education sciences

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Study Habits Developed by Mexican Higher Education Students during the Complexity of the COVID-19 Pandemic

Carlos Enrique George-Reyes [1], Leonardo David Glasserman-Morales [2,*], Francisco Javier Rocha-Estrada [2] and Jessica Alejandra Ruíz-Ramírez [2]

[1] Institute for the Future of Education, Tecnologico de Monterrey, Monterrey 64849, Mexico; cgeorge@tec.mx
[2] School of Humanities and Education, Tecnologico de Monterrey, Monterrey 64849, Mexico; fcojvr25@gmail.com (F.J.R.-E.)
* Correspondence: glasserman@tec.mx

Abstract: During the first 700 days of the COVID-19 pandemic in Mexico, higher education institutions adopted different types of technology-supported learning to provide continuity of teaching activities. The pandemic forced students to change their study habits to face the challenges of learning in the distance modality while using technologies for learning and knowledge. In this research, a questionnaire called "Survey of Study Habits for University Students after more than 700 days of the Pandemic in Mexico" was applied to inquire about habits that were strengthened or emerged in undergraduate and graduate university students who participated in non-face-to-face learning environments during the pandemic. The study involved 3000 students from public (n = 1500) and private (n = 1500) universities located in six areas of Mexico (comprising 32 states). The findings indicated that most of the students acquired at least one digital device and expanded their internet service, and perceived an improvement in their self-study skills and greater autonomous learning development.

Keywords: study habits; higher education; distance education; technology; educational innovation

Citation: George-Reyes, C.E.; Glasserman-Morales, L.D.; Rocha-Estrada, F.J.; Ruíz-Ramírez, J.A. Study Habits Developed by Mexican Higher Education Students during the Complexity of the COVID-19 Pandemic. *Educ. Sci.* **2023**, *13*, 563. https://doi.org/10.3390/educsci13060563

Academic Editor: Han Reichgelt

Received: 13 April 2023
Revised: 18 May 2023
Accepted: 23 May 2023
Published: 30 May 2023

1. Introduction

Research on study habits in formal education is vital to identify those variables that increase or decrease the development of academic activities. These habits refer to the students' continuously repeating behaviors that serve them to perform school activities with different levels of success [1]. Study habits are essential during university education because a correlation has been found between cultivating good study habits and gaining high academic results [2]. It has even been stated that students with positive habits achieve performance levels similar to students classified as outstanding [3].

It is recognized that well-developed study habits are helpful for students to feel successful, have a positive attitude about themselves, learn topics without having to study them repeatedly, and improve in memorizing the topics they consider most important [4]. Several authors have examined the topic in higher education to understand the levels of knowledge a student may need to cope with a subject and improve their academic performance [5,6]. Other scientific publications suggest that study habits predict academic performance [7–10], and that they condition students' results in assessment activities [11].

Conceptually, study habits are defined as the habitual tendencies and practices people deploy while obtaining information through learning [12]. Likewise, they are understood as consistent and often unconscious patterns that daily express the effectiveness or ineffectiveness of facing the demands of the university [13]. Additionally, they are linked to some almost perpetual behaviors that students apply to ensure and facilitate knowledge acquisition [14].

They are habitual, daily, lasting practices that students have internalized to conduct themselves differently from their peers during the academic training process [15]. However,

this habitus can be modified by experiences, the accumulation of different capitals during the school trajectory, and the student's exposure to a changing academic ecosystem [16]. Thus, students' habits can be affected by various factors [17], such as the conditions of the spaces in which academic training is presented, the presence or lack of a place for study, the attitudes of teachers and peers [18], the perspective of educational quality at the university [19] and institutional norms [20].

Study Habits during the COVID-19 Pandemic

When the COVID-19 pandemic started, most countries in the world migrated from face-to-face instruction to non-face learning experiences, accompanied by a change in students' study habits [21,22]. Online learning in education surged, forcing students to devote time and energy to familiarizing themselves with technology-based teaching platforms [23]. They unexpectedly had to accumulate some material resources ("capital") [24] related to using communication devices and services [25], and non-material capital that included digital literacy, skills and competencies related to technology [26].

This accumulation of capital strengthened the study habits that students had already developed to cope with non-face-to-face learning. Moreover, it allowed their transformation and the emergence of new habits during the isolation period, which proved indispensable to participating in school dynamics. Students benefitted from using the Internet, having a greater home–school connection [27], and performing predominant academic practices such as videoconferencing and using digital platforms, sending, and receiving digital files and improving written communication through forums and chats [28].

During the pandemic, research emerged from various perspectives. Some analyzed university students' study habits from the perspective of academic performance and the skills they acquired [29]. Others studied the changes in learning habits by socio-economic status [30], and the relationship between study locations and types of schoolwork performed [31].

Other research compared the results of online learning during the confinement period with face-to-face teaching in previous semesters [32]. It was also reported that university students developed anxiety when migrating from face-to-face learning to the online virtual modality, probably due to the lack of study habits to manage time effectively, organize tasks, and fulfill academic responsibilities [33]. It is even stated that although students enrolled in educational programs in the online modality, they had specific, established ways of using learning technologies. Additionally, they were affected in their study habits by the transition of training modalities, especially in managing the workload and having limited interactions with other students [34].

