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Scientific paper

Analysis of the attitudes and knowledge in digital environments of the students of the Faculty of Engineering, Industry and Architecture - ULEAM

Randy Espinal-Lino [1] **Lindsay Rangel-Anchundia** [1,2] **Lia Cedeño-Zambrano** [1] **Noemí Peña-Miguel**[2] **Lázaro Echegaray**[3]

[1] Universidad Laica Eloy Alfaro de Manabí – ULEAM. Facultad de Ingeniería, Industria y Arquitectura. Manta – Ecuador.

[2] Universidad del País Vasco/ Euskal Herriko Unibertsitatea (UPV/EHU). Bizkaia – España.

[3] Cámarabilbao University Business School. Bilbao – España.

Corresponding author: *lindsay.rangel@uleam.edu.ec*

Abstract

This study investigates the attitudes and knowledge of students from the Faculty of Engineering, Industry, and Architecture at Universidad Laica Eloy Alfaro de Manabí (ULEAM) toward digital environments. This study employed a computerized survey incorporating the ACMI questionnaire (Attitudes and Knowledge in Computer Media), augmented with a Likert scale to assess the variables within the attitude dimension. Furthermore, open-ended questions were incorporated to stimulate discourse regarding the results. The research involved a sample of 303 students chosen from a population of 2,763 students enrolled in the faculty for the 2023-2 academic term. The assessment concentrated on three key dimensions: demographic information, attitudes toward digital environments, and degree of digital competencies. Students exhibit a positive disposition and understanding of digital media; yet, there exists an urgent need for continuous training to rectify existing shortcomings and guarantee adequate professional preparedness in anticipation of an era characterized by relentless technological advancement.

Keywords: *attitudes, knowledge, digital environments, digital skills, survey, students.*

Análisis de las actitudes y conocimientos en entornos digitales de los estudiantes de la Facultad de Ingeniería, Industria y Arquitectura - ULEAM

Resumen

Este estudio analiza las actitudes y conocimientos en entornos digitales de los estudiantes de la Facultad de Ingeniería, Industria y Arquitectura de la Universidad Laica Eloy Alfaro de Manabí (ULEAM). Se realizó utilizando una encuesta en medio digital basada en el cuestionario ACMI (Actitudes y Conocimientos en Medios Informáticos) con una ampliación a la escala Likert de las variables a evaluar de la dimensión de actitudes, además de agregarse preguntas abiertas que alientan a la discusión de los resultados. Se llevó a cabo a una muestra de 303 estudiantes de una población de 2763 estudiantes de la Facultad al periodo académico 2023-2. Se evaluaron tres dimensiones principales: datos demográficos, actitudes hacia los entornos digitales y nivel de competencias digitales. Se concluye que, aunque los estudiantes muestran una disposición positiva de actitudes y conocimientos hacia el medio digital, existe una necesidad imperativa de capacitación continua para cerrar las brechas existentes y asegurar una adecuada preparación profesional ante un futuro inminente de constante avance tecnológico.

Palabras Clave: *actitudes, conocimientos, entornos digitales, competencias digitales, encuesta, estudiantes*.

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1. Introduction

The integration of technology in the educational environment has become an essential component in the training of students. The development of digital skills and knowledge of technological tools facilitates access to information and enhances learning and preparation for the labor market. Particularly, students in technical majors, such as engineering, industry and architecture, are in a privileged position to take advantage of these technologies, given that their field of study is intrinsically linked to innovation and the use of digital tools (George-Reyes, 2023; Vargas-Murillo, 2019).

Digital competencies involve both the ability to use devices and software, as well as the ability to navigate critically in digital environments, solve technical problems and apply technological knowledge effectively. These competencies are increasingly valued in the professional environment, where digitization and automation of processes are predominant trends. But, despite their importance, there is a significant gap in the level of digital literacy among students from different disciplines and educational contexts (Reis et al., 2019; Sánchez and Carrasco, 2021).

The Faculty of Engineering, Industry and Architecture of the Universidad Laica Eloy Alfaro de Manabí (ULEAM) is no stranger to these challenges. In this context, it is crucial to analyze the attitudes and knowledge of students regarding digital environments. This analysis will provide a clear picture of their level of preparedness and identify areas for improvement and specific training needs.

The objective of this article is to investigate the perception and use of digital technologies by ULEAM students in their learning process. The following research questions were considered as fundamental to understand the current situation and develop strategies to strengthen digital education in the faculty: *1) to what extent are students equipped with the necessary digital competencies? and, 2) how do students' attitudes towards technology influence their academic performance and future career?*

2. Literature Review

Interaction in the digital environment has profoundly transformed the way people communicate, learn and work. In this context, it is vital to examine prior studies on digital competencies, attitudes towards technology, and the utilization of digital environments in higher education to expand the understanding of this issue.

The concept of digital competencies refers to the ability of individuals to use digital technologies effectively. These competencies are crucial in higher education as they condition students to meet the challenges of the modern working world. Reis et al. (2019) emphasizes the need to clearly define terms such as "digital literacy" and "digital competence" to avoid confusion and facilitate their application in education. Their study revealed that, despite technological advances, the lack of clear definitions remains a significant problem.

Vargas-Murillo (2019) explored digital competencies in the context of information and communication technologies (ICT) in higher education. Their interpretive analytical approach highlights the importance of these competencies for educational and professional development. However, it does not include statistical results, which limits the generalizability of its conclusions.

In another study, Sánchez and Carrasco (2021) used an ad hoc questionnaire to assess the degree of assimilation of digital competencies among students of communication and innovative education majors. Their findings indicated gender differences in the development of these competencies, highlighting the need for specific strategies to close these gaps.

Attitudes towards technology also play a fundamental role in the adoption and use of digital tools in education. George-Reyes (2023) investigated the relationship between computational thinking and digital literacy, highlighting the importance of these skills in the training of 21st century professionals. His systematic review of the literature highlights the need to incorporate computational thinking in modern education (Aguilar and Otuyemi, 2020).

Restrepo-Palacio and Segovia (2020) developed an assessment instrument called "Digital Campus" to measure students' digital competencies. Their results showed that, although most students reached an acceptable level of digital competence, there are still areas that require improvement, especially in the technological dimension.

The use of digital environments in higher education has been the subject of numerous studies. Saltos et al. (2019) conducted a systematic review to assess the presence of digital competencies in higher education institutions in Latin America. Their results indicated an insufficient presence of digital competencies in these institutions, highlighting the need for greater preparation for both teachers and students.
León-Pérez et al. (2020) evaluated the self-perception of digital skills of students at the Universidad Autónoma de Querétaro, Mexico. Using a questionnaire, they found that students use technology mainly for academic projects, highlighting the need to integrate ICT more effectively into classroom activities.

The literature review also reveals significant gaps in the training and use of digital technologies. Alvarado (2020) highlighted the differences in ICT management between students and teachers, indicating a lack of updating and continuous training in the use of these technologies. This suggests the need to address these challenges to improve learning in the digital era.

