TRANSCULTURAL ANALYSIS OF THE DIGITAL ENVIRONMENT FOR MANAGING LEARNING IN UNIVERSITY STUDENTS

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ABSTRACT

Objective: This study strategically focuses on the cross-cultural analysis of digital environments mediated by the use of ICT for learning management in students from the University of La Guajira - Colombia (Uniguajira) and the Autonomous University of Nuevo León - Mexico (UANL).

Method: Methodologically, a non-experimental comparative research design was adopted, with a probabilistic sample of (n: 399) participants. The results show differences in the use and appropriation of digital environments, with a greater tendency for communication and collaboration at Uniguajira and for learning management at UANL.

Results and Discussion: Based on the students perceptions, an integrative SWOT analysis was generated, highlighting the innovative and didactic contributions of digital environments, as well as the gaps and challenges associated with accessibility, adaptability, relevance, flexibility, comprehensiveness, autonomy, and appropriation for the improvement of the teaching-learning process in the context of higher education.

Research Implications: This study contributes to understanding the digital divide in learning scenarios and the processes of incorporating ICT in higher education in two Latin American countries.

Originality/Value: The relevance of this research lies in presenting the differential impact of digital divides in terms of accessibility, connectivity, and the use of digital technology in learning environments.

Keywords: Competencies, University Students, Preparatory Training, Digital Divide, Educational Technology.

ANÁLISE TRANSCULTURAL DO AMBIENTE DIGITAL PARA A GESTÃO DA APRENDIZAGEM EM ESTUDANTES UNIVERSITÁRIOS

RESUMO

Objetivo: Este estudo foca estrategicamente na análise transcultural dos ambientes digitais mediados pelo uso de TIC para a gestão da aprendizagem em estudantes da Universidade de La Guajira - Colômbia (Uniguajira) e da Universidade Autonoma de Nuevo León - México (UANL).

Método: Metodologicamente, adotou-se um design de pesquisa não experimental de corte comparativo, com uma amostra probabilística de (n: 399) participantes. Os resultados mostram diferenças no uso e na apropriação dos ambientes digitais, com uma maior tendência para comunicação e colaboração na Uniguajira e para gestão da aprendizagem na UANL.

Resultados e Discussão: Com base nas percepções dos estudantes, foi gerada uma análise SWOT integrativa, destacando as contribuições inovadoras e didáticas dos ambientes digitais, bem como as lacunas e desafios

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associados à acessibilidade, adaptabilidade, relevância, flexibilização, integralidade, autonomia e apropriação para a melhoria do processo de ensino-aprendizagem no contexto do ensino superior.

Implicações da Pesquisa: Este estudo contribui para a compreensão da brecha digital presente nos cenários de aprendizagem e os processos de incorporação das TIC no ensino superior em dois países no contexto latino-americano.

Originalidade/Valor: A relevância desta pesquisa está em apresentar o impacto diferencial das brechas digitais em termos de acessibilidade, conectividade e uso da tecnologia digital nos ambientes de aprendizagem.

Palavras-chave: Competências, Estudantes Universitários, Formação Preparatória, Brecha Digital, Tecnologia Educacional.

ANÁLISIS TRANSCULTURAL DEL ENTORNO DIGITAL PARA GESTIONAR EL APRENDIZAJE EN ESTUDIANTES UNIVERSITARIOS

RESUMEN

Objetivo: Este estudio se ha enfocado estratégicamente al análisis transcultural de los entornos digitales mediados por el uso de TIC para la gestión del aprendizaje en estudiantes de La Universidad de la Guajira – Colombia (Uniguajira) y la Universidad Autónoma de Nuevo León - México (UANL).

Método: Metodológicamente se asumió una investigación no experimental de corte comparativo, con una muestra probabilística de (n: 399) participantes. Los resultados evidencian que existen diferencias en el uso y apropiación de los entornos digitales, con una mayor tendencia en comunicación y colaboración para Uniguajira y en gestión del aprendizaje para UANL.

Resultados y Discusión: A partir de la percepción de los estudiantes se generó un análisis DOFA integrador, compartiendo el aporte innovador y didáctico de los entornos digitales, así como las brechas y desafíos asociados con accesibilidad, adaptabilidad, pertinencia, flexibilización, integralidad, autonomía y apropiación para el mejoramiento del proceso de enseñanza – aprendizaje en el contexto de la educación superior.

Implicaciones de la investigación: Este estudio contribuye en la comprensión de la brecha digital presente em los escenarios de aprendizaje y los procesos de incorporación de las TIC en educación superior de dos países en el contexto Latinoamericano.

