Integration of ICT in the Attitudes and Knowledge of University Students

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Abstracts

This article arises in the Ecuadorian context of Higher Education where the insertion of Information and Communication Technologies (ICT) has a considerable impact on the knowledge and attitudes of students. The purpose of the research is to analyze the integration of ICT in attitudes and knowledge in students of the Bolivar State University in the careers of Accounting and Business Administration. The methodology used in a sample of 150 students presents a quantitative research design, exploratory type, correlational scope and cross-sectional; in addition, an exploratory factor analysis, KMO sample adequacy and Bartlett's test were used, central trend and dispersion measures, Pearson's correlation. The results show that, despite the direct relationship between the variables, there are no statistically significant differences between knowledge and attitude, that is, the perception and understanding of ICTs between the two cohorts of students are similar. It is concluded that students have an average level of knowledge about ICT and their attitude to the use of them is indifferent.

Keywords: Attitudes, Information and Communication Technologies, Knowledge, university students.

1. Introduction

The integration of Information and Communication Technologies (ICT) in the educational field has become the cornerstone of the teaching process, especially at the higher education level, since it is essential to adapt to the contemporary and innovative education system that seeks the development of new academic methodologies, technological platforms and pedagogical approaches that take full advantage of these tools.

ICT has become an integral part of modern society and has brought about significant changes in business, institutions and education, since, it encompasses various technologies used for

information processing, storage, transmission and retrieval and which are capable of improving the internal functioning, service delivery and teaching methods in universities (Gargallo, 2018).

Therefore, these tools present a number of benefits in the educational process, from the creation and sharing of open educational resources, providing alternative materials for teaching and learning; to innovative methods to fulfill this process, for example, the facility provided for distance learning. Thus, the strategic integration of these elements in higher education requires clear institutional changes, the training of educators and the development of students' digital literacy skills (Espíritu et al., 2022).

Several previous researches have examined the effects of ICT integration on students' attitudes and knowledge, this is the case of a study by Martinez et al. (2021) that analyzed how the implementation of digital learning platforms influenced students' participation and perception of the usefulness of technology. Where findings imply that, while ICTs have the potential to improve the accessibility and flexibility of education, they also pose challenges in terms of interaction and active participation.

In contrast, research such as that conducted by Pacheco and Martínez (2021) has focused on evaluating the influence of ICTs on academic performance and the acquisition of specific competencies. This study revealed that the effective assimilation of the digital technology tool was positively linked to the cultivation of critical skills, such as analytical thinking and problem solving.

Likewise, research by Paz et al. (2022) has drawn attention to the importance of diffusing innovation, stating that the reception and integration of technology depends to a large extent on personal attitudes towards novelty. In education, this translates into the need to understand students' perceptions of and connections to ICT, and how these perceptions influence their engagement and participation in the educational process.

Thus, despite all the benefits of adopting these tools in higher education, it is not an easy task to fully implement this change, since there are several factors (external and internal) that make it difficult to integrate these technological mechanisms into the teaching-learning process. Circumstances such as scarcity of resources, lack of training and support for teachers, inadequate infrastructure, teachers' attitudes and beliefs, complicate the implementation of ICT in universities (Gonzáles, 2015). However, there are also factors directly related to students that limit the fulfillment of this process, emphasizing the attitude towards the use of ICT for educational purposes, their skills and basic knowledge in this field.

The integration of technological resources in higher education emerges as an essential pillar in the teaching process, responding to the need to adapt to a contemporary and innovative educational system, this change leads to the creation of academic methodologies and pedagogical approaches that maximize their potential. Encompassing diverse technologies, causing significant transformations in modern society, impacting companies, institutions and, especially, education.

Therefore, the article aims to analyze the integration of ICT in attitudes and knowledge in students of the Bolivar State University, Faculty of Administrative Sciences in the careers of

Accounting and Business Administration through a statistical study, where the ACUTIC questionnaire will be used, designed to assess the attitude, knowledge and use of ICT in students, providing a detailed perspective of the integration of these digital tools in higher education.

2. Methods

In order to fulfill the proposed objective, this quantitative research is exploratory and cross-sectional.

Materials

The target population for the research comprises a total of 150 university students, belonging to two careers: 60 Business Administration students and 90 accounting students. The instrument used was the "Questionnaire for the study of attitude, knowledge and use of ICT (ACUTIC)", which is a tool designed for the purpose of investigating aspects related to ICT, classifying the data collected in different sections such as attitudes and knowledge of university students.