Finally, Bernate et al. (2021) analyzed digital competencies in students majoring in Physical Education, finding acceptable scores in several dimensions while also highlighting issues that necessitate intervention. This study emphasizes the significance of tailored curricula and ongoing adaptation in the application of technology in education.

3. Materials and methods

This cross-sectional study was designed as a descriptive analysis with a quantitative approach, using a digital survey to collect data on the attitudes and knowledge in digital environments of students of the Faculty of Engineering, Industry and Architecture of the Universidad Laica Eloy Alfaro de Manabí (ULEAM). The methodological process followed to carry out this research is detailed below.

For data collection, the ACMI (Attitudes and Knowledge in Computer Media, from the Spanish Actitudes y Conocimientos en Medios Informáticos) questionnaire developed by Amorós-Poveda (2019) was adapted. This instrument has proven to be effective in the assessment of digital competencies in educational contexts. The ACMI questionnaire is structured in three main dimensions: 1) identification, which collects basic demographic data of respondents, including age, gender, semester of study and academic major; 2) attitudes, which assesses the perception and disposition of students towards digital environments, segmenting general attitudes, by age and academic major; and 3) knowledge, which measures the level of digital competencies of students, including previous computer training, frequency of use of digital devices, and knowledge and use of computer programs.

Revisions were implemented to the original questionnaire to gather more information for the ensuing study. The Likert scale was extended from 5 to 10 in the questions of the attitudes dimension and the following open-ended questions were added to gather the opinions of the students: *1) what digital skills do you consider most important to develop as a professional in your field?; 2) what kind of additional training or support would you like to receive to improve your skills in digital environments?; 3) how do you think technological evolution will affect your professional field in the coming years?; and 4) what recommendations would you give to improve the integration of technology in the educational process of the faculty?*

The survey was distributed digitally to students of the Faculty of Engineering, Industry and Architecture of ULEAM. Participation was voluntary and the confidentiality of the responses was guaranteed. The sample was composed of students from different semesters and majors within the faculty, with the objective of obtaining a representative view of the level of digital competencies in this group.

The data collected through the questionnaire was analyzed using descriptive statistical techniques to summarize and present the findings. Tables, graphs and frequency analysis were used to illustrate the results according to the dimensions and sub-dimensions of the ACMI questionnaire. For the inferential analysis of the data, the IBM SPSS version 26 statistical software was used.

The attitude and knowledge dimensions were analyzed in terms of several variables; mainly academic major and semester of study. ANOVA analysis was applied to determine the relationship between different variables and the independence of the evaluated digital competencies dimensions.

4. Results analysis

After analyzing the results, the most relevant findings that contribute to the discussion were selected to be shown in this section of the study.

A total of 303 responses were obtained from the population of 2763 students in the Faculty of Engineering, Industry and Architecture for the study period of 2023-2. Of the sample analyzed, 4 questionnaire responses were considered as missing data, since 4 people did not enter their academic major. Table **1** shows the sample obtained, segmented by academic major.

The Cronbach's alpha of the survey is 0.934. Thus, the questions asked with the Likert scale have reliable results, as shown in **Table 2.**

The data collected from the surveys was exported to Microsoft Excel to code the qualitative responses into quantitative ones. Then, the database was entered into IBM SPSS version 26 software to obtain frequency tables and graphs of the responses for their descriptive analysis. In addition, in the descriptive analysis segmented by semester and academic major in the attitudes dimension, the Chi-Square statistical test was performed to examine the relationships between variables and to evaluate the independence between categories and determine if there are statistically significant differences.

One-factor ANOVA was applied to compare means between groups, while Levene's test was used to confirm assumptions and post hoc with Games-Howell to ensure the validity of the analyses and address possible inequalities in variances. The data complies with the assumption of normal distribution necessary for applying ANOVA, as it aligns with the Central Limit Theorem (CLT), which states that, given a sufficiently large sample, the mean distribution of the data resembles a normal distribution (Delgado, 2022).

Table 1: Sample obtained segmented by academic major.

Pursued academic major					
		Frequency	Percent	Valid percent	Cumulative percentage
Valid	Civil Engineering	48	15,8	16,1	16,1
	Maritime Engineering	25	8,3	8,4	24,4
	Electricity	33	10,9	11,0	35,5
	Architecture	72	23,8	24,1	59,5
	Industrial Engineering	96	31,7	32,1	91,6
	Food Engineering	25	8,3	8,4	100,0
	Total	299	98,7	100,0	
Lost	System	4	1,3		
Total		303	100,0		

Table 2: Reliability statistics of the Likert scale questions

Reliability statistics		
Cronbach's alpha	Cronbach's alpha based on standardized items	N elements
,934	,929	70

The ANOVA decision rule is: if the significance (Sig.) value is less than or equal to 0.05, the null hypothesis of equality of variances is rejected, indicating that variances are unequal, so post hoc tests such as Games-Howell, which do not require equality of variances, are used, providing more robust and reliable results in these cases. This ensures that conclusions are accurate and that significant differences are correctly detected.

Each question in these objectives has its Chi-Square statistical test table, which shows the value to determine whether or not significant differences exist, in the cross cell of the "Asymptotic significance (bilateral)" column and the "Pearson's Chi-Square" row. The decision rule is: if the value is less than or equal to 0.05, there are significant differences; if it is greater than 0.05, there are no significant differences.

Attitudes in relation to the semester

This section seeks to understand the relationship between students' attitudes and their semester of study. As such, the hypotheses are as follows:

- Ho: Students' attitudes towards the computer environment remain the same in relation to the semester they are studying.
- H1: Students' attitudes towards the computer environment have significant differences in relation to the semester they are studying.

Table **3** shows the data between the pairs of attitude adjectives towards computer use and their relationship to a student's current semester of study. Most of the pairs do not show significant differences, given that the p-values are greater than 0.05, and thus, the null hypothesis was accepted. This suggests that attitudes towards the computer medium are similar among the different semesters of study of the sample. However, the pairs of adjectives [Inaccessible—Accessible] and [Individual—Group] show significant differences ($p < 0.05$), and for these two cases, the null hypothesis was rejected.

Table 3: Chi-Square test on pairs of adjectives [attitudes], in relation to the semester

Pair of adjectives	df	Asymptotic significance (bilateral)	α	Decision rule
Boring—Entertaining	81	0,515	0.05	No
Clumsy—Agile	81	0,654	0.05	No
Ineffective—Effective	81	0,286	0.05	No
Worthless—Valuable	81	0,640	0.05	No
Inaccurate—Precise	81	0,716	0.05	No
Stupid—Smart	81	0,313	0.05	No
Inaccesible—Accesible	81	0,013	0.05	Yes
Individual—Group	81	0,010	0.05	Yes

As seen on Table **4**, Levene's test shows that the pair of adjectives [Boring—Entertaining] has a significance level of 0.068; thus, the null hypothesis was accepted and the homogeneity of variance in this group was confirmed. On the other hand, for the rest of the pairs of adjectives, the significance level was lower than 0.05, which evidences the existence of differences in the groups' variance. Likewise, the ANOVA results indicate that all the significances of the pairs of adjectives selected are less than 0.05; as such, the null hypothesis was rejected, revealing statistically significant differences between attitudes and the semester attended by the students.