Originalidad/Valor: La relevancia de esta investigación se evidencian en presentar presentar de manera comparativa las brechas digitales en materia de accesibilidad, conectividad, y uso de la tecnología digital en los ambientes de aprendizaje.

Palabras clave: Competencias, Estudiantes Universitarios, Formación Preparatoria, Brecha Digital, Tecnología Educacional.

1 INTRODUCTION

Information and communication technologies (ICT) are transforming education, offering greater flexibility and accessibility in learning, facilitating collaboration and teamwork, and allowing teachers and students to access a wide variety of digital tools

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(Richardson et al. al., 2022; Pinto et al., 2022). However, the COVID-19 pandemic has shown that the challenges involved in integrating ICT into educational settings are different to make the most of its benefits and improve the learning experience (García-Prieto et al., 2022; Pinto and Pérez, 2022; Martínez et al., 2023), and that it is necessary to develop alliances between organizations, governments and the population (Zampier et al., 2022).

Despite technological progress and new learning scenarios, education continues to have challenges to advance in the process of accessibility and quality (Rodríguez-Hoyos et al., 2021; Martínez et al., 2023). This is because many students and teachers still do not have optimal access to emerging learning scenarios, and lack the digital skills to take advantage of them (Barragán and Ruiz, 2013; Pinto-Santos et al., 2019; Galván and Medina, 2023). In this regard, it is important to keep in mind that the integration of ICT in the educational environment entails certain challenges, related to digital skills (Kerdsawad and Lekcharoen, 2024), social equity so that students have access to technological resources and optimal Internet connection. (Pinto-Santos et al., 2022), and the institutional capacities to design teaching processes appropriating digital technology (Romero et al., 2023).

In the case of Mexico and Colombia, opportunities for the use of digital technology and the Internet have improved in recent years, but there are still challenges in terms of equity and coverage (Unesco, 2021). In Mexico, in 2023 internet penetration reached approximately 78.6% of the population. For its part, in Colombia, internet penetration is also high, with approximately 75.7% of the population having access to the internet. The majority of internet users in both countries access it through mobile devices, and the use of fixed and mobile broadband is also increasing. According to the Internet usability metrics of Digital Report 2023, the average daily time spent using the Internet through any device during 2023 in Mexico was 9 hours and in Colombia approximately 10 hours.

Although both countries have made significant efforts in terms of ICT infrastructure to improve the coverage and quality of telecommunications networks, in Mexico, as in Colombia, there are challenges in terms of geographic equity, with limited access to the Internet connection. , especially in rural and remote areas. In this way, despite technological advances and new learning scenarios, university education faces important challenges. In this sense, this study aims to develop a cross-cultural analysis of digital environments mediated by the use of ICT for the management of learning in students of the University of La Guajira - Colombia (Uniguajira) and the Autonomous University of Nuevo León - Mexico (UANL).

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2 THEORETICAL FRAMEWORK

The rise of ICT resources has had a significant impact on the educational context, due to the increase in tools and consumption of these technologies (Ismail, 2018; Pinto et al., 2017). Digital technology has allowed university communities to have access to educational resources in real time from any location, allowing greater flexibility, improving accessibility and participation for those who previously presented a type of marginalization (Bower et al., 2020; Pinto- Santos et al., 2022; Choles et al., 2022). It is necessary to make greater efforts in the productive use of ICT in knowledge management (Cabero and Martínez, 2019; Rodríguez-Hoyos et al., 2021).

The process of digitalization of society has led to ICTs acquiring a crucial role in connecting people, guaranteeing the functioning of activities and supporting distance work and education (OECD, 2020). Likewise, the pandemic has had a significant impact on higher education worldwide, forcing many institutions to quickly adapt to new teaching-learning models (Cabero-Almenara and Llorente-Cejudo, 2020; Rodríguez-Hoyos et al., 2021). . For example, platforms such as Moodle, Blackboard and Google Classroom have allowed real-time interaction between students and teachers, through tools such as videoconferencing and chat (Hodges et al., 2020), and were adopted by institutions. of higher education according to the capabilities, policies, and available resources (Romero et al., 2023).

Currently, various types of learning environments have been developed to meet the needs of students and teachers (Pinto, 2020; Rodríguez-Hoyos et al., 2021; Turpo-Gebera et al., 2021). Some focus on collaboration and communication, while others focus on personalization and gamification. These emerging learning scenarios also offer new forms of assessment and feedback, including different tools of artificial intelligence and virtual reality, so that students can experience virtual environments that allow them to interact, collaborate and experiment (Bower et al., 2020) .