Considering the research by Mirete et al. (2015) regarding the ACUTIC questionnaire, it indicates that the initial section of the questionnaire focused on students' attitudes towards ICTs, employing questions aimed at delving into their willingness to incorporate technological advances in their academic and daily lives. Its objective was to learn about their perception of the importance of ICTs in personal and professional development, as well as in the learning process. The next section was devoted to assessing the students' level of knowledge in relation to ICTs. It covered aspects such as their familiarity with specific software, their understanding of fundamental technological concepts and their ability to effectively use digital tools in the academic environment. This component facilitated the identification of gaps in the participants' technological knowledge. Finally, the third section examines students' use of ICTs and the ease with which they access digital resources, also analyzing any barriers that may affect their experience with technology.

For the resolution of the questionnaire, a rating scale has been incorporated for each dimension. The instructions given were to complete the questionnaire indicating the option that most closely aligns with your personal identification. The instrument was administered uniformly to both groups, which ensured the representativeness of the responses. Emphasis was placed on providing clear instructions and formulating the questions in a neutral manner, with the aim of mitigating possible biases. The data collected were subjected to exhaustive statistical analysis with the aim of identifying patterns, trends and possible correlations between the variables studied.

Participants

The selection of participants for the research was meticulously carried out, taking into account their academic level and distribution in two specific fields of study. The study was carried out at the Faculty of Administrative Sciences of the Bolivar State University.

According to the researcher's criteria, it was decided to include all students in the first semester of the Business Administration course, with a total of 60 participants, and all students in the first

semester of the accounting course, with a total of 90 participants. This decision was based on the fact that these students are exposed to the ICT subject in their curriculum in the specific semesters chosen. In addition, it was presumed that students in the more advanced stages of their education would have a better understanding and familiarity with the use of technologies compared to students in the initial semesters.

Table 1. Distribution of participants involved in the research

		Career		Total
		Business Administration	Accounting	
Gender	Male	37	44	81
	Female	23	46	69
Total		60	90	150

Source: Own elaboration using SPSS Software (2024).

Table 1 presents the distribution of students by gender and career in a total sample of 150 participants, divided between the careers of Accounting and Business Administration. It is worth mentioning that, in accounting, the number of female students (46) slightly exceeds the number of male students (44), while in Business Administration, the number of male students (37) is higher than the number of female students (23). Overall, the complete sample consists of 81 male students and 69 female students.

Thus, the participant selection process followed ethical and transparent principles. The necessary authorization was obtained from the academic authorities and the objectives and procedures of the research were explained in detail to the selected students. Participation in the study was voluntary and strict confidentiality measures were implemented to safeguard the data collected. The questionnaire was administered face-to-face, which allowed direct interaction with the participants and facilitated the resolution of any doubts that might arise. Maintaining effective communication with the students was crucial to ensure the accuracy of their responses and minimize possible biases.

Tasks and Methods

The following methods have been used for the analysis and processing of the data obtained.

Cronbach’s alpha

To evaluate the internal consistency of the ACUTIC instrument, an analysis using Cronbach's alpha coefficient was employed. This statistical measure is commonly used to evaluate the internal consistency of a set of items within a measurement instrument, such as a questionnaire or a scale.

Cronbach's alpha coefficient ranges from 0 to 1, with a higher value indicating greater internal consistency between items. This suggests that the items consistently measure the same construct. Conversely, a lower Cronbach's alpha, closer to 0, indicates weaker internal consistency and increases the possibility that the items are not effectively measuring the same construct. It should be noted that a high Cronbach's alpha does not automatically guarantee the validity of the instrument. Rather, it only signifies internal consistency (Luzuriaga et al., 2023).

The process of calculating Cronbach's alpha coefficient involves determining the average correlation between all possible pairs of instrument items. This analysis is particularly valuable in fields such as social research, psychology, education and other disciplines where accurate and reliable measurement of constructs is of utmost importance.

Pearson correlation

This research will also employ Pearson's correlation, a statistical measure used to evaluate the linear association between two continuous variables (Fiallos, 2021). This measure is calculated by dividing the covariance of the two variables by the product of their standard deviations. The resulting coefficient ranges from -1 to 1, whereby values close to -1 indicate a perfect negative correlation, values close to 1 indicate a perfect positive correlation, and a value of 0 suggests the absence of a linear correlation.