Table 4: Levene's test [attitudes], in relation to semester and ANOVA significance

Pair of adjectives	Levene's test	Sig.	Sig. between groups
Boring—Entertaining	1,797	0,068	0,033
Clumsy—Agile	4,619	0,000	0,020
Ineffective—Effective	5,785	0,000	0,008
Worthless—Valuable	3,227	0,001	0,048
Inaccurate—Precise	3,822	0,000	0,024
Stupid—Smart	5,024	0,000	0,043
Inaccesible—Accesible	2,479	0,010	0,035
Individual—Group	2,163	0,025	0,010

Once the significant differences between the variables mentioned above were verified, the Games-Howell post hoc test was used to identify the groups that differ. This test is appropriate for the case, since it does not require homogeneity of variances or equality in sample sizes. The Games-Howell results indicate significant differences in attitudes in relation to the semester of study, as shown in

Table **5**.

Table 5: Results of the Games-Howell Post Hoc test [attitudes & semester]

Dependent variable	Semester	8	10
Boring—Entertaining	3	0,025	-
Clumsy—Agile	2	0,007	-
	3	0,013	-
Ineffective—Effective	2	0,019	0,007
	3	0,003	0,001
Worthless—Valuable	3	0,022	-
Inaccurate—Precise	2	0,045	0,004
	3	0,033	0,005
Stupid—Smart	2	0,046	-
	3	0,009	-
Inaccesible—Accesible	2	-	0,001
	3	-	0,005
Individual—Group	-	-	-

To facilitate the understanding of the findings, Figure **1** and Figure **2** highlight the most relevant graphs that show the data count and the differences between the attitudes to the computer environment of the different semesters indicated by the post hoc test.

The responses were mostly positive from the higher semesters, with semesters 8 and 10 standing out. On the other hand, the lower semesters do register negative responses, although they still have a strong presence of positive responses. Conversely, the lower semesters tend to have negative responses with a few favorable exceptions.

On Figure **2**, similar to the previous graph, the higher semesters do not register negative responses; however, semesters 2 and 3 show a lower presence in the negative side and present more positive responses.

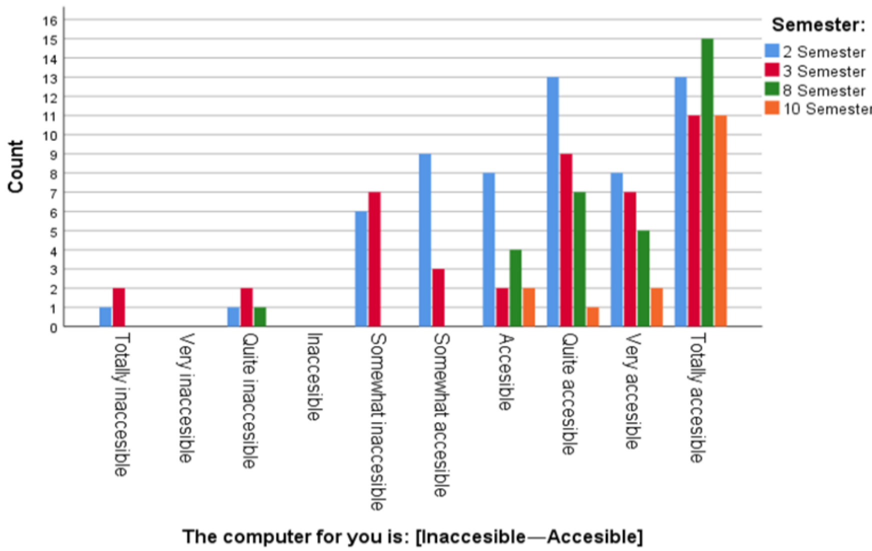

Figure 1: Bar chart of attitudes [Inaccessible—Accessible], in relation to the semester

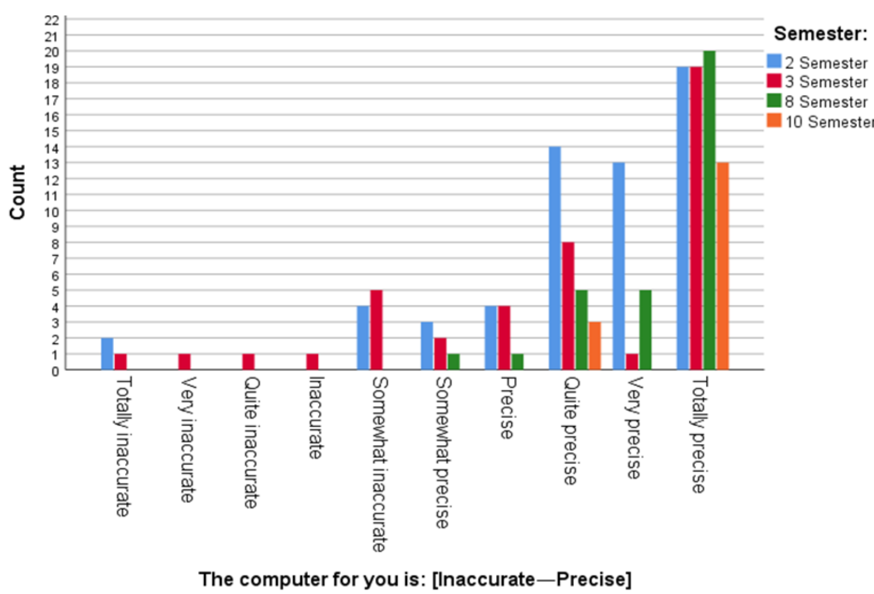

Figure 2: Bar chart of attitudes [Inaccurate—Accurate], in relation to the semester

Attitudes in relation to the academic major

This section seeks to understand the relationship between students' attitudes and their selected academic major. As such, the hypotheses are as follows:

- Ho: Students' attitudes towards the computer environment remain the same in relation to their selected academic major.
- H1: Students' attitudes towards the computer environment have significant differences in relation to their selected academic major.

Table **6** shows the data between the pairs of attitude adjectives towards computer use and their relationship to a student's academic major. Most pairs present a p-value less than 0.05, evidencing significant differences in the analyzed variables. In contrast, the pairs [Worthless—Valuable], [Useless—Useful], [Stupid—Smart], [Awkward—Comfortable] and [Detrimental—Beneficial] show a p-value greater than 0.05, demonstrating no significant differences.