3 METHODOLOGY

The present study assumed a methodological approach from the empirical-analytical approach, with a non-experimental, cross-sectional, comparative design (Jorrín et al., 2021). Comparative research allows establishing differences between two or more groups, it is characterized by studying the phenomenon as it actually occurs, there is no manipulation or control of variables, and it seeks to find the causes of the significant differences of the compared

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groups. In this study, the main trends in the learning scenarios of two official higher education institutions in Colombia and Mexico are analyzed.

3.1 SAMPLE

The study presents a non-probabilistic quota sampling design based on the representation of students enrolled in the two universities (UANL – Mexico and UniGuajira – Colombia). For this purpose, there was a general sample of (n: 399) participants, of which 50.9% (n1: 203) belong to UniGuajira and 49.1% (n2: 196) are in UANL. Within the general characteristics of the sample of participants, it was identified that the Colombian participants belong to the Faculty of Education Sciences, and that 80.3% are women. While at UANL the participants belong to the Faculty of Communication and 73.5% belong to the female gender. Likewise, 52.9% of the population is between 20 and 24 years old, followed by 17.1% mainly between 25 and 29 years old. Additionally, 67.3% of the students are studying the range between advanced semesters (VI to X), while 32.7% are in the first semesters (I to V).

3.2 INSTRUMENT

The Characterization Questionnaire was used for access and use of ICT resources in university students (Pinto et al., 2022). The questionnaire is made up of 28 items, which are rated on a frequency scale with four degrees (always, almost always, sometimes, never) and a final section made up of 3 semi-structured items aimed at knowing the opinions that the participants have. students about the incorporation and use of digital technology in the teaching-learning processes, which were analyzed under the SWOT model. With the study sample, the Cronbach's Alpha reliability level was estimated (α: .857), the averages of the items ranged between ($\bar{x}$: 2.13 and $\bar{x}$: 3.78), with deviation levels between (s : .377 and s: .1,405) providing evidence of internal consistency in the measurement process, with a range of positive and directly proportional correlations at the item - scale level between (r: .033 and r: .575), as evidenced in table 1.

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Table 1

Descriptive Analysis of Items and Internal Consistency of the Scale.

Ítems	$\bar{x}$	s	r	α
1. Search for information	3,88	,377	,359	,849
2. Search images	3,75	,629	,373	,847
3. Create mental maps	3,18	1,105	,550	,840
4. Create tables and graphs	3,06	1,193	,516	,841
5. Communicate with my students	2,83	1,347	,422	,845
6. Communicate with my colleagues	3,68	,768	,378	,846
7. Reading books	2,81	1,181	,394	,845
8. Preparation of texts]	3,29	1,008	,452	,844
9. Video creation	3,39	1,029	,575	,840
10. Preparation of presentations	3,54	,934	,536	,842
11. Record grades	2,53	1,359	,441	,844
12. Publish information	3,41	1,038	,569	,840
13. Work collaboratively	3,60	,811	,446	,845
14. View educational web pages	3,55	,846	,558	,842
15. Create educational web pages	2,40	1,354	,575	,838
16. Do online activities	3,64	,836	,458	,844
17. Create questionnaires (test)	2,88	1,291	,481	,842
18. Use the educational platform	3,70	,708	,477	,844
19. Institutional Email	3,56	,768	,033	,854
20. Digital Library	2,13	1,154	,391	,845
21. Virtual classrooms - Classroom	3,26	,959	,050	,855
22. Google doc	2,92	1,206	,375	,846
23. WhatsApp	2,82	1,405	,088	,858
24. Hangouts - Meet	2,85	1,238	,167	,854
25. Google Scholar	3,12	1,124	,325	,848
26. Youtube	3,53	,873	,325	,847
27. Online assessment	2,89	1,194	,376	,846
28. Social networks - twitter - Facebook	3,58	,875	,221	,850

x̄ = Average; s = Deviation; r = Item – Scale Correlation; α = Cronbach's alpha if the Item were removed.