In Mexico, when the COVID-19 health crisis was declared on 14 March 2020, universities had to migrate to online teaching–learning modalities to ensure academic continuity. The above suggests that, as in other contexts, new study habits emerged, making it possible to cope, with varying levels of success, to the changes in teaching–learning scenarios. However, considering the return to non-face-to-face environments, educators must discover students' opinions about their access and experience with technologies, the effects on the teaching–learning dynamics, and how these enable them to participate in the emerging formative modalities after the pandemic.

This research presents the main findings from analyzing a national survey in Mexico on university students' study habits after 700 days of participating in the non-face-to-face online modality. The main objective of this study was to learn about the access of students from public and private universities to digital devices and applications, as well as the knowledge related to their efficient use in online learning environments, in order to analyze whether these enabled them to develop study habits to carry out their training activities during confinement by COVID-19. Consequently, our research question was raised regarding how access to digital devices and applications, as well as knowledge related to them, generated study habits in Mexican higher education students who participated in non-face-to-face online education during the COVID-19 pandemic.

2. Materials and Methods

This study employed a quantitative approach [35], using a non-experimental research design [36].

2.1. Participants

The sample was representative and non-probabilistic, with 3000 participants distributed in the six regions into which the Mexican territory is segmented: North, Northeast, Lowlands, Central, Mexico City, and Southeast, as designated by Nielsen Areas [37]. At the time of their participation, the students were attending classes on university campuses that had to migrate their academic training to digital, remote online learning modalities. The sampling technique by quotas segmented the students into two groups: (1) students from public universities (n = 1500) and (2) students from private universities (n = 1500), with a sampling error of +/−1.8% at 95% confidence. In addition, one of the inclusion criteria was participants being over 18 years of age. Of the total sample, 1477 were women, 1474 were men and 49 did not identify their gender.

2.2. Instrument

To collect the information, the research team designed an ad hoc questionnaire called the "Survey of Study Habits for University Students after more than 700 days of the Pandemic in Mexico" (HEEU-700), which is available for free at https://bit.ly/3WiFI6G (accessed on 3 March 2023). Table 1 shows the dimensions and categories of the questionnaire. The instrument was validated by researchers from the School of Humanities and Education (EHE) at Tecnologico de Monterrey using as a strategy the modified Delphi method [38], with which the relevance of the items and their representativeness were analyzed through expert judgment to obtain a consensus opinion about the objective of the research [39]. It is worth noting that this method has been used effectively to validate instruments in areas related to the use of technologies in the teaching–learning processes [40], so it is relevant to employ it in the present study.

Table 1. Dimensions and categories of the instrument.

Dimension	Categories	Items by Category
Context and digital infrastructure	Demographics Digital infrastructure and services	15
Access to and experience with the use of technologies	Digital devices Media and communications Packages, applications and software	18
Study habits	Digital literacy Learning experiences Motivation to learn Engagement	36
Pandemic context	Learning in the pandemic	7
	Total	76

Once the instrument had been designed and validated, a reliability analysis was carried out with 101 students from a public university in central Mexico. The dimensions whose response options had a Likert-type scale (Digital literacy, Learning experiences, Motivation to learn, Engagement) were selected. The result was an overall Cronbach's Alpha coefficient of 0.9213, indicating high internal consistency.

2.3. Procedure

The questionnaire was applied digitally using the Qualtrix XM tool during the final part of the Fall Semester (August–December 2021), which coincided with the partial end of the COVID-19 confinement in Mexican universities and the staggered return to the

face-to-face modality. Students answered the questionnaire individually and without time limitations. Initially, we requested their consent to participate in the research and informed them of the anonymity of the information they would be providing.

The information was stored in an internet cloud server database and was exported, cleaned, and analyzed with IBM SPSS Version 26 statistical software. To achieve the objectives of this research we performed two types of analysis; one was descriptive, in which the context of the participating students in the non-face-to-face training was explored. The second was inferential, in which the normality test, chi-square, Spearman's rho, Mann–Whitney U and Kruskal–Wallis tests were used to examine how the instrument categories were linked to the six regions of the study.

3. Results

Next, the findings regarding the characteristics of distance learning are presented, followed by the analysis of access to and experience using technologies. Finally, the correlational analyses of the categories that integrate the study habits' dimensions corresponding to digital literacy, learning experiences, motivation to learn, university students' commitment, and the pandemic context are presented.

3.1. Context Characteristics and Digital Infrastructure

Figure 1 shows that 53% of the students surveyed dedicate between three and five hours a week to carrying out training activities during the classes they took online. It should be noted that this time includes connecting to synchronous classes and performing asynchronous tasks. A total of 27% spent one to three hours, 14% more than five hours and 6% less than one hour.