Table 6: Chi-Square test on pairs of adjectives [attitudes], in relation to the academic major

Pair of adjectives	df	Asymptotic significance (bilateral)	α	Decision rule
Unnecessary—Necessary	45	0,018	0.05	Yes
Ineffective—Effective	45	0,004	0.05	Yes
Worthless—Valuable	45	0,186	0.05	No
Impractical—Practical	45	0,000	0.05	Yes
Useless—Useful	45	0,411	0.05	No
Hindering—Facilitating	45	0,001	0.05	Yes
Trivial—Important	45	0,030	0.05	Yes
Inaccurate—Precise	45	0,000	0.05	Yes
Stupid—Smart	45	0,075	0.05	No
Awkward—Comfortable	45	0,104	0.05	No
Discouraging—Motivating	45	0,010	0.05	Yes
Complex—Friendly	45	0,004	0.05	Yes
Detrimental—Beneficial	45	0,290	0.05	No

As seen on Table **7**, Levene's test shows that the pairs of adjectives [Discouraging-Motivating] and [Detrimental-Beneficial] have a significance level higher than 0.05; thus, the null hypothesis was accepted, confirming the homogeneity of variance in these groups. For the other pairs, the significance was less than 0.05, which indicates differences in the variances between groups. In addition, the ANOVA results reveal that all pairs of adjectives have significance values of less than 0.05. As such, the null hypothesis was rejected, showing significant differences between attitudes toward the computer environment and the academic major of the students.

Table 7: Levene's test [attitudes], in relation to the academic major and ANOVA significance

Pair of adjectives	Levene’s test	Sig.	Sig. between groups
Unnecessary—Necessary	5,024	0,000	0,005
Ineffective—Effective	8,797	0,000	0,000
Worthless—Valuable	6,815	0,000	0,001
Impractical—Practical	3,903	0,002	0,000
Useless—Useful	7,432	0,000	0,008
Hindering—Facilitating	3,640	0,003	0,000
Trivial—Important	5,191	0,000	0,002
Inaccurate—Precise	9,700	0,000	0,000
Stupid—Smart	5,638	0,000	0,002
Awkward—Comfortable	2,370	0.039	0,016
Discouraging—Motivating	1,594	0,162	0,010
Complex—Friendly	2,748	0,019	0,025
Detrimental—Beneficial	1,793	0,114	0,017

The Games-Howell post hoc test highlights Architecture as the academic major that varies the most with respect to the other majors in all pairs of attitude adjectives. Of all these pairs, the most relevant one is [Hindering—Facilitating], which indicates that there are significant differences between Architecture and Civil Engineering, Maritime Engineering, Electricity and Industrial Engineering.

The only exception is the adjective pair [Inaccurate—Precise], which indicates that there are differences between Architecture, Civil Engineering and Industrial Engineering; and between Maritime Engineering and Industrial Engineering. See Figure **3** and Figure **4** accordingly.

The Architecture major shows a notable trend towards positive responses, especially in the category "Totally facilitating," where it concentrates the majority of its responses. Industrial Engineering follows in second place in this category. In general, all majors tend to concentrate the most responses in positive attitude categories, both intermediate and high.

Table 8: Results of the Games-Howell Post Hoc test [attitudes & academic major]

Dependent variable	Academic major	Civil engineering	Maritime engineering	Electricity	Architecture	Industrial engineering	Food engineering
Unnecessary—Necessary	Architecture	0,017	-	0,013	-	0,041	-
Ineffective—Effective	Architecture	-	-	0.003	-	0,011	-
Worthless—Valuable	Architecture	0,014	-	0,033	-	0,003	-
Impractical—Practical	Architecture	0,020	-	0,001	-	-	-
Useless—Useful	Architecture	-	-	-	-	0,022	-
Hindering—Facilitating	Architecture	0,030	0,025	0,001	-	0,044	-
Trivial—Important	Architecture	0,028	-	0,015	-	-	-
Inaccurate—Precise	Maritime Engineering	-	-	-	-	0,034	-
	Architecture	0,016	-	-	-	0,000	-
Stupid—Smart	Architecture	0,015	-	0,022	-	0,024	-
Awkward—Comfortable	Architecture	-	-	0,034	-	-	-
Discouraging—Motivating	Electricity	-	-	-	0,047	0,036	-
Complex—Friendly	N/A	-	-	-	-	-	-
Detrimental—Beneficial	Architecture	-	-	0,402	-	0,281	-

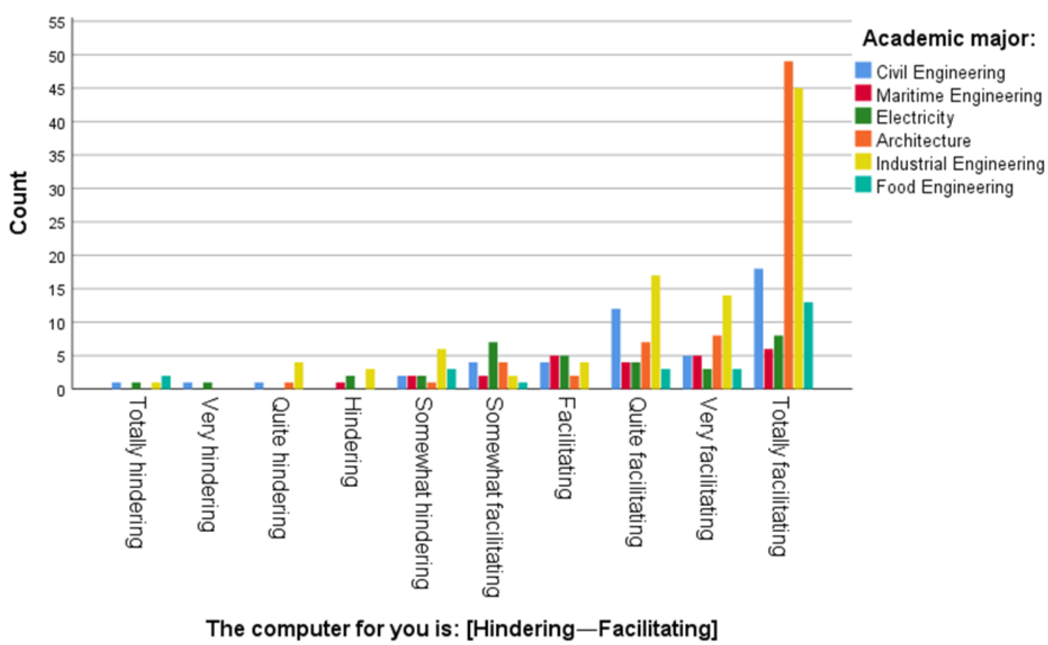

Figure 3: Bar chart of attitudes [Hindering—Facilitating], in relation to the academic major

Figure **4** shows that, in most categories, Industrial Engineering has a higher response count compared to Maritime Engineering and shows a trend towards positive responses. However, in the category "Totally precise," Architecture outperforms Industrial Engineering, registering the highest number of responses in this category.