3.3 PROCEDURE

The development of the study included four procedural phases:

1. Selection of the data collection instrument;

2. Request for informed consent in the two institutions;

3. Application of the characterization questionnaire for ICT access and use;

4. Data coding and analysis with the statistical program SPSS version 21.

4 RESULTS AND DISCUSSIONS

The main findings derived from the comparative cross-cultural analysis of access and availability of ICT resources are presented below. Table 2 identifies that in general terms La UANL surpasses Uniguajira in the indicators associated with the availability and accessibility

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of equipment and Internet connectivity conditions. First of all, it is worth highlighting that regarding the availability of a computer with internet access at La UANL there is a percentage level of 99.5% compared to the 45.3% reported by Uniguajira students. In relation to the percentage levels of smartphone use with Internet access, the two groups tend to present greater similarity, in Uniguajira with 82.8% of students, and in La UANL with 91.2%. Regarding the type of internet access, it was found that the internet plan is the most used in La UANL with 60.7%, while in Uniguajira 37.4% of students recharge data packages or megabytes. Likewise, when reviewing the frequency of internet connectivity, the results also show greater opportunities for La UANL with 98% of students connecting every day, compared to the reported level of 48.3% in Uniguajira.

Table 2

Accessibility profile and availability of ICT resources

ICT access and availability		UNIVERSITY		
		UNIGUAJIRA - COLOMBIA	UANL - MEXICO	General Sample
1. You have a computer or laptop with Internet access	YES	45,3%	99,5%	71,9%
	NO	54,7%	,5%	28,1%
	Total	100,0%	100,0%	100,0%
2. You have a smartphone with Internet access	YES	82,8%	100,0%	91,2%
	NO	17,2%	0,0%	8,8%
	Total	100,0%	100,0%	100,0%
3. Type of internet access	internet plan	36,5%	60,7%	48,4%
	Data package (all included)	15,3%	23,0%	19,0%
	Data package (Megas)	37,4%	15,8%	26,8%
	Wifi	10,8%	,5%	5,8%
	Total	100,0%	100,0%	100,0%
4. Internet connection frequency	Every day	48,3%	98,0%	72,7%
	3 or 4 times a week	31,0%	2,0%	16,8%
	1 or 2 times a week	16,3%	0,0%	8,3%
	Less than once a week	4,4%	0,0%	2,3%
	Total	100,0%	100,0%	100,0%

Within the statistical processing with the set of 28 items in the frequency scale of the questionnaire, two exploratory factor analyzes were carried out with the principal components method and a varimax rotation criterion. The first exploratory factor analysis was carried out with the first 18 items that correspond to the use of ICT for learning management, while the second exploratory factor analysis was carried out with the 10 that correspond to the use of ICT for communication and collaboration processes.

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From the first exploratory factor analysis, the KMO Criteria and the Bartlett Test were estimated with adjusted and statistically significant values (KMO: .860; Bartlett: 2394.87; gl. 153; sig. .000). (5) principal components were identified with eigenvalues greater than (1), which account for 61.21% of the explained variance. Below, the results of the exploratory classification of the 28 items related to the use of ICT in learning management are presented, taking into account both the factor component and the analytical dimensions of the questionnaire structure.

In the first component are the items that are contributing with their factor loading to the use of ICT in learning management made up of the items (1, 18, 16, 13, 2, 14, 12). The second group of items corresponds to the dimension of instrumental learning management and is made up of items (10, 4, 9, 3). In a third group are the items corresponding to the third dimension aimed at the creation and use of tools for monitoring and evaluating learning with the items (17, 15, 11). The fourth group corresponds to reading books and writing texts with items (7 and 8). Finally, in the fifth component are the items (5 and 6) related to the communication processes with students and colleagues, as evidenced in Table 3.

Table 3

Configuration of the exploratory factor analysis of the ICT dimension in learning management

Item Set (1 to 18)	Component				
	1	2	3	4	5
1. Use of ICT to search for information	.716				
18. Use the educational platform	.690				
16. Do online activities	.596	.321	.314		
13. Work collaboratively	.566				
2. Use of ICT to search for images	.564				
14. View educational web pages	.495			.495	
12. Publish information	.442	.307	.349		
10. Preparation of presentations		.773			
4. Create tables and graphs		.727			
9. Video creation		.694			
3. Use of ICT to create mental maps		.690			
17. Create online questionnaires (tests)			.800		
15. Create educational web pages			.727		
11. Record grades			.683		.498
7. Reading books				.849	
8. Preparation of texts		.338		.639	
5. Communicate with my students			.368		.743
6. Communicate with my colleagues	.307				.687

The second exploratory factor analysis was carried out with the set made up of items 19 to 28, which correspond to the dimension of communication and collaboration in the teaching-learning process. Again for this set of items, the KMO Criteria and the Bartlett Test were

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estimated with adjusted and statistically significant values (KMO: .730; Bartlett: 806.737; gl. 45; sig. .000). (3) principal components were identified with eigenvalues greater than (1), which account for 58.92% of the explained variance.