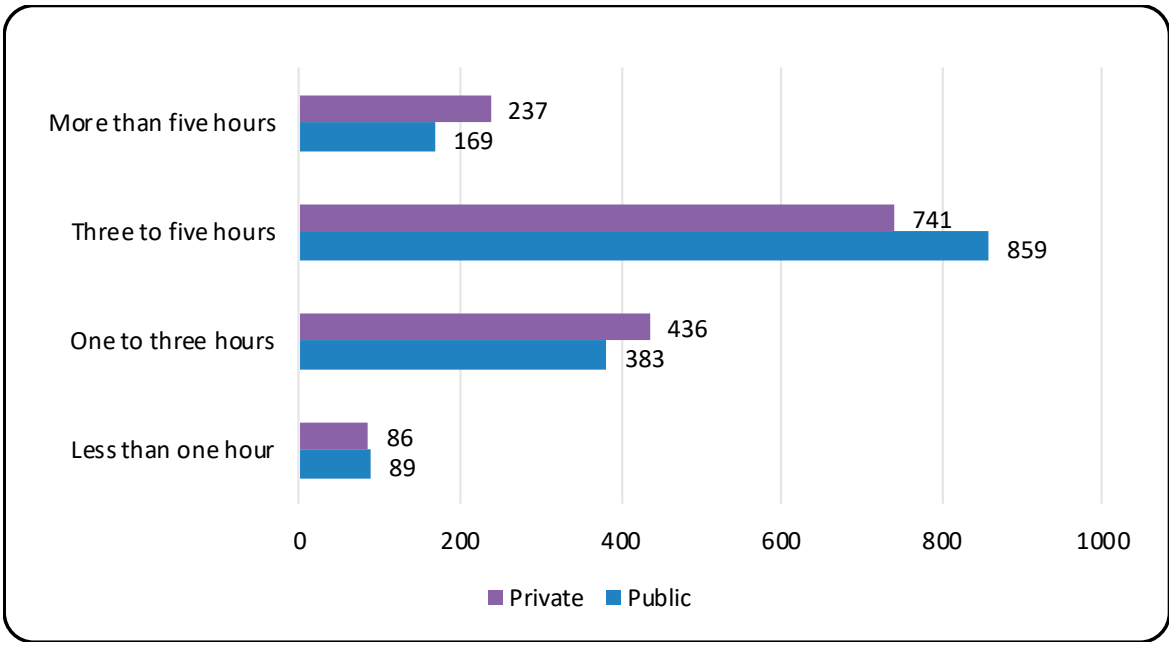

Figure 1. Hours dedicated to school activities.

It can be observed that there were some differences between public and private universities; in particular, it can be noted that the students who dedicated three to five hours to their academic activities mostly belonged to public universities (see Table 2). To determine the difference between the type of university and the participants' hours of dedication, we used the Chi-square test with Yates' continuity correction, which gave a significant correlation, a value of 23.573 and a $p = 0.000$. The correlation intensity was medium, presenting a Cramer's V coefficient of 0.089, and the predictive power of association was small with a Lambda of 0.081.

Table 2. Type of university and hours of dedication.

		Hours of Dedication per Week				Total
		1	2	3	4	
Public University	Count	89	383	859	169	1500
	% in University	5.90%	25.50%	57.30%	11.30%	100.00%
	% in hours of dedication per week	50.90%	46.80%	53.70%	41.60%	50.00%
Private University	Count	86	436	741	237	1500
	% in University	5.70%	29.10%	49.40%	15.80%	100.00%
	% in hours of dedication per week	49.10%	53.20%	46.30%	58.40%	50.00%

Regarding the acquisition of devices, Figure 2 shows that 67% of the students acquired between one and two devices for distance learning classes, 28% acquired none and 5% obtained three or four devices. This confirms that during the pandemic, many families were forced to make an economic outlay to purchase at least one digital device to continue training activities and not halt their studies [41].