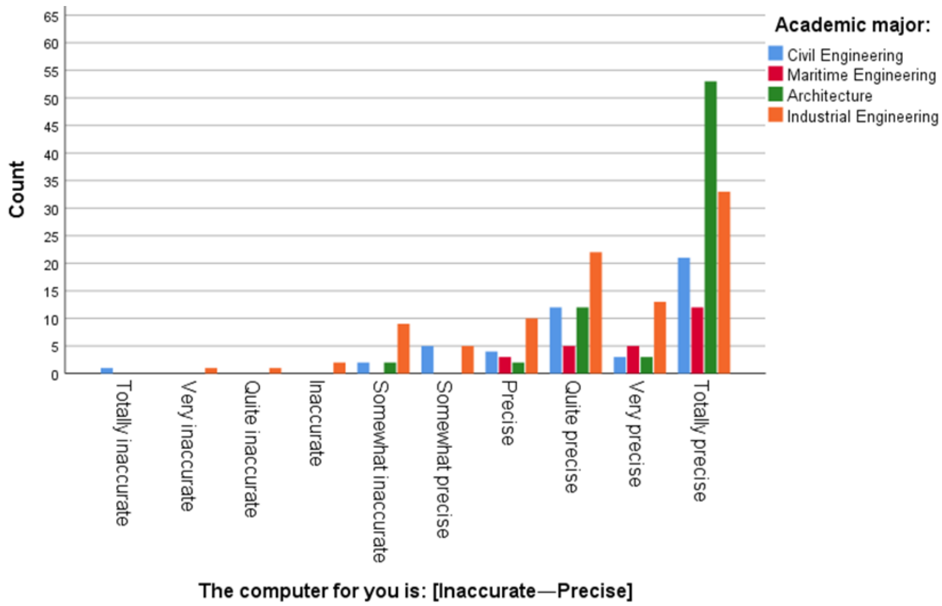

Figure 4: Bar chart of attitudes [Inaccurate—Precise], in relation to the academic major

Knowledge in relation to the semester

This section seeks to understand the relationship between students' knowledge and their semester of study. As such, the hypotheses are as follows:

- Ho: Students' knowledge towards the computer environment remains the same in relation to the semester they are studying.
- H1: Students' knowledge towards the computer environment has significant differences in relation to the semester they are studying.

Table **9** shows the data between knowledge and frequency of program use by semester, with mixed results. The Database, Simulation and Hypertexts programs have a p-value greater than 0.05; as such, the knowledge and frequency of use of these programs is similar between semesters. In contrast, for the rest of the programs, there are significant differences in knowledge and frequency of use between semesters ($p < 0.05$).

Table 9: Chi-Square test on programs [knowledge], in relation to the semester

Programs	df	Asymptotic significance (bilateral)	α	Decision rule
Text processors	36	0,046	0,05	Yes
Database	36	0,151	0,05	No
Spreadsheets	36	0,003	0,05	Yes
Drawing programs	36	0,004	0,05	Yes
Simulation	36	0,206	0,05	No
Hypertexts	36	0,163	0,05	No
Multimedia	36	0,038	0,05	Yes
Tutorial programs	36	0,013	0,05	Yes
Design programs	36	0,000	0,05	Yes
Modeling programs	36	0,000	0,05	Yes

As seen on Table **10**, Levene's test shows that the Hypertexts, Multimedia, Drawing, Design and Modeling programs have a significance lower than 0.05, evidencing differences in the variances between the groups for these programs. In contrast, the rest of the programs present a significance level higher than 0.05, demonstrating the homogeneity in the variances of these groups.

ANOVA results indicate that the value of the significances in most of the selected programs is less than 0.05. Thus, there are significant differences between the students' knowledge of these programs and their current semester of study, differing only on the Simulation and Hypertexts programs, whose significance values were greater than 0.05, indicating no significant differences.

Table 10: Levene's test [knowledge], in relation to the semester and ANOVA significance

Programs	Levene's test	Sig.	Sig. between groups
Text processors	1,387	0,193	0,000
Database	0,503	0,872	0,020
Spreadsheets	1,386	0,194	0,000
Drawing programs	2,923	0,002	0,010
Simulation	1,582	0,120	0,120
Hypertexts	2,048	0,034	0,134
Multimedia	2,508	0,009	0,001
Tutorial programs	1,671	0,096	0,004
Design programs	4,243	0,000	0,000
Modeling programs	3,982	0,000	0,000

The Games-Howell test shows significant differences in the use of programs between students of different semesters, except in Simulation programs. The most notable differences are found in Spreadsheets, where students in semester 8 differ from those in semesters 1, 2, 3 and 5. Differences are also observed in Modeling programs, where students in semester 6 differ from those in semesters 1, 2, 3, 5 and 8. These results are detailed in Table **11** and illustrated in Figures 5 and 6.

Table 11: Results of the Games-Howell Post Hoc test [programs & semester]

Dependent variable	Semester	6	7	8	9	10
Text processors	1	0,002	0,017	0,001	-	-
	3	0,019	-	0,011	-	-
Database	1	-	0,025	0,028	-	-
Spreadsheets	1	0,018	-	0,004	-	-
	2	-	-	0,004	-	-
	3	0,045	-	0,004	-	-
	5	-	-	0,034	-	-
Drawing programs	2	0,023	-	-	-	-
Simulation	N/A	-	-	-	-	-
Hypertexts	5	-	-	-	0,009	-
Multimedia	2	0,000	-	0,003	-	0,032
Tutorial programs	1	-	-	-	0,015	-
	2	-	-	-	0,014	-
	5	-	-	-	0,006	-
Design programs	2	0,000	0,002	-	-	0,018
	3	0,002	-	-	-	-
	5	0,019	-	-	-	-
	6	-	-	0,008	-	-
Modeling programs	1	0,035	-	-	-	-
	2	0,000	-	-	-	0,011
	3	0,000	-	-	-	-
	5	0,027	-	-	-	-
	6	-	-	0,036	-	-

As seen on Figure **5**, Semester 8 students show a more balanced use of spreadsheets, with significant counts in the "Frequently" and "Very Frequently" categories, and no records in the "Never" and "Rarely" categories, denoting a clear evolution in this program's use over the semesters. In parallel, students in semester 2 also have significant counts in the most frequent categories, even surpassing those in semester 8 in one of them, which could reflect the increasing complexity of academic tasks and greater digital competencies acquired over time. Figure **6** suggests that, as students advance in their training, particularly in semester 6, they increase their use of modeling programs. This may be attributed to the necessity of this digital expertise in more advanced semesters or particular projects that require it.