In the first component, the items corresponding to the communication network platforms (virtual classrooms, WhatsApp, institutional email and Hangouts - Meet - Zoom) are grouped together. It should be noted that WhatsApp assumes a negative charge which indicates that its use has a differential value in relation to other tools. In the second component are the items related to the sources of information and online evaluation (digital library, Google Docs, Google Academic and online evaluation tools. Finally, in the third component are the applications of (social networks, Twitter, Facebook and YouTube), as evidenced in table 4.

Table 4

Configuration of the exploratory factor analysis of the communication and collaboration dimension

Conjunto de ítems (19 a 28)	Componente		
	1	2	3
3. Virtual classrooms - Classroom	.824		
5. WhatsApp	-.759	.303	
1. Institutional Email	.714		
6. Hangouts – Meet – Zoom	.714		
2. Digital library		.752	
4. Google docs		.739	
7. Google Scholar		.624	
9. Online assessment		.516	
10. Social networks - twitter - Facebook			.844
8. Youtube			.817

Based on the average levels of use on a scale of (1 to 4), differences greater than (0.30) have been highlighted, within which a higher level of use is highlighted in La UANL corresponding to developing mental maps, creating tables and graphics, create videos, presentations, record grades, create Web pages and online questionnaires. Additionally, a higher level of use is evident in UniGuajira corresponding to reading books, as shown below in table 5.

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Table 5

Comparative analysis of the use of ICT in learning management depending on the University

ÍTEM - UNIVERSIDAD	Average ($\bar{x}$)		Standard deviation (s)	
	UNIGUAJIRA - COL	UANL MÉX	UNIGUAJIRA - COL2	UANL MÉX
1. Use of ICT to search for information	3.89	3.88	.420	.329
2. Use of ICT to search for images	3.74	3.76	.701	.547
3. Use of ICT to create mental maps	2.98	3.38	1.310	.792
4. Create tables and graphs	2.73	3.40	1.393	.814
5. Communicate with my students	2.80	2.86	1.414	1.276
6. Communicate with my colleagues	3.64	3.72	.892	.614
7. Reading books	3.00	2.62	1.313	.993
8. Preparation of texts	3.24	3.35	1.200	.759
9. Video creation	3.27	3.53	1.193	.807
10. Preparation of presentations	3.32	3.77	1.164	.520
11. Record grades	2.36	2.70	1.426	1.267
12. Publish information	3.31	3.52	1.180	.856
13. Work collaboratively	3.54	3.65	.976	.592
14. View educational web pages	3.58	3.52	.932	.747
15. Create educational web pages	2.00	2.81	1.333	1.254
16. Do online activities	3.51	3.78	1.021	.555
17. Create online questionnaires (tests)	2.41	3.36	1.423	.915
18. Use the educational platform	3.73	3.67	.745	.668

Table 6 presents the comparative analysis of the levels of ICT use for communication and collaboration in teaching-learning processes based on student reports. Once again, the average levels are compared on a scale from (1 to 4) and the main differences greater than (.30) have been highlighted. In this dimension of communication and collaboration, higher average levels of ICT use were reported at UniGuajira, especially in relation to institutional email, virtual classrooms – Classroom, Hangouts – Meet – Zoom; while the levels of use were higher in La UANL regarding the use of Google docs and WhatsApp.

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Table 6

Comparative analysis of the use of ICT for communication and collaboration depending on the University.

| ITEM - UNIVERSITY	Average ($\bar{x}$)		Standard deviation (s)	
	UNIGUAJIRA - COL	UANL – MÉX	UNIGUAJIRA - COL	UANL – MÉX
19. Institutional Email	3.95	3.15	.294	.885
20. Digital Library	2.09	2.16	1.322	.952
21. Virtual classrooms - Classroom	3.87	2.62	.530	.889
22. Google docs	2.71	3.14	1.396	.926
23. WhatsApp	1.84	3.83	1.300	.493
24. Hangouts – Meet – Zoom	3.49	2.18	1.069	1.030
25. Google Scholar	3.18	3.05	1.247	.978
26. Youtube	3.60	3.46	.930	.806
27. Online assessment	2.93	2.85	1.346	1.015
28. Social networks - twitter - Facebook	3.47	3.70	1.040	.645

Below, in Figure 1, the general comparative analysis corresponding to the two central dimensions of ICT use in learning management and communication and collaboration processes is presented. As illustrated, at UniGuajira a higher level of use is reported in the communication and collaboration dimension ($\bar{x}$: 3.11) compared to the average level reported in learning management ($\bar{x}$: 2.97); while at La UANL the trend is reversed and therefore the average level of ICT use for learning management was higher ($\bar{x}$: 3.20) compared to the average level of ICT use in communication and collaboration processes ($\bar{x}$: 3.01).