Mann – Whitney U test

The Mann-Whitney U test, a nonparametric statistical tool that compares the medians of two independent groups, will also be used. This test is useful for ordinal or interval variables without assumptions of normality. The U-test evaluates whether the samples are from the same population, based on ranks and sums of ranks. If the sums of the ranks differ significantly, the median differences are significant. This test, it is valuable in the analysis of nonparametric data without assuming normal distributions (Ramírez & Polack, 2020).

Exploratory factor analysis

Exploratory factor analysis (EFA) will also be considered for this study. EFA is a statistical technique that identifies patterns in multivariate data. Its objective is to reduce the dimensionality of variables by identifying fewer latent factors that explain most of the variance in the data. The proportion of the total variance explained by the selected factors of the model indicates its effectiveness in summarizing the original variables; for the dimensions to be valid, the cumulative % must be greater than 0.50 or 50%. For its part, Varimax rotation simplifies the interpretation of the factors by maximizing the variance of the squares of the loading coefficients, which reveals clearer patterns in the resulting factor structure (Ledesma et al., 2019).

Sampling adequacy KMO and Bartlett’s test

This study also includes the KMO and Bartlett tests that are important in exploratory factor analysis. The KMO measures the proportion of variance in the observed variables that can be explained by latent factors. A KMO close to 1 indicates a good fit. Bartlett's test tests whether there is a relationship between the variables. A significant result allows to continue with the AFE. These tests are crucial for the adequacy of the data and the validity of the results in AFE (Pizarro & Martínez, 2020).

3. Results

The results derived from this exploratory study carried out at the Faculty of Administrative Sciences are presented below, providing fundamental evidence that contributes to the statistical support of the research:

Table 2. Sampling adequacy KMO and Bartlett's Sphericity

Kaiser-Meyer-Olkin measure of sampling adequacy		0,735
Test of sphericity Bartlett's test	Approx. chi-square	1360,897
	gl	171
	Sig.	0,000

Source: Own elaboration using SPSS Software (2024).

Prior to the exploratory factor analysis, it is necessary to use a sample adequacy KMO, since this measure evaluates the adequacy of the data to carry out the factorization process. In this case, the value of 0.735 indicates that the sample is suitable for factor analysis.

In addition, Bartlett's Sphericity test with a significance value of 0.000, and an approximate Chi-square of 1360.897, reveals that the null hypothesis of sphericity can be rejected. This means that there is sufficient correlation between the variables to justify performing a factor analysis.

Table 3. Total explained variance of the factors of the instrument

Component	Initial eigenvalues			Sums of loads squared by extraction		
	Total	% variance	% accumulated	Total	% variance	% accumulated
1	11,243	36,268	36,268	11,243	36,268	36,268
2	5,834	18,819	55,087	5,834	18,819	55,087
3	2,789	8,997	64,084	4,456	2,450	57,537
4	2,263	7,300	71,384			
5	1,735	5,597	76,981			
6	1,508	4,865	81,845			
7	0,852	2,748	84,594			
8	0,715	2,306	86,900			
9	0,648	2,090	88,990			
10	0,521	1,681	90,671			
11	0,507	1,635	92,306			
12	0,439	1,416	93,723			
13	0,358	1,155	94,877			
14	0,313	1,010	95,887			
15	0,216	0,697	96,584			
16	0,209	0,674	97,258			
17	0,188	0,606	97,865			
18	0,135	0,435	98,300			
19	0,091	0,294	98,594			

Source: Own elaboration using SPSS Software (2024).

Table 3 presents the total variance explained by the factors of the ACUTIC instrument. The first two components significantly explain 55.09% of the variance, suggesting substantial

representation. As subsequent components are examined, the contribution to variance gradually decreases, showing that the first two factors, "Attitude" and "Knowledge", capture most of the information.

Table 4. Matrix of rotated components

Items	Coefficient in factor
Factor 1: Attitude towards the use ofICTs	
Attitude item 1	0,675
Attitude item 2	0,692
Attitude item 3	0,683
Attitude item 4	0,749
Attitude item 5	0,701
Attitude item 6	0,657
Attitude item 7	0,584
Factor 2: Level of ICT Knowledge	
Knowledge item 8	0,663
Knowledge item 9	0,759
Knowledge item 10	0,746
Knowledge item 11	0,581
Knowledge item 12	0,628
Knowledge item 13	0,684
Knowledge item 14	0,578
Knowledge item 15	0,657
Knowledge item 16	0,671
Knowledge item 17	0,662
Knowledge item 18	0,721
Knowledge item 19	0,715
Factor 3: Use of ICT	
Use item 20	0,173
Use item 21	0,149
Use item 22	0,238
Use item 23	0,251
Use item 24	0,175
Use item 25	0,526
Use item 26	0,225
Use item 27	0,231
Use item 28	0,592
Use item 29	0,187
Use item 30	0,156
Use item 31	0,203
Extraction method: Principal component analysis. Removed weights < 0.50 Rotation method: Varimax normalization with Kaiser.	