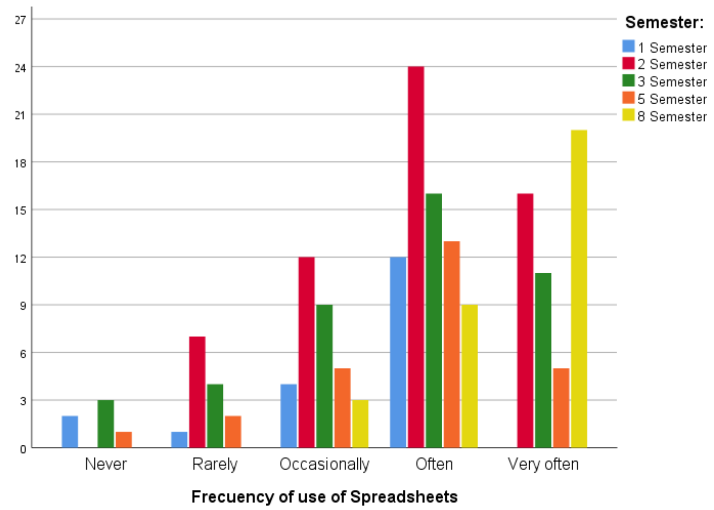

Figure 5: Bar chart of Spreadsheets' use, in relation to the semester

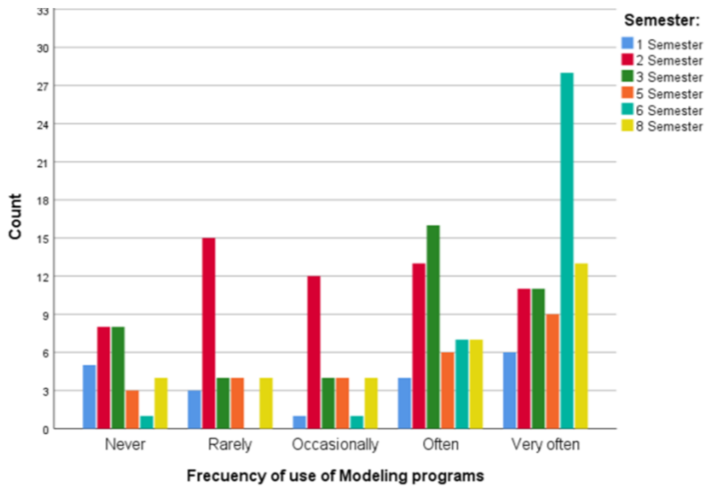

Figure 6: Bar chart of Modeling programs' use, in relation to the semester

Knowledge in relation to the academic major

This section seeks to understand the relationship between students' knowledge and their selected academic major. As such, the hypotheses are as follows:

- Ho: Students' knowledge towards the computer environment remains the same in relation to their selected academic major.
- H1: Students' knowledge towards the computer environment has significant differences in relation to their selected academic major.

Table **12** shows the data between knowledge and frequency of program use by academic major, with mixed results. Text processors, Hypertexts, Multimedia and Tutorial programs have a p-value higher than 0.05, indicating that knowledge in the use of these programs is similar among academic majors. In contrast, for the rest of the unmentioned programs, there are significant differences in the knowledge of their use between majors ($p < 0.05$).

As seen on Table **13** Levene's test shows that the Text processors, Drawing, Design and Modeling programs have a significance level of less than 0.05, indicating differences in the variances between groups. For the other programs, the significance level is greater than 0.05, thus confirming the null hypothesis and indicating homogeneity of variances between groups. ANOVA results show significant differences in the knowledge of use of most of the programs between majors ($p < 0.05$), except for Hypertexts and Tutorial programs, where the significance values are greater than 0.05. For these two programs, the null hypothesis was accepted, evidencing no significant differences.

Table 12: Chi-Square test on programs [knowledge], in relation to the academic major

Programs	df	Asymptotic significance (bilateral)	α	Decision rule
Text processors	20	0,081	0,05	No
Database	20	0,025	0,05	Yes
Spreadsheets	20	0,008	0,05	Yes
Drawing programs	20	0,000	0,05	Yes
Simulation	20	0,050	0,05	Yes
Hypertexts	20	0,720	0,05	No
Multimedia	20	0,058	0,05	No
Tutorial programs	20	0,318	0,05	No
Design programs	20	0,000	0,05	Yes
Modeling programs	20	0,000	0,05	Yes

Table 13: Levene's test [knowledge], in relation to the academic major and ANOVA significance

Programs	Levene's test	Sig.	Sig. between groups
Text processors	3,377	0,006	0,030
Database	0,999	0,418	0,019
Spreadsheets	0,487	0,786	0,006
Drawing programs	6,329	0,000	0,000
Simulation	1,001	0,417	0,002
Hypertexts	0,283	0,922	0,224
Multimedia	1,500	0,190	0,006
Tutorial programs	0,329	0,895	0,402
Design programs	4,396	0,001	0,000
Modeling programs	3,196	0,008	0,000

The Games-Howell test highlights most of the programs with significant differences, except for Hypertexts and Tutorial programs. As seen on Table **14**, Industrial Engineering stands out for presenting more differences in the use of programs compared to other majors, especially in Design programs and Modeling programs, where it is observed that this major differs from the rest, except for Food Engineering.

Table 14: Results of the Games-Howell Post Hoc test [programs & academic major]

Dependent variable	Academic major	Civil engineering	Maritime engineering	Electricity	Architecture	Industrial engineering	Food engineering
Text processors	Industrial engineering	0,002	-	-	-	-	-
Database	Civil Engineering	-	-	-	0,025	-	-
Spreadsheets	Civil Engineering	-	-	-	0,005	0,008	-
Drawing programs	Civil Engineering	-	-	-	-	0,000	-
	Architecture	-	-	0,026	-	0,000	0,023
Simulation	Industrial engineering	0,003	-	0,019	-	-	-
Hypertexts	N/A	-	-	-	-	-	-
Multimedia	Architecture	-	-	-	-	0,003	-
Tutorial programs	N/A	-	-	-	-	-	-
Design programs	Industrial engineering	0,000	0,021	0,000	0,000	-	-
	Architecture	-	-	-	-	-	0,007
Modeling programs	Industrial engineering	0,000	0,026	0,000	0,000	-	-
	Architecture	-	-	-	-	-	0,050

Figure **7** and Figure **8** show that, in general, all the majors show a low incidence in the use of Design and Modeling programs. A notable exception to this statement is the Industrial Engineering major, which is present in all the categories of frequency of use, being only surpassed in the

"Very Frequent" use of both programs by the Architecture major.

