.710	.
TPS2	LE	Correlation cf.	0.722	0.594	0.155	0.239
		p value	0.002	0.015	0.567	0.373
	Grade	Correlation cf.	0.105	0.128	0.287	-0.172
		p value	0.698	0.638	0.281	0.524
	Lear	Correlation cf.	0.521	0.476	0.053	-0.305
		p value	0.039	0.062	0.846	0.251
GCS1	LE	Correlation cf.	0.606	0.430	.	.
		p value	0.000	0.016	.	.
	Grade	Correlation cf.	-0.061	0.212	.	.
		p value	0.743	0.253	.	.
	Lear	Correlation cf.	0.392	0.673	.	.
		p value	0.029	0.000	.	.
GCS2	LE	Correlation cf.	0.544	0.538	0.787	0.788
		p value	0.002	0.002	0.000	0.000
	Grade	Correlation cf.	0.403	0.105	0.330	0.371
		p value	0.025	0.576	0.070	0.040
	Lear	Correlation cf.	0.925	0.671	0.413	0.571
		p value	0.000	0.000	0.021	0.001

Source: authors creation

For apprentices, during the face-to-face modality, a correlation was found between the LE and interest in the class, learning and liking the class, which revealed their preferences for interaction with the academic community; however, in remote mode, the LE conditioned all the social variables analyzed in such a way that the students recognized the impact generated by the change of LE and how this event affected their performance.

Formative well-being and comfort, the former understood as the characteristics of the environment necessary to comfortably develop academic exercises, were variables that had a frequency of 100% and were recognized by the students as face-to-face identity elements, which is explained because the participants enrolled in a face-to-face chemical engineering program and valued the resources related to that environment.

However, the analysis of social variables for connoisseurs showed that in face-to-face, there was a relationship between learning with liking the class and in remote conditions between the LE and interest, which is understandable because when you enjoy doing an activity you get better results from it [20]. Explicitly, the performance of connoisseurs was not affected by the change in LE, which was corroborated by the results in Table 3, where they showed a special talent to accommodate the new environment. COVID-19 presented a time of educational crisis in which connoisseurs, sixth-semester students, demonstrated the ability to respond successfully to forced situational changes, translated as an ability to adapt, which in terms of [14] can be understood as a maturity of the mental context.

What happened to academic achievement?

The last analysis carried out was to validate the results obtained from the perception of the students with quantitative data. Because of the evaluation process of Group S compared with C, the first and third term grades were contrasted, that is, Moments 1 and 2 (Table 5).

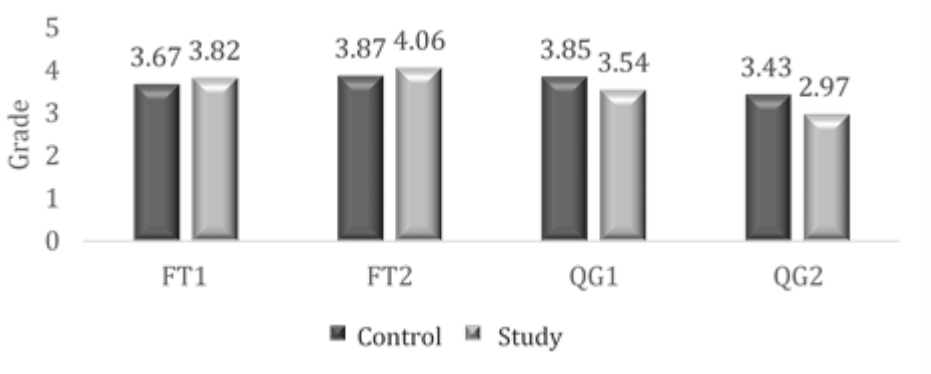
Table 5. Evaluation results of TPC, TPS, GCC, GCS, and descriptive statistics.

Group	Minimum	Maximum	Average	Standard Deviation
TPC1	2.40	4.80	3.67	0.74
TPC2	2.40	4.70	3.87	0.66
TPS1	2.70	4.90	3.82	0.63
TPS2	2.90	4.90	4.06	0.69
GCC1	3.10	5.00	3.85	0.72
GCC2	1.90	5.00	3.43	1.03
GCS1	2.00	5.00	3.54	7.57
GCS2	0.00	4.40	2.97	9.78

Source: authors creation

Table 5 shows that the grades of S are different from those of C; nevertheless, the subject maintained the same trends; in TP, the average grade increased, while in GC, it decreased (Figure 1).

Figure 1. An average grade of the TP and GC groups at Moments 1 and 2.



Source: authors creation

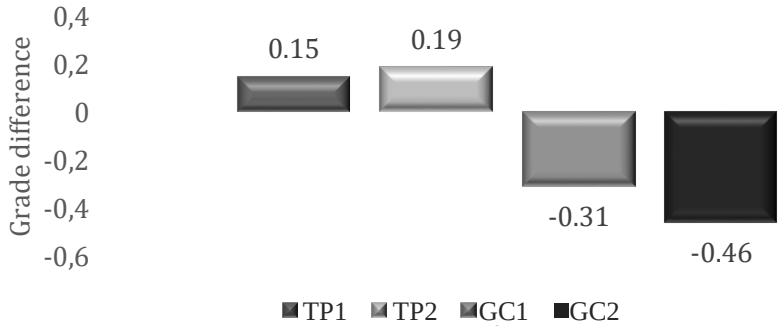
To evaluate the significance of the statistical results in Table 5, the Mann–Whitney U correlation test (Table 6) was applied and is plotted in Figure 2.