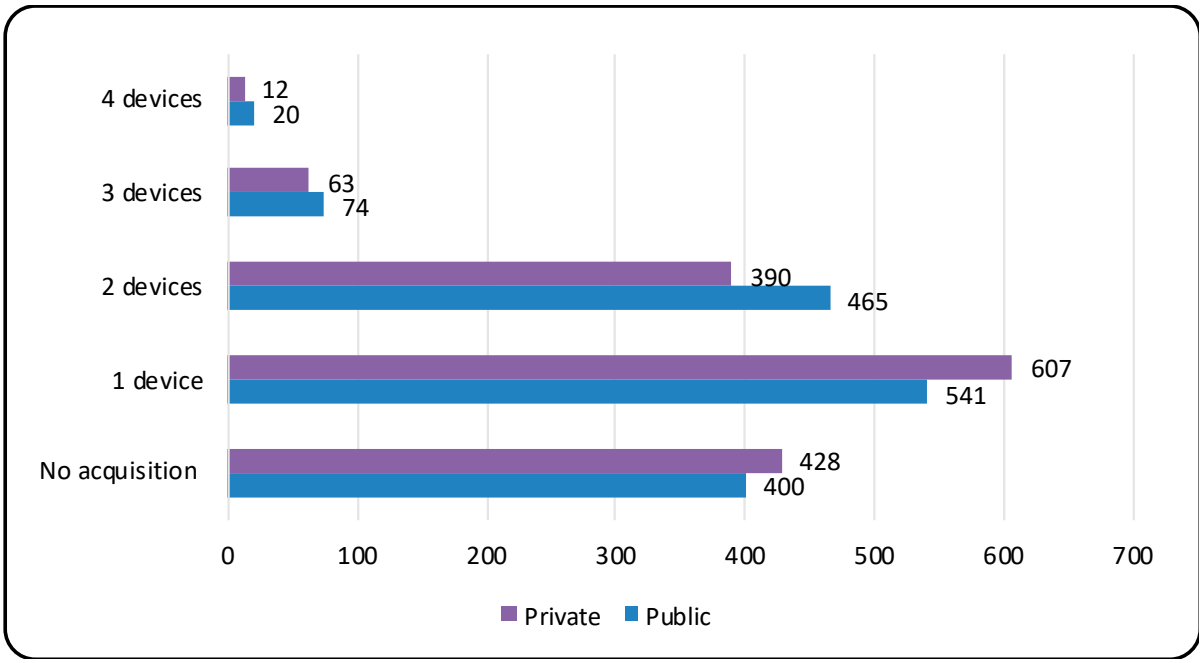

Figure 2. Number of devices purchased.

Concerning the university type and device acquisition, we found a significant correlation with a value of 14.203 and a $p = 0.007$. The correlation intensity was medium, having a Cramer's V coefficient of 0.069; the predictive power of association was small, with a Lambda of 0.063. We observed differences between students from public and private universities: students from public universities acquired one or two devices, and those from private institutions acquired one or none (see Table 3).

Regarding the Nielsen region differences in the participants' study time dedication, we used the same statistical test, which showed a significant correlation with a value of 73.980 and a $p = 0.000$. The correlation intensity was medium (0.91 Cramer's V), and the predictive power was lower (Lambda = 0.34). After reviewing the cross-tabulations, we observed differences between the Nielsen regions and the time spent. Students from the northeast region and Mexico City mainly dedicated three to five hours to their academic activities, and in a lower percentage more than five hours per day (see Table 4).

Table 3. Type of university and acquisition of devices.

		Acquisition of Devices					Total
		0	**1**	**2**	**3**	**4**	
Public University	Count	400	541	465	74	20	1500
	% in University	26.70%	36.10%	31.00%	4.90%	1.30%	100.00%
	% in hours of dedication per week	48.30%	47.10%	54.40%	54.00%	62.50%	50.00%
Private University	Count	428	607	390	63	12	1500
	% in University	28.50%	40.50%	26.00%	4.20%	0.80%	100.00%
	% in hours of dedication per week	51.70%	52.90%	45.60%	46.00%	37.50%	50.00%

Table 4. Nielsen regions and hours of dedication.

Region		Hours of Weekly Dedication				Total
		1	**2**	**3**	**4**	
North	Count	22	137	267	74	500
	% in Area	4.40%	27.40%	53.40%	14.80%	100.00%
	Hours of dedication	12.60%	16.70%	16.70%	18.20%	16.70%
Northeast	Count	45	129	290	36	500
	% in Area	9.00%	25.80%	58.00%	7.20%	100.00%
	Hours of dedication	25.70%	15.80%	18.10%	8.90%	16.70%
Lowlands	Count	18	131	252	99	500
	% in Area	3.60%	26.20%	50.40%	19.80%	100.00%
	Hours of dedication	10.30%	16.00%	15.80%	24.40%	16.70%
Center	Count	28	150	241	81	500
	% in Area	5.60%	30.00%	48.20%	16.20%	100.00%
	Hours of dedication	16.00%	18.30%	15.10%	20.00%	16.70%
Mexico City	Count	29	143	291	37	500
	% in Area	5.80%	28.60%	58.20%	7.40%	100.00%
	Hours of dedication	16.60%	17.50%	18.20%	9.10%	16.70%
Southeast	Count	33	129	259	79	500
	% in Area	6.60%	25.80%	51.80%	15.80%	100.00%
	Hours of dedication	18.90%	15.80%	16.20%	19.50%	16.70%

Finally, the relationship between the region and the participants' device acquisitions was analyzed, Table 5 shows that a significant correlation value of 98.523 and a $p = 0.000$. The correlation intensity was medium (V Cramer = 0.91), and the predictive power was small (Lambda = 0.051). While students in the Northeast and Lowlands regions acquired one device, those in the northern region acquired two. Regarding internet service, 71% of the students upgraded their home or cell phone services, while others contracted a new internet service. In addition, 78% of the students had a connection at home, 63% made use of mobile data, 38% had access from the homes of family or friends, and 38% connected from public spaces.

Table 5. Digital devices and internet access.

Context Factor	Answer Options	University		Overall Total	%		Percentage Differences	% Total
		Public	Private		Public	Private		
Number of additional internet services	0	564	728	1292	43.65%	56.35%	29%	43.07%
	1	409	400	809	50.56%	49.44%	−2%	26.97%
	2	474	348	822	57.66%	42.34%	−27%	27.40%
	3	51	24	75	68.00%	32.00%	−53%	2.50%
Number of internet accesses	1	447	496	943	47.40%	52.60%	11%	31.43%
	2	611	525	1136	53.79%	46.21%	−14%	37.87%
	3	238	141	379	62.80%	37.20%	−41%	12.63%
	4	204	338	542	37.64%	62.36%	66%	18.07%

3.2. Access to and Experience with the Use of Technologies

Regarding the results for university students' access to digital devices and applications, 86% of the respondents indicated that they had extensive knowledge and mastery of technological devices such as smartphones, desktop computers, laptops, tablets and digital televisions. Similarly, 86% of the students indicated that they had extensive knowledge and mastery of communication media such as email, videoconferencing, instant messaging, social network chats and educational platforms. On average, 87% of the students indicated extensive knowledge and mastery of office automation tools, browsers and social networks. However, they did not have a broad command of digital libraries and educational platforms, so these tools were underutilized during their university education (see Table 6). It should be clarified that this study contemplates that not having access to a technology does not imply not having the knowledge to use it, so it will be necessary in future studies to delve into the reasons why a user has not been able or has not decided to use certain digital tools and devices.