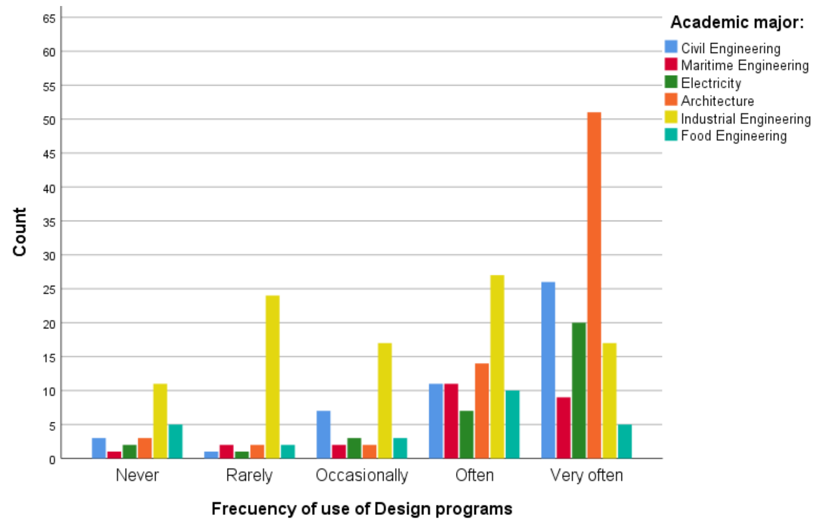

Figure 7: Bar chart of Design programs' use, in relation to the academic major

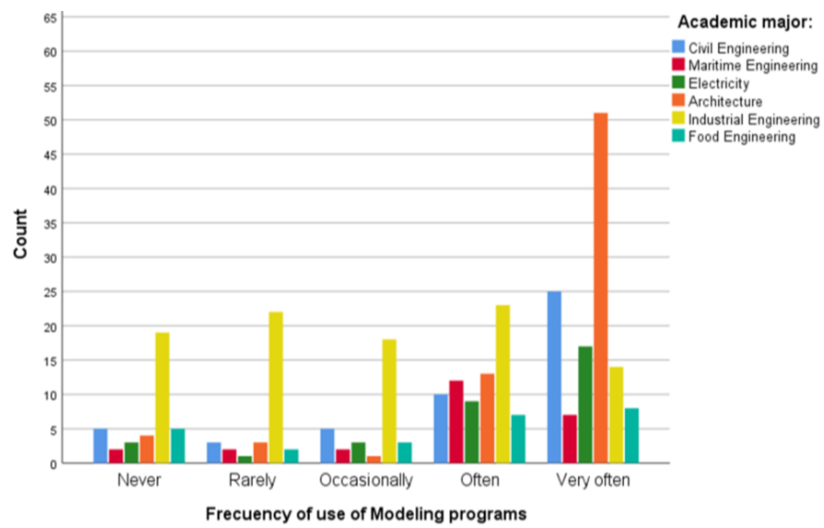

Figure 8: Bar chart of Modeling programs' use, in relation to the academic major

Analysis Overview

The attitude towards the computer medium is generally positive, since the computer represents for the students a TOTALLY necessary, effective, valuable, useful and intelligent instrument (Med = 10), as well as being VERY entertaining, agile, pleasant, practical, facilitating, controllable, comfortable and beneficial (Med = 9), it is also considered to be VERY manageable, simple, educational and essential (Med = 8). The students also consider that the computer is a socializing instrument (Med = 7), but of individual use (Med = 5).

As seen on Figure **9** the pair of attitude adjectives [Unnecessary—Necessary], has a cumulative percentage of 87.46% in positive responses, which corroborates that the vast majority of students consider the computer media provided by the computer as Necessary.

More than half of the students qualify the computer as an individual medium, with 55.11% of accumulated percentage of negative answers, leaving the rest with an accumulated percentage of 44.89% who consider, on the contrary, that it is a group medium

Table 15: Attitudes about the computer

Pair of adjectives	Mo	M	Z min.	Z max.	Median
Boring—Entertaining	10	8,01	1	10	9,00
Rigid—Flexible	10	6,92	1	10	7,00
Unfair—Manageable	10	7,85	1	10	8,00
Clumsy—Agile	10	8,33	1	10	9,00
Unnecessary—Necessary	10	8,52	1	10	10,00
Unpleasant—Pleasant	10	8,13	1	10	9,00
Ineffective—Effective	10	8,63	1	10	10,00
Complicated—Simple	10	7,38	1	10	8,00
Worthless—Valuable	10	8,63	1	10	10,00
Malignant—Educational	10	7,87	1	10	8,00
Impractical—Practical	10	8,49	1	10	9,00
Useless—Useful	10	8,75	1	10	10,00
Hindering—Facilitating	10	8,36	1	10	9,00
Trivial—Important	10	8,63	1	10	9,00
Uncontrollable—Controllable	10	8,35	1	10	9,00
Inaccurate—Precise	10	8,55	1	10	9,00
Expendable—Essential	10	7,80	1	10	8,00
Isolator—Socializer	10	6,62	1	10	7,00
Stupid—Smart	10	8,60	1	10	10,00
Awkward—Comfortable	10	8,00	1	10	9,00
Discouraging—Motivating	10	7,80	1	10	8,00
Usual—Novel	10	7,23	1	10	8,00
Complex—Friendly	10	7,73	1	10	8,00
Inaccesible—Accesible	10	8,00	1	10	8,00
Individual—Group	5	5,48	1	10	5,00
Detrimental—Beneficial	10	8,33	1	10	9,00

Where: 1= Totally negative; 2= Very negative; 3= Quite negative; 4= Negative; 5= Somewhat negative; 6= Somewhat positive; 7= Positive; 8= Quite positive; 9= Very positive; 10= Totally positive.

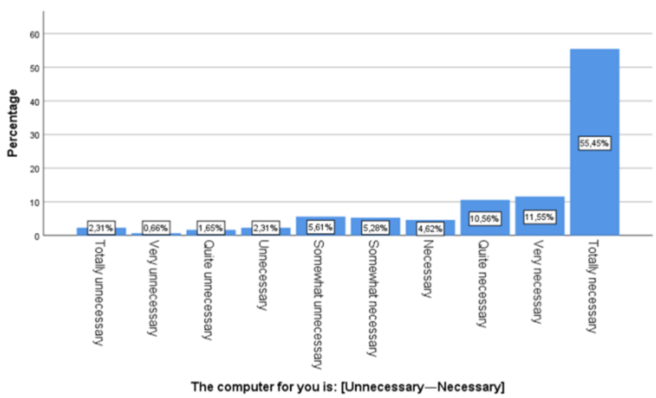

Figure 9: Bar chart of attitude [Unnecessary-Necessary]

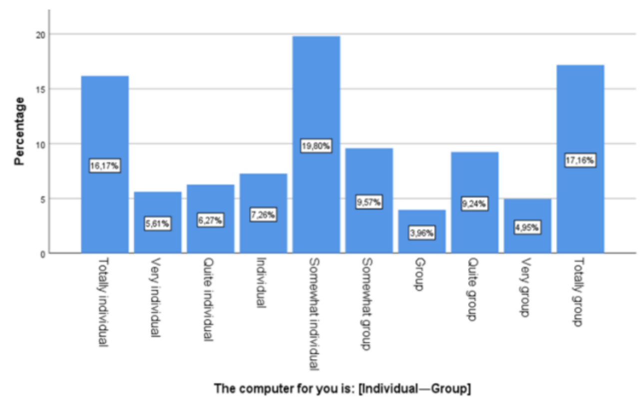

Figure 10: Bar chart of attitude [Individual—Group

Table **16** results show that Text processors, Database, Spreadsheets, Videogames, Simulation, Hypertexts, Drawing, Tutorial, Design and Modeling programs are FREQUENTLY used by students (Med = 4) and multimedia programs are VERY FREQUENTLY used (Med = 5). Programs such as hypertexts have a significantly lower usage, being used RARELY or OCCASIONALLY (M = 2.73 and Med = 3).

A 49.17% of the students use Hypertexts programs infrequently or not at all, while 37.29% of the students expressed that they use this program frequently, leaving the remaining 13.53% with an occasional frequency of use.