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Figure 1

Comparative Analysis Learning Management, Communication and Collaboration
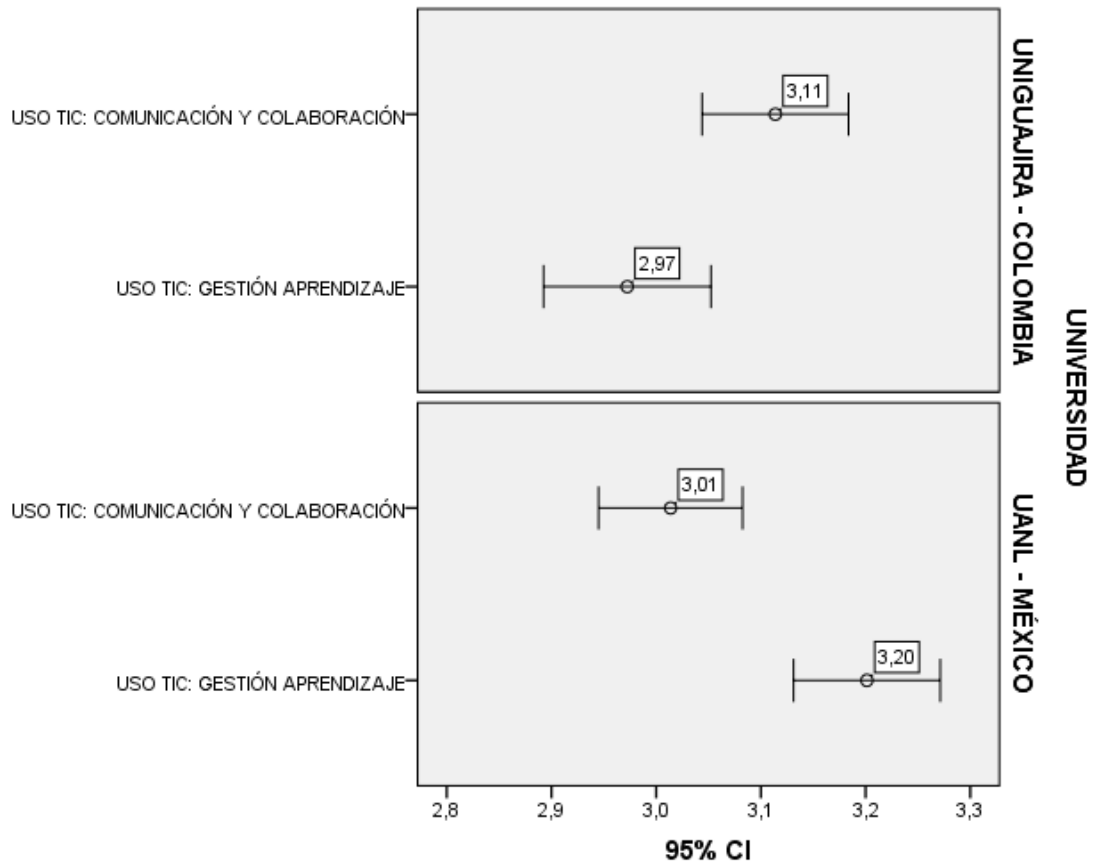
Finally, Table 7 presents the results derived from the analysis of the three semi-structured questions about the opinions reported by the students, associated with the processes of incorporating ICT and digital environments in their educational institutions. For this purpose, a systematic content analysis was carried out from the SWOT model with the perceptions of the students, identifying a set of emerging categories, namely: Accessibility, Adaptability, Relevance, Comprehensiveness, Interactivity, Flexibility, Autonomy, Didactics, Pedagogy and Added value.