Table 6. Conditions of access to digital devices and applications.

Categories	Items	Public		Private	
Digital devices	Smartphone	4.553	91.07%	4.568	91.36%
	Desktop computer	4.295	85.89%	4.297	85.95%
	Laptop computer	4.170	83.40%	4.223	84.45%
	Digital tablet	4.317	86.33%	4.328	86.56%
	Smart/digital TV	4.341	86.83%	4.333	86.67%
Media and communications	Electronic mail	4.553	91.07%	4.568	91.36%
	Videoconferencing platforms	4.295	85.89%	4.297	85.95%
	Instant messaging platforms	4.170	83.40%	4.223	84.45%
	Social network chats	4.317	86.33%	4.328	86.56%
	Educational platforms	4.341	86.83%	4.333	86.67%
Packages, applications and software	Office automation tools	4.389	87.77%	4.425	88.51%
	Office tools in the cloud	4.211	84.21%	4.225	84.51%
	Educational software	4.021	80.43%	4.086	81.72%
	Educational platforms	4.057	81.15%	4.091	81.83%

Table 6. *Cont.*

Categories	Items	Public		Private	
	Digital libraries	4.056	81.12%	4.064	81.28%
	Browsers	4.119	82.37%	4.205	84.09%
	Social networks	4.211	84.23%	4.237	84.75%
	Video repositories/websites	4.245	84.91%	4.287	85.75%

It was found that online classes were mainly taught using videoconferencing tools (41%), followed by commercial, educational platforms (33%), institutional, educational platforms (17%) and, to a lesser extent, virtual messaging applications (8%). In the area of communication, priority was given to the use of open-access tools, highlighting instant messaging applications (31%) and social networks (28%); however, communication services of educational platforms (16%), email (15%) and, to a lesser extent, telephone calls (9%) were also used (see Table 7).

Table 7. Media and communications.

Context Factor	Answer Options	University		Overall	University		Percentage	%
		Public	Private	Total	Public	Private	Differences	Total
Main medium online classes	Virtual messaging	133	110	243	54.73%	45.27%	−17%	8.10%
	Commercial platform	484	506	990	48.89%	51.11%	5%	33.00%
	Institutional platform	241	276	517	46.62%	53.38%	15%	17.23%
	Videoconferencing	642	608	1250	51.36%	48.64%	−5%	41.67%
Main means of communication	E-mail	208	250	458	45.41%	54.59%	20%	15.27%
	Phone call	146	132	278	52.52%	47.48%	−10%	9.27%
	Instant messaging	490	441	931	52.63%	47.37%	−10%	31.03%
	Institutional platform	210	270	480	43.75%	56.25%	29%	16.00%
	Social networks	446	407	853	52.29%	47.71%	−9%	28.43%

3.3. Analysis of Study and Learning Habits in the Pandemic Context

To determine the type of statistical analysis to be performed, we executed a normality test to determine the data distribution. Since our sample had more than 3000 cases, we used the Kolmogorov–Smirnov test, obtaining a significance of 0.00 and statistics for age (0.157), digital literacy (0.098), learning experience (0.100), motivation (0.076), commitment (0.100) and pandemic context (0.108). Therefore, it was deduced that the distribution was not normal, and we decided to use non-parametric tests. We employed Spearman's Rho statistical test to determine how the nominal and ordinal variables were related to the scale variables. The results are presented in Table 8.

Regarding the type of university, two significant relationships were found: the first with age (0.004), showing low intensity and positivity; and the other with motivation to learn (0.000), indicating low intensity and positivity. Concerning the hours of weekly dedication, six significant associations were found: the first with age (0.000), showing low intensity ($p = -0.083$) and negativity; the second with digital literacy (0.000), low intensity ($p = 0.154$) and positivity; the third with learning experience (0.000), low intensity ($p = 0.154$) and positivity; the third with learning experience (0.000), low intensity ($p = 0.124$) and positivity; the fourth with motivation to learn (0.000), low intensity ($p = 0.131$) and positivity; the fifth with engagement (0.000), low intensity ($p = 0.115$) and positivity; and the sixth with pandemic context (0.000), low intensity ($p = -0.097$) and positivity.

Table 8. Correlations between variables and subscales.