Table 16: Knowledge about the use of programs

Program use	Mo	M	Z min.	Z max.	Median
Text processors	5	3,92	1	5	4,00
Database	4	3,45	1	5	4,00
Spreadsheets	4	4,01	1	5	4,00
Drawing programs	5	3,84	1	5	4,00
Videogames	5	3,81	1	5	4,00
Simulation	5	3,57	1	5	4,00
Hypertexts	1	2,73	1	5	3,00
Multimedia	5	4,17	1	5	5,00
Tutorial programs	5	3,51	1	5	4,00
Design programs	5	3,85	1	5	4,00
Modeling programs	5	3,69	1	5	4,00
Where: 1= Never; 2= Rarely; 3= Occasionally; 4= Often; 5= Very Often					

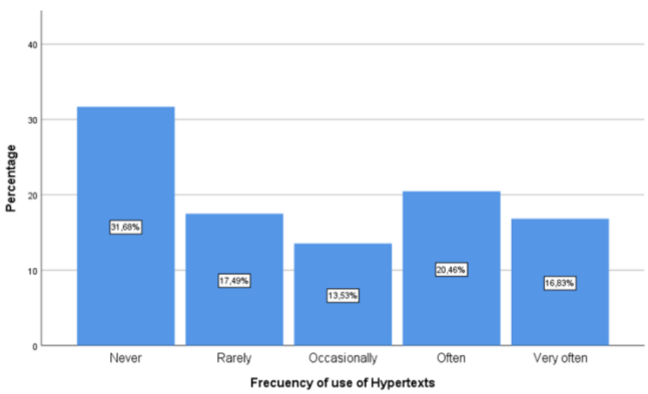

Figure 11: Bar chart of knowledge in program use [Hypertexts]

The vast majority of students indicated that they use Spreadsheets, with 75.57% of them using it frequently, as opposed to 8.91% of students who reported never using this program or using it infrequently. The remaining 15.51% use it occasionally.

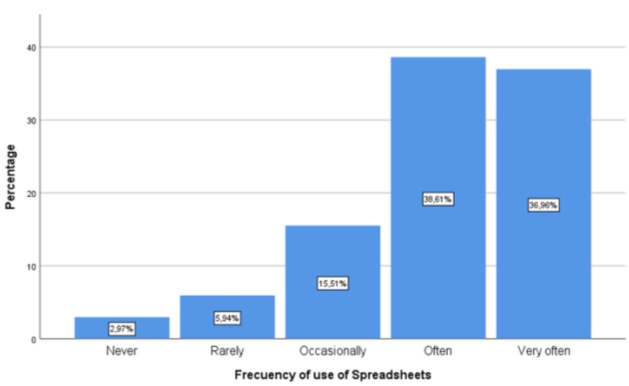

Figure 12: Bar chart of knowledge in program use [Spreadsheets]

79.54% of the students indicated that they frequently use multimedia programs, in contrast to 9.24% of the students who reported using this program infrequently or not at all, with the remaining 11.22% of students using it occasionally.

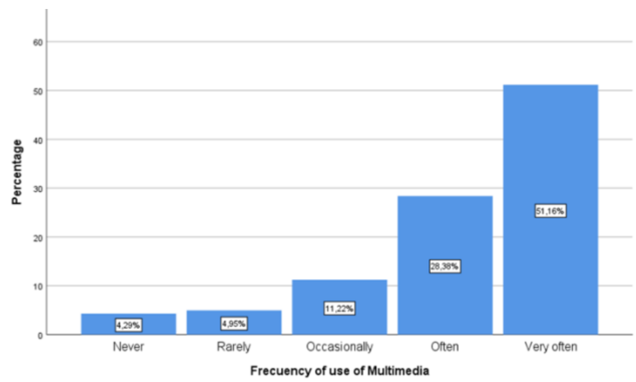

Figure 13: Bar chart of knowledge in program use [Multimedia]

5. Discussion

This study evaluated the perception of attitudes and knowledge in digital environments among students of different majors and semesters of the Faculty of Engineering, Industry and Architecture of the Universidad Laica Eloy Alfaro de Manabí, using the ACMI questionnaire of Amorós-Poveda (2019). To address the research questions, frequency tables and both descriptive and inferential analyses were conducted using the SPSS software, comparing data from the employed digital questionnaire by contrasting the variables of the dimension of attitudes and knowledge across different majors and semesters.

The attitudes and knowledge of the students have shown positive results, with most of them having a good knowledge of the use and management of technological media. Most of the medians in the frequency tables have results close to the upper limits (Med = 10 and 9 in attitudes; Med = 4 and 5 in knowledge). These results coincide with the study by Bernate et al. (2021), where they were able to show that most of the people sampled had a good knowledge of the use and management of technological media by obtaining an approximate mean of 5 on a Likert scale in a variable that evaluated digital literacy. Despite that, there are areas for improvement, since in their sample there were registers closer to lower values.

Among the key findings, it was found that most students consider computers to be accessible, especially in advanced semesters, with Architecture and Industrial Engineering students standing out, who perceive the computer as a facilitator instrument.

It was observed that the use of specialized programs, such as Excel and AutoCAD, increases in higher semesters due to the academic and professional demands of certain majors. Architecture and Industrial Engineering stood out in the frequency of use of these programs, essential in their fields, while in other careers the general use of software predominated. However, no use or limited use of tutorials and hypertexts was identified in all majors.

In the open-ended questions, many students noted the importance of handling specialized software and the Office Suite, expressing interest in receiving free, personalized training from the university. They also shared mixed opinions about the impact of technology in their professional fields, reflecting expectations about future changes.

Finally, when comparing the results obtained with those of other related studies, it can be seen that the ACMI questionnaire has a very general evaluative approach that does not allow it to make more specific comparisons to studies such as those of León-Pérez et al. (2020) and Restrepo-Palacio and Segovia (2020), where they have a different questionnaire design and results analysis based on the formulated variables.

6. Conclusiones

Among the results obtained in the analysis of each question, it stands out that the vast majority of students of the Faculty of Engineering, Industry and Architecture have positive attitudes towards the computer environment. Students possess knowledge and frequently use various computer programs that allow them to function in digital environments, such as the use of Spreadsheets, Design programs and modeling, etc. Conversely, there is a large percentage of students who do not know about Hypertexts and use them infrequently or not at all.

Through the open questions applied on the survey, the students evidenced their opinions about the digital skills that they consider important and useful in their respective majors and about the training they would like to receive. Students have positive expectations of their future and are interested in acquiring skills that are useful for them to face the trends of the labor market.

The ACMI questionnaire has proven to be effective in generally assessing students' digital competencies. However, areas for improvement were identified that could optimize its applicability. It is suggested to reduce the number of variables to simplify its use and to adjust the identification dimension, limiting it to the categories "Male" and "Female" to avoid interpretation errors. In addition, it would be pertinent to update the questionnaire by incorporating variables related to current trends, such as artificial intelligence and Big Data, in the dimensions of attitudes and knowledge. This would respond to students' expectations about the impact of these technologies on their training and professional future, broadening the relevance and accuracy of the assessment.

These findings prompt reflection on how activities that previously required a face-to-face environment can now be conducted digitally, often with more agility and efficiency. As time progresses, conventional work methodologies will transform, making it essential for students to navigate digital surroundings in a forthcoming era where their digital competencies will increasingly have more significance.
This initial research paves the path for potential subsequent studies utilizing the acquired data, with the ongoing objective of enhancing the digital competencies of future professionals.

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