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Table 7

Integrative SWOT Analysis of student perception of digital environments and use of ICT

Emerging Categories	Strengths	Opportunities	Weaknesses	Threats
Accessibility	Faster and easier access to quality educational information and resources, together with intuitive management of the platforms.	Increase in free tools, various workspaces for learning, communication with classmates and teachers.	Lack of access to digital technology limits the opportunities for students and teachers, since not everyone has the resources to purchase equipment or pay for the internet.	Lack of knowledge of teachers and students about the productive use of educational technology, and dependence on digital technology in leisure activities.
Adaptability	The ease of use of ICT by students provides access to a wide variety of online educational resources that helps you communicate and collaborate.	The institution has resources and digital platforms for the educational community that allow students to adapt to the current learning dynamics.	Frustration on the part of students and teachers regarding the number of tasks and reports, and difficulty in taking advantage of digital resources for teaching-learning.	The dependence on digital technology by students and the poor development of transversal skills such as critical thinking can affect the readiness of students for learning.
Relevance	Technology also allows for effective feedback as it helps communicate and connect with other students and teachers.	It allows the development of a wide range of extracurricular tasks and activities that help with professional training.	Difficulties in the development of learning activities given that technology has not been adequately integrated into teaching.	Lack of continuity in the work assigned by teachers and effective feedback on tasks to advance learning outcomes.
Comprehensiveness	The effective use of ICT allows efficiency, speed, practicality, saving time and money.	Students can experience learning with various resources, and have greater ease in producing work.	The costs of access to resources and training in digital competence for students and teachers need to be assumed.	The availability and efficiency of Internet networks as well as devices that students and teachers have.
Interactivity	It allows greater participation and involvement of students in active learning processes.	It allows teachers to support students through immediate and personalized feedback.	Not all students adapt to new ways of socializing with other classmates and teachers.	There are teachers and students who prefer more traditional methods of teaching and learning.
Flexibility	Teacher support and understanding of student difficulties, making it possible to focus on specific areas of interest or need.	It allows students' learning to be personalized and adapted to their individual needs and preferences.	Lack of experience and organization of the educational institution in the organization of flexible learning processes.	There is a lack of greater understanding on the part of teachers and students of the implications of the flexibility of learning.
Autonomy	Students have greater control over their learning, being able to	Students acquire digital skills that are valued in today's job market.	Difficulties on the part of students to motivate themselves and	Difficulties organizing time, making a commitment to the

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	decide how, when and where to study.		stay focused on the teaching process.	pace of learning, and procrastinating.
Didactics	Allow students to learn at their own pace, which can increase understanding of teaching.	There are various educational resources and tools that can help personalize learning, especially those that have incorporated artificial intelligence.	There is little dynamism, integration, and there is a lack of use of learning ecosystems.	Teachers' resistance to proposing teaching activities for digital environments, and ignoring the contributions of artificial intelligence.
Pedagogy	Teachers have been training and improving their skills to develop emerging pedagogies.	It allows educational programs to be designed for a greater number of students, especially those in remote places.	Teachers who only read presentations, do not conduct their interactive classes, and do not promote educational innovation processes.	Prevalence of the traditional class in emerging learning environments.
Value added	Teachers share educational materials and collaborate with people from different cultures.	Training opportunities for students located in places far from the university.	Learning may be limited to the extent that the demands are lower for both students and teachers.	There are teachers and students who prefer traditional teaching, and feel that they do not learn as much in virtual settings.

The findings related to the synthesis of the SWOT analysis highlight among the strengths the ease of handling the platforms, the wide variety of digital educational resources available on the Internet, the participation of students in the active learning process, support from teachers, and possibilities to get involved in their learning. Opportunities include the possibilities of communication with teachers and classmates in a timely manner, the use of the platforms and resources provided by the educational institution, personalized and immediate feedback, and the opportunities to access education by students who are in secluded places.

Likewise, among the weaknesses, the lack of access to equitable conditions regarding the use of ICT, the optimal quality of the Internet, digital competence, frustration with excessive tasks, the lack of experience of the institution and teachers to plan stand out. teaching-learning processes, traditional classes in emerging learning scenarios, and lower demands on learning results. Finally, the lack of knowledge of students and teachers about the productive use of educational technology, the excessive dependence on digital technology, the difficulties in organizing time and making commitments, the predominance of the traditional class, and the resistance to change by students and teachers.

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The study made it possible to identify the differential impact of digital divides in terms of accessibility and connectivity, taking into account that access to information and communication technology (ICT) resources and the Internet is an important aspect for the economic and social development of a country. In this sense, in the cases of Mexico and Colombia, access to ICT resources and the Internet has improved in recent years, but challenges still remain in terms of equity and coverage. Particularly, reports of internet access are higher in the case of UANL (95%) compared to UNIGUAJIRA (45.3%). However, this difference is contrasted, given that it does not maintain the same proportionality when reviewing the indicators obtained in relation to the connectivity reports in each country generated by the 2022 Digital Report. In this sense, this is explained by the fact that the students of the Uniguajira live in the periphery of the country where connectivity presents the greatest gap, especially in the urban and rural areas (Pinto et al., 2022).