Spearman's Rho	Hours of Dedication	Acquisition of Devices
Age	−0.083 ** 0.000	−0.051 ** 0.000
Digital literacy	0.154 ** 0.000	0.219 ** 0.000
Learning experience	0.124 ** 0.000	0.229 ** 0.000
Motivation to learn	0.131 ** 0.000	0.265 ** 0.000
Engagement	0.115 ** 0.000	0.255 ** 0.000
Pandemic Context	0.097 ** 0.000	0.213 ** 0.000

** The correlation is significant at the 0.01 level (bilateral).

As for device acquisition, six significant associations were found: the first with age (0.000), low intensity ($p = -0.051$) and negativity; the second with digital literacy (0.000), low intensity ($p = 0.219$) and positivity; the third with learning experience (0.000), low intensity ($p = 0.229$) and positivity; the fourth with motivation to learn (0.000), low intensity ($p = 0.265$) and positivity; the fifth with commitment (0.000), low intensity ($p = 0.255$) and positivity; and the sixth with pandemic context (0.000), low intensity ($p = -0.213$) and positivity.

In the geographical area study, six significant associations were found: the first with age (0.000), low intensity ($p = -0.047$) and positivity; the second with digital literacy (0.010), low intensity ($p = -0.066$) and negativity; the third with learning experience (0.001), low intensity ($p = -0.061$) and negativity; the fourth with motivation to learn (0.000), low intensity ($p = -0.099$) and negativity; the fifth with commitment (0.000), low intensity ($p = -0.064$) and negativity; and the sixth with pandemic context (0.000), low intensity ($p = -0.095$) and negativity. In addition, relationships also appeared between the scale variables, which are presented in Table 9.

Table 9. Spearman's Rho between scale variables.

Spearman's Rho	Digital Literacy	Learning Experience	Motivation to Learn	Engagement	Pandemic Context
Age	−0.319 ** 0.000	−0.358 ** 0.000	0.323 ** 0.000	−0.306 ** 0.000	−0.319 ** 0.000
Digital literacy	-	0.770 ** 0.000	0.628 ** 0.000	0.698 ** 0.000	0.689 ** 0.000
Learning experience	0.770 ** 0.000	-	0.689 ** 0.000	0.725 ** 0.000	0.698 ** 0.000
Motivation to learn	0.628 ** 0.000	0.689 ** 0.000	-	0.668 ** 0.000	0.623 ** 0.000
Engagement	0.698 ** 0.000	0.725 ** 0.000	0.668 ** 0.000	-	0.712 ** 0.000
Pandemic Context	0.689 ** 0.000	0.698 ** 0.000	0.725 ** 0.000	0.668 ** 0.000	-

** The correlation is significant at the 0.01 level (bilateral).

Concerning age, we found five significant associations: the first with digital literacy (0.000), medium intensity ($p = -0.319$) and negativity; the second with learning experience

(0.000), medium intensity ($p = -0.358$) and negativity; the third with the motivation to learn (0.000), medium intensity ($p = 0.323$) and positivity; the fourth with the commitment to learn (0.000), medium intensity ($p = -0.306$) and negativity; and the fifth with the pandemic context (0.000), medium intensity ($p = -0.319$) and negativity. Regarding the subscales, we found all significantly associated with high intensity and positivity, and at the bilateral level of 0.01: Literacy with learning experience (0.000) and ($p = 0.770$); literacy with motivation (0.000) and ($p = 0.628$); literacy with engagement (0.000) and ($p = 0.698$); and literacy with pandemic (0.000) and ($p = 0.689$). Learning experience with motivation (0.000) and ($p = 0.689$); learning experience with engagement (0.000) and ($p = 0.725$); and learning experience with pandemic (0.000) and ($p = 0.698$). Motivation with engagement (0.000) and ($p = 0.668$); motivation with pandemic (0.000) and ($p = 0.623$); and commitment with pandemic (0.000) and ($p = 0.712$).

To discover if there were differences between students from public and private universities in the five subscales, we used the Mann–Whitney U test, finding significant differences in motivation with a value of $p = 0.000$. The p-value being less than 0.05, we could conclude that there was a difference in motivation scores by type of university. After analyzing the p-values, we identified that public university students were more motivated (see Table 10).

Table 10. Differences between public and private universities.

	Digital Literacy	Learning Experience	Motivation to Learn	Engagement	Pandemic Context
Significance	0.515	0.531	0.000	0.446	0.386
Median Public	23	29	38	26	23
Median Private	23	29	37	26	23

To determine whether there were differences between the geographic area of the students in the five subscales, we used the Kruskal–Wallis test and found significant differences between digital literacy, learning experience, motivation, commitment and pandemic context (see Table 11). Having a value of less than 0.05 meant we could conclude that there was a difference in the scores by region. To compare the groups individually, we used the Mann–Whitney U test.

Table 11. Differences by Nielsen region using Kruskal–Wallis.

	Digital Literacy	Learning Experience	Motivation to Learn	Engagement	Pandemic Context
Kruskal–Wallis H Test	60.802	67.439	93.035	55.841	79.244
Significance	0.000	0.000	0.000	0.000	0.000
Median North	24	30	39	26.50	24
Median Northeast	23	29	38	26	23
Median Lowlands	23	29	37	26	23
Median Central	23	29	37	26	23
Median Mexico City	22	28	36	25	22
Median Southeast	23	29	38	26	23

The Northern region had significant differences in twenty-two crossings, the Northeast in thirteen, the Lowlands in thirteen, the Central in eleven, Mexico City in all twenty-five crossings, and the Southeast in twelve. After analyzing the values, we identified that those students from the Northern region obtained higher scores than the rest, while students from Mexico City obtained the lowest. The detailed analysis of the areas using Mann–Whitney U is available at the following link: https://bit.ly/3H70crt (accessed on 3 March 2023).