Table 6. Comparison of the average grade of Groups C and S, Mann–Whitney U test.

Group	Moment 1	Moment 2
TP	0.567	0.288
GC	0.000	0.000

Source: authors creation

Figure 2. Subtrafromorm average grade of Groups C and S at Moments 1 and 2.



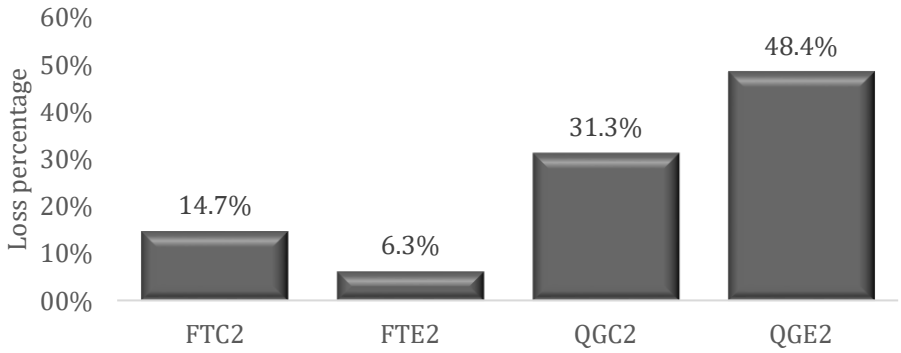
Source: authors creation

Table 6 shows that for connoisseurs, there were no significant differences between the grades of S and C before and after COVID-19, indicating that the impact of the change in LE was positive since they improved their performance, perhaps because they managed to use the isolation time to efficiently develop their academic activities without wasting time in accustoming their mental context to new challenges, thus obtaining better results.

For apprentices, the results were different, although Group S presented lower grades at both times (Table 5), with significant differences (Table 6). At Moment 2, the achievement was considerably lower, while the subtraction between the grades of S and C at Moment 1 was 0.31, in the second 0.46 (Figure 2), which showed that moving to the remote modality had a negative effect on the academic performance of first-semester students.

These results were better visualized by reviewing the percentages of loss of the subject at Moment 2 (Figure 3), where it was observed that the change in LE affected learners categorically and negatively, while connoisseurs improved.

Figure 3. Moment 2 loss percentage, TPS, TPC, GCS and GCC.



Source: authors creation

The differences found between Groups S and C can be explained if we understand the context in which the students developed. On the one hand, connoisseurs had studied at the university for 3 years, which allowed them to adapt their learning contexts to the formative dynamics framed in the institutional culture, and to be part of an academic community, which surely resulted in them developing skills to build their knowledge through various approaches, strategies, methodologies and techniques of autonomous learning; this may have impacted their brain maturity, which nuanced their mental development of neuronal plasticity, giving them the ability to adapt to new situations with challenges and challenges [14], [16].

In contrast, apprentices had recently graduated secondary basic training (baccalaureate) and, being novices of the higher formative process, were in an exploratory stage where they had

not defined their role within the community or their priorities, instead focusing on social interactions and collective construction and generating a socio-academic dependence reflected in the immaturity of their mental context [29].

These results can serve as a guide that supports the actions that universities take in critical situations, in which the accompaniment of students in the first semesters must be reinforced to help them acclimate to the university and teach them to assume their role within the training process, and in situations of controlled restriction, if possible, their return to the facilities should be privileged to strengthen their social integration and autonomous development.

Conclusions

A change in learning environment negatively affects the performance of apprentices, but not connoisseurs, among students of the chemical engineering program, given that the latter's' university experience has given them the ability to adapt and respond to different challenges such as COVID-19 because throughout their formative process they have been educated integrally, focusing on the development of skills necessary to respond to the needs of society.

The face-to-face environment favors formative well-being, assisted by the facilities and activities offered by the university campus, which results in assertive communication processes that link channels such as verbal and nonverbal language, facilitating the development of transversal competencies, since it is the environment in which students have been educated most of their life and which they recognize as their own and natural for their training.

The remote environment conditions the methodology and demands a period of adaptation that depends on the mental context of all the participants in the educational act. It is important to highlight that Universidad de La Sabana had prepared to develop academic processes mediated through technologies with the development of the Virtual Sabana platform and the acquisition of MS Teams; likewise, the university already had experience in the virtual environment with the academic units of the Forum Institute and the Technology Center for the Academy.

Changing the environment does not affect the evaluation process since it is an exercise that is declared institutionally and does not depend on the learning spaces. In its strategic plan for 2018-209, the university established that formative evaluation must be implemented at all levels; it must include elements that guarantee transparency and evaluative quality, turning the process into a learning opportunity that promotes integral development [30].

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