Source: Own elaboration using SPSS Software (2024).

This table shows that the first two dimensions are significant due to the high loading coefficients in the rotated component matrix, because they exceed the relative 0.50. Furthermore, these coefficients indicate a robust relationship between the items and the "Attitude" and "Knowledge" dimensions. The structure is clear and the substantial loadings on these components suggest that they are critical in explaining the variance in the data, justifying their consideration as significant dimensions in the analysis. However, in the context of the Varimax rotation, the items associated

with the "Use" dimension show significantly low loading coefficients, at least 10 below the lower boundary of0.50. Since the items related to "Use" do not meet this criterion, it was decided to eliminate the third dimension, since it does not contribute significantly to the explanation of the variance in the data.

Table 5. Reliability of the instrument

Dimensions	Specification	Cronbach's coefficient alpha	Elements
Knowledge	Identifies the level of knowledge that students have about some ICTs.	0,928	12
Attitudes	Determines the attitudes presented by students in the use of ITCs.	0,895	7
Instrument "Questionnaire for the study of the attitude, knowledge and use of ICT (ACUTIC)".		0,912	19

Source: Own elaboration using SPSS Software (2024).

Cronbach's alpha coefficient of 0.928 for the knowledge dimension indicates high internal consistency among the items that assess students' knowledge of some ICTs. Similarly, the obtained coefficient of 0.895 for the attitudes dimension reveals a high reliability among the items of this dimension that measure students' attitudes towards the use of ICTs. Finally, the ACUTIC instrument as a whole shows high consistency, with a Cronbach's alpha coefficient of 0.912 that allows its reliable application.

Table 6. Descriptive statistical analysis by careers

Careers	Factors	Average	Minimum	Maximum	Standard deviation
Business Administration	Knowledge	3,06	1,50	3,83	0,38
	Attitudes	3,04	1,57	4,43	0,56
Accounting	Knowledge	2,98	2,08	4,00	0,41
	Attitudes	3,07	1,71	4,29	0,57
Total	Knowledge	3,01	1,5	4	0,40
	Attitudes	3,06	1,57	4,43	0,56

Source: Own elaboration using SPSS Software (2024).

When evaluating the knowledge of certain ICT in the Faculty of Administrative Sciences, it is observed that the overall average is 3.01, approaching 3 on the Likert scale. This result indicates that, as a whole, the students of Accounting and Business Administration present a knowledge considered "medium level" about ICT. The observed minimum of 1.50 is close to 2, suggesting a "low level of knowledge", while the maximum of 4 represents a "high level" of knowledge. The standard deviation of the data, overall, in this dimension is 0.40.

As for attitudes toward ICT, the mean is 3.06, reflecting an "indifferent average attitude" of the students. The minimum point of 1.57 is close to 2, indicating a "disagree attitude", while the maximum of 4.43, close to 4, suggests that students "agree" with ICT in the learning process. The standard deviation of the data in this dimension is 0.56.

Continuing with the specific analysis, by careers, it is evident that the students of Business Administration have an average knowledge of 3.06, which is close to 3 and means that the

students of this career have an estimated "medium level" knowledge about ICT. On the other hand, regarding attitudes about ICTs, an average of 3.04 is observed, which is close to 3 and indicates that students are "in agreement" with them.

Finally, it is interpreted that accounting students present an average knowledge of 2.98 close to 3, which represents a "medium level" of knowledge towards ICT. In addition, in the attitude dimension, students indicate having an "indifferent attitude" towards ICT, since the average of 3.07, which is close to 3, symbolizes this level.

Table 7. Pearson's correlation between Knowledge and Attitudes dimensions

		Knowledge	Attitudes
Knowledge	Correlation Pearson's	1	0,832
	Sig. (bilateral)		0,000
	N	150	150
Attitudes	Correlation Pearson's	0,832	1
	Sig. (bilateral)	0,000	
	N	150	150

Source: Own elaboration using SPSS Software (2024).