Figure 3 shows the statistical distribution segmented by public and private universities against the main categories of analysis. In the Likert scale presented (1–4), 1 refers to Strongly Disagree and 4 to Strongly Agree.

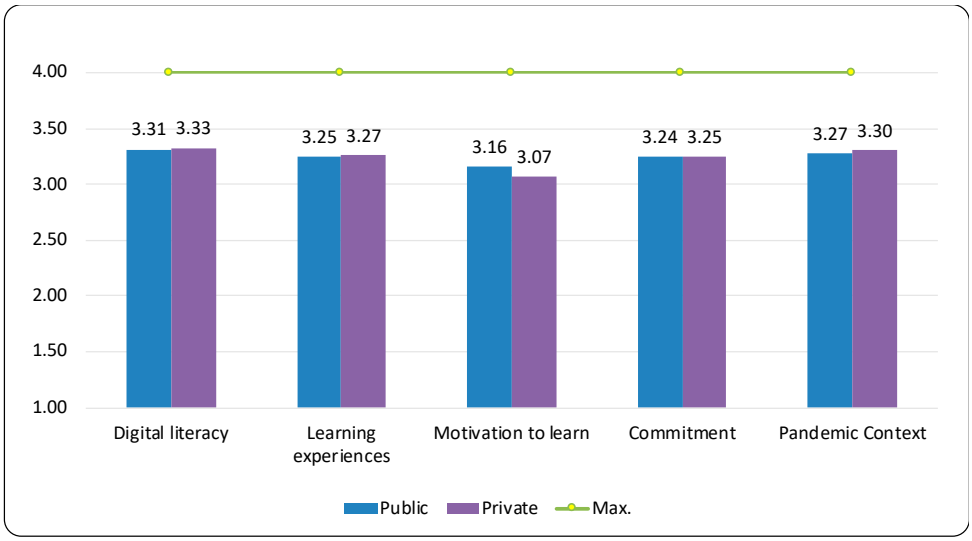

Figure 3. Average by category.

4. Discussion

This research confirms the findings of other studies in the sense that the pandemic allowed students to apply knowledge that had remained latent during their face-to-face training during the online learning process [28,30,32]. Likewise, the perception that the access and use of digital tools allowed students to detonate competences, and in some cases, study habits [31], which could be useful to improve learning in face-to-face environments, was validated [7].

In the context of this research, we identified that 53% of the students dedicated between three and five hours per week to school activities in distance learning classes. Although there were no differences between male and female genders, the non-binary group dedicated one to three hours to their activities; however, it should be considered that the non-binary gender represents only 1.6% of the sample. This coincides with [12], who stated that students managed their time adequately in distance environments; however, there were no differences between males and females.

Regarding the university type, the students who mainly dedicated three to five hours to their academic activities belonged to public institutions. The students who dedicated more than five hours per week were from private universities. This could be explained because the students from private institutions had more tools at their disposal, and consequently they needed more time to learn how to use them. Regarding geographic area, students from the North and Mexico City dedicated the most time (between three and five hours), but they were also the areas with the fewest students dedicating more than five hours. After the students migrated to the non-face-to-face modality, they had to dedicate more time to their academic duties because, in addition to having the responsibility of fulfilling their activities, they also had to familiarize themselves with the use of digital platforms and tools [21–23].

Regarding device acquisitions, about three-quarters of the students had to obtain electronic equipment, and most of them acquired a device (38%). Among the major purchases were laptops, smartphones and tablets. When analyzing the data by gender, we found no difference. However, the same was not true when comparing university types. While students from public institutions acquired one or two devices, those from private schools acquired one or none; this was perhaps because students from private institutions

already had technological devices, so they did not have to acquire more, unlike students from public universities, who needed to obtain them.

Similarly, when comparing Nielsen regions, we found a significant difference between students in the Northern region and those in the rest of the country, since they acquired two devices, while those in the Northeast and Lowlands acquired only one. This coincides with what is reported on social mobility in Mexico by [42]. He stated that people in the northern region have better economic conditions than those in other regions of the country, which consequently allows them to acquire devices more handily. That is, the socio-economic level determines the acquisition of study habits, since those with more economic resources tend to suffer less from environmental changes and experience a faster adaptation to them [30].

Regarding the internet, almost three-quarters of the students had their services extended, either for their home or mobile telephony; however, 19% did not have this service at home and had to contract it, causing an additional expense for students' and families' purchases of devices [12]. Most students connected from their homes or used mobile data, while, to a lesser extent, some had access from the homes of relatives or friends, or from public spaces. This confirms the results of some studies that indicate that the strengthening of Internet networks is essential for academic continuity, regardless of the place of connection [27].

The primary means for teaching online classes were videoconferencing tools (41%), followed by commercial (33%) and institutional (17%) educational platforms and, as the last option, virtual messaging applications (8%). To communicate, students preferred to use tools with which they were familiar, such as messaging applications and social networks; however, they also used other, more formal tools to a lesser extent, such as educational platforms and email, and some even communicated via telephone calls. Videoconferencing platforms were the most used for attending classes, while for communication forums on educational platforms and chats on social media networks were the most used [28].