Regarding the comparative analysis of the use of ICT for learning management, the UANL reports greater use of tools to create mental maps, create tables and graphs, create videos and presentations. In UniGuajira, a higher level of use corresponding to reading books is evident. Likewise, in the comparative analysis of the use of ICT for communication and collaboration, higher average levels were reported in UniGuajira, especially in relation to the use of institutional email and virtual classrooms; while at La UANL they have greater use of Google docs and WhatsApp.

The statistical analysis allows us to identify the key components that drive communication and collaboration. In the case of institutional email, UNIGUAJIRA obtained a higher score than the UANL in terms of use and effectiveness. In the case of Hangouts-Meet-Zoom, the UANL obtained a lower score than UNIGUAJIRA in terms of frequency and effectiveness of use. Despite these differences, both universities used technological tools such as Google Scholar, YouTube and social networks, which indicates recognition of the rapid adoption of these technologies (Rodríguez-Hoyos et al., 2021). Likewise, the choice and implementation of appropriate technological tools are intrinsically related to the requirements and particularities of each university institution (García-Prieto et al., 2022). However, evaluations of the performance and efficiency of the use of these tools were not perceived, being essential to ensure their effectiveness in optimization in the educational field (George & Salado, 2022; Pinto and Pérez, 2022; Turpo-Gebera et al ., 2021).

The results of the integrative SWOT analysis indicate a positive perception of the students of the two institutions regarding the incorporation of ICT and digital environments in their educational institutions. However, some weaknesses and threats were also identified, such

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as lack of access to and excessive dependence on technology, limited training in digital competence, and difficulty in organizing flexible learning processes. These results align with previous research that highlights the need to advance learning personalization processes (Ismail, 2018; Bower et al., 2020). It is highlighted that education currently presents challenges inherent to digital culture, with the holistic development of digital competencies being essential (Lores et al., 2019; Pei et al., 2023), effective digital inclusion policies and practices (Romero et al., 2023), flexible curricula that appropriate technology (Pinto and Pérez, 2022), and digital transformation of university institutions (Quezada, 2023).

5 CONCLUSION

The present study allows us to generate a new cross-cultural analysis scenario on the assessment of the use of digital environments, based on student reports from a comparative perspective in the central dimensions of learning management, communication and collaboration, based on the particular contexts of each of the two universities. In this sense, differences are evident in the levels of accessibility and use, identifying a greater trend oriented towards the dimension of communication and collaboration in the case of the University of Guajira (UNIGUAJIRA), while in the Autonomous University of Nuevo León (UANL) a greater tendency is reported oriented towards learning management processes.

In summary, the dynamics of assessment and use of digital environments mediated by ICT within the context of higher education have cross-cultural differences between the two universities in general terms of accessibility and trends of use compared to the dimensions of learning management. communication and collaboration, as well as some similarities are evident specifically in the recognition of the added value that digital environments have.

Likewise, students from the two universities converge on the need to develop strategies and processes that allow increasing the levels of adaptability, comprehensiveness, didactics and autonomy in emerging learning scenarios. In this sense, the role of teachers as facilitators in the permanent construction of knowledge is recognized regardless of the modality of study. However, at UANL and UNIGUAJIRA, weaknesses are evident for effective integration in the digital ecosystem related to the use of ICT resources provided by the educational institution, teaching feedback processes, and learning results.

Based on this study, we seek to expand the level of understanding of the challenges of education in hybrid modality in scenarios with unequal access to digital technology, to generate strategic proposals that enable the resources, conditions and opportunities for the development

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of flexible learning processes where digital environments are taken advantage of to promote educational innovation. For future work, it is recommended to carry out comparative analyzes at the university level, in which the differences between the uses of digital technology by educational programs and levels are established, and in which the experiences of adaptability, collaboration and evaluation can be analyzed. in the learning ecosystems provided by higher education institutions.

Likewise, it is essential in future studies to deepen the understanding of the opportunities and barriers to access and use of digital technology in relation to the particular need presented at different educational levels in post-pandemic contexts. It is necessary to address problems associated with accessibility to digital services, availability of educational materials adapted to differences, digital inclusion, emerging pedagogical approaches, among others.

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