Table 7 shows an analysis of the correlation between the dimensions of knowledge and attitudes towards ICT, which is examined through the correlation coefficient of Pearson. The coefficient obtained is 0.832; this positive value close to 1 indicates a strong positive relationship between the two dimensions. In other words, there is a significant positive association between knowledge and attitudes towards ICTs, a relationship that shows that as the level of knowledge about ICTs increases, attitudes towards this topic also tend to increase. In addition to the above, the bilateral significance of 0.000 shows that the correlation is statistically significant, which reinforces the confidence in the relationship found.

Table 8. Contrast statistics

	Knowledge	Attitude
Mann-Whitney U	840	956
W for Wilcoxon	135	231
Z	3,45	3,95
Asymptotic sign (bilateral)	0,078	0,083

a. Grouping variable: Student's career

Source: Own elaboration using SPSS Software (2024).

In the table provided, contrast statistics are presented between two groups of students according to their career (Accounting and Business Administration). The Mann-Whitney U has a value of 840 for Knowledge and 956 for Attitude. Wilcoxon's W values are 135 and 231, respectively. The Z values are 3.45 and 3.95 for Knowledge and Attitude, respectively. The asymptotic (bilateral) significance values are 0.078 and 0.083 for Knowledge and Attitude, respectively. These results suggest that, although the values of U, W, and Z are different between the two variables, the significance values (p) are greater than 0.05 for both, indicating that there is insufficient evidence to reject the null hypothesis that there are no significant differences between the groups in terms of Knowledge and Attitude. In other words, no statistically

significant differences were found in Knowledge and Attitude between the different careers of the students.

4. Discussion

The present research by means of a statistical analysis revealed notable aspects related to the incorporation of ICT in the evaluated educational environment. In the study, in general terms, no statistically significant differences were found between the variables Knowledge and Attitude among students of Accounting and Business Administration majors of the Faculty of Administrative Sciences of the Bolivar State University. This finding implies that, within the context examined, there is a similarity in the perception and understanding of ICT between the two cohorts of students.

The students' attitude towards the use of ICTs, measured with the ACUTIC questionnaire, demonstrates the students' optimistic inclination towards the integration of these technologies in their educational trajectory. This coincides with previous academic work such as that of Paz et al. (2022) which emphasizes the importance of a positive outlook in order to take full advantage of the educational possibilities offered by ICTs.

Regarding knowledge, the findings suggest that students possess a satisfactory degree of understanding regarding the use and implementation of ICTs in the academic environment. These findings can be interpreted as indicative of the growing knowledge of digital technologies by young people, who, for the most part, have grown up in an environment immersed in electronic devices and Internet-based services (Martínez et al., 2021).

In addition, the research emphasizes the importance of taking into account students' attitudes and knowledge as they are correlated factors. A favorable attitude has the potential to influence the student's desire to acquire knowledge in relation to ICT and, conversely, the acquisition of knowledge can also influence their attitude. This supports the idea of Pacheco and Martinez (2021) who mention that ICT training should encompass a comprehensive approach, encompassing not only the acquisition of technical skills, but also the cultivation of positive attitudes towards their educational use.

Limitations of this study include the exclusive focus on one university, which limits the generalizability of the results to other university contexts. In addition, the research relied on self-reports provided by students, which could introduce biases and limitations that could hinder the objectivity of the data. Thus, future research could explore institutional diversity and employ a combination of methodologies to gain a comprehensive understanding. In addition, incorporating educators' views and assessing the effectiveness of ICT integration strategies in higher education could enrich future analyses.

5. Conclusions

In conclusion, this study has revealed that the integration of ICT in higher education is fundamental, especially in the Knowledge and Attitudes dimensions. The statistical results

obtained, by means of an exploratory factor analysis process, show that these two categories of the instrument used are significant and explain the variance of the data.

Throughout the research, it has also been shown that the level of knowledge about ICTs among students of Accounting and Business Administration at the Bolivar State University is of medium scale. In addition, the attitude they present when they use them, on average is indifferent. This is due to the fact that, despite the growing importance of ICT in today's society, the implementation in the educational field has not reached its full potential.

In addition, the high and positive correlation obtained between the variables of analysis shows that as the level of ICT knowledge increases among students, they also tend to show more positive attitudes towards the use and application of these technologies. Therefore, it is recommended to strengthen ICT training, since it could have a positive impact on the attitudes and knowledge of university students towards these technological tools.

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