Regarding the most used applications, office automation tools such as Microsoft Office and Google Drive stand out, followed by social networks and video repositories, while the least used were digital libraries and educational platforms. This coincides with what has been reported, which states that the use of educational platforms is one of the least developed skills. The above reflects that students preferred to complement their knowledge in non-formal environments and use applications with which they were already familiar. On the other hand, it was found that while the perception of digital literacy was higher, so were the learning experience, motivation to learn, commitment, and adaptation to the pandemic context, and it was also confirmed that the knowledge of how to use digital devices is essential to improve user experiences [25].

We found that older students were more motivated to learn, and younger students had better digital skills and reported having better learning experiences, greater commitment, and better ability to cope with the pandemic context. However, in other research the opposite was found concerning age and the health crisis environment, because students younger than 25 years old had more difficulties developing in the pandemic context [31–34]. Regarding the type of university, the only difference was motivation, as students from public institutions were more motivated, which is crucial to mitigate the negative consequences of the new learning environment. Finally, when performing analyses of Nielsen geographical regions, significant differences were found in all the subscales. The region with the highest scores was the North, while Mexico City had the lowest.

5. Conclusions

The development of this research allowed us to answer the following research question: What study habits emerged in Mexican higher education students who participated in non-face-to-face educational environments during the COVID-19 pandemic? We found that developing study habits was fundamental for university students to adequately participate in the non-face-to-face modalities necessitated by the COVID-19 pandemic. In this research, demographic characteristics such as participants' age, gender, the type of university they

attend, and the Nielsen region were determinants in strengthening the time dedicated to academic activities, device acquisitions, and experience using technology. In addition, they were also related to elements such as digital literacy, learning experience, motivation, commitment, and adaptation to the pandemic context.

The participants demonstrated a rapid capacity to adapt to the virtual environment; however, it would be essential to analyze whether these study habits persisted once the university students returned to the face-to-face modality, and identify which ones were modified and which new ones emerged. In this regard, it should be remembered that good study habits facilitate learning, foster a positive attitude, and allow students to succeed in the academic environment [4].

In subsequent research, the instrument design can be applied to other educational levels for comparative studies that allow for knowing if there are significant differences in different populations. Nevertheless, this research should be considered the first contribution to future studies that analyze the longitudinal impact of the pandemic on emerging teaching–learning scenarios in the post-pandemic environment.

Finally, it should be mentioned that the habits that strengthened or emerged in non-face-to-face education should be used in face-to-face scenarios as students are gradually incorporated, to encourage learning spaces where strategies use videoconferencing tools, internet applications and technologies such as virtual reality and new content delivery modalities.

Among the limitations of the study, we can mention the need to compare the results shown here with those of other investigations that arise in different geographical contexts in order to develop multinational analyzes that indicate the convergences and differences in the study habits shown by the students. Another limitation has to do with the fact that no correction was made for the accumulation of alpha errors, so it would be convenient to do so in subsequent studies.

Likewise, it is necessary to take advantage of the accumulation of experiences that technology-based remote teaching models have left during the first 700 days of the pandemic, in order to move towards an enriching teaching practice through the intentional pedagogical use of digital tools. As for future lines of study, it is suggested to inquire into how the return to face-to-face learning is being implemented, where the identified habits appropriated in university students become routines with a higher degree of intention and effort and discover how the digital systems could be leveraged in physical spaces.

Author Contributions: Conceptualization, C.E.G.-R., L.D.G.-M., F.J.R.-E. and J.A.R.-R.; Data curation, C.E.G.-R., L.D.G.-M., F.J.R.-E. and J.A.R.-R.; Formal analysis, C.E.G.-R., L.D.G.-M., F.J.R.-E. and J.A.R.-R.; Funding acquisition, C.E.G.-R.; Investigation, C.E.G.-R., L.D.G.-M., F.J.R.-E. and J.A.R.-R.; Project administration, C.E.G.-R.; Software, F.J.R.-E. and J.A.R.-R.; Supervision, C.E.G.-R.; Validation, C.E.G.-R.; Visualization, J.A.R.-R.; Writing—original draft, C.E.G.-R., L.D.G.-M., F.J.R.-E. and J.A.R.-R.; Writing—review and editing, C.E.G.-R., L.D.G.-M., F.J.R.-E. and J.A.R.-R. All authors have read and agreed to the published version of the manuscript.

Funding: The authors would like to acknowledge the financial support from Tecnologico de Monterrey through the "Challenge-Based Research Funding Program 2022". Project ID # I004-IFE001-C2-T3–T.

Institutional Review Board Statement: Ethical review and approval were waived for this study due to the fact that it was carried out considering the Federal Law for the Protection of Personal Data Held by Private Parties in force in Mexico.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data used is only available through a formal request to the author, who will act in accordance with the precepts of the Federal Law for the Protection of Personal Data Held by Private Parties in force in Mexico.

Acknowledgments: The authors wish to acknowledge the financial and technical support of Writing Lab, Institute for the Future of Education, Tecnologico de Monterrey, Mexico, in the production of this paper.

Conflicts of Interest: The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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