

Latin American professors' research culture in the digital age

Cultura investigativa del docente en Latinoamérica en la era digital

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ABSTRACT

The processes of social confinement caused by the global health crisis (COVID-19), have forced professors to assume new research competencies that allow them to improve science indicators and contribute to the research culture in the digital era for the Latin American region. This article analyzes the research culture of Latin American professors in 20 countries in the digital era, and their relationship with the production of scientific papers indexed in the Journal Citation Report (JCR) between 1996 and 2019. A questionnaire (with validity and reliability criteria) with a Likert-type scale was applied to 2,215 professors selected from five international scientific events. The main results show that 78% of the professors have less than 15 years of teaching experience, with ages under 44 years of age and 38.9% of them with an undergraduate academic level, 62.5% of whom responded that they have never published in indexed journals, and that they do not know the proper application of paradigms and research designs. On the other hand, 23.86% of the total citations are self-citations. Therefore, the results reflect a significant relationship between the research culture of professors and Latin American scientific production. Finally, Latin American professors have found themselves in economic, political and social circumstances that affect good research and scientific publication practices, leaving a training gap in research competencies in the new digital era.

RESUMEN

Los procesos de confinamiento social provocados por la crisis de salud mundial (COVID-19), han obligado a los docentes a asumir nuevas competencias investigativas que le permitan mejorar los indicadores de ciencia y aportar a la cultura de investigación en la era digital para la región latinoamericana. Este artículo analiza la cultura investigativa de los docentes latinoamericanos de 20 países, en la era digital y su relación con la producción de documentos científicos indexados en Journal Citation Report (JCR) entre 1996 y 2019. Se aplicó un cuestionario (con criterios de validez y confiabilidad) con escala tipo Likert a 2.215 docentes derivados de cinco eventos científicos internacionales. Los principales resultados dan cuenta que el 78% de los docentes tienen menos de 15 años de experiencia docente con edades que no superan los 44 años y un nivel académico del 38,9% de pregrado. Estos, a su vez, en un 62,5% respondieron que nunca han publicado en revistas indexadas, además desconociendo la aplicación adecuada de los paradigmas y diseños de investigación. Por otra parte, el 23,86% de las citaciones totales son auto citas. Por tanto, los resultados reflejan una relación significativa entre la cultura investigativa del docente y la producción científica latinoamericana. Finalmente, los docentes latinoamericanos se han visto en circunstancias económicas, políticas y sociales que afectan las buenas prácticas de investigación y publicación científica dejando entre ver una brecha de formación sobre competencias investigativas en la nueva era digital.

KEYWORDS | PALABRAS CLAVE

Scientific culture, digitization, pandemics, professor education, cultural research, science.
Cultura científica, digitalización, pandemia, formación de docentes, investigación cultural, ciencia.

1. Introduction and state of the art

The mission of the contemporary university is to promote, stimulate, and disseminate knowledge aimed at seeking continuous improvement in the integral formation of human beings and their role within society. They are also platforms for the continuous development of innovation, science, and technology. New professionals should not only focus on good academic training, but also on promoting a commitment to good research practices (Batista-Mainegra et al., 2017). To this end, academic centers, research groups, and other entities involved in scientific processes tend to organize themselves according to the criteria established by international quality systems (Strauka, 2020). Institutions with state-of-the-art higher education profiles tend to boast about their good work, effectiveness, efficiency, greater connection with the public, private, and social spheres, and their capacity to produce multidisciplinary and applied knowledge (Basso et al., 2021), in contrast to the supposedly unproductive and self-referential inertia of traditional university research, based on codified knowledge and socially irrelevant and economically sterile disciplinary jurisdictions.

International university rankings have been an alternative used by governments and international cooperation agencies to provide funding for projects and scholarships (Kalhor & Mehrparvar, 2020). These quality processes are examined through an evaluation system and indicators such as teaching qualification aspects, research, transfer, and internationalization. However, the increase in scientific production and its impact are determining factors in world rankings such as Webometrics Ranking of World Universities, The World University Ranking, World's best universities Ranking, Ranking Shanghai, Performance Ranking of Science Papers for World Universities, and the Leiden Ranking. In summary, worldwide research is measured by indicators of productivity, impact, and the academic visibility of its researchers (Powell, 2020).

The research materialized in documents produced and their social impact permeates the relationship between educational quality and development through scenarios for knowledge management and intellectual efforts of their professors, crystallized in the knowledge and ability to produce scientific knowledge. Universities that allocate resources to the generation of knowledge increase their scope and impact on society, as their responsibility is not only to give quality education to their students but also to promote the development and professional improvement of their professors in terms of research, aiming to provide them a sustainable research culture for the benefit of society (González-Díaz et al., 2021). However, this new era has brought with it new challenges and ways of doing science through virtual technologies; this requires a diagnosis (institutional and individual) of the new professor's training needs and to be able to maintain the institutional educational-quality criteria. Thus, universities try to connect pedagogical practice with current knowledge derived from empirical evidence of each area of study, fostering spaces for a sustainable research culture where the scientific growth of each member of the university community is stimulated (Castro-Sánchez, 2021).

It should be noted that the features of a research culture refer to a set of cognitive, evaluative, and attitudinal elements shared by a particular educational community and, at the same time, to the practice, promotion, and irradiation of these elements directed to those who are linked to it. At the core of the research culture, these shared elements refer to a set of meanings, values, and behaviors that permeate the entire network of activities (concerning training, service, and innovation) developed as part of social interactions in specific contexts. Therefore, it can be associated with the set of interactions present in the research activity, focused on the concept of responsibility in the academic context with its own characteristics (Criado-Dávila et al., 2020). The effects of research culture extend to its different manifestations, from the relationship between research and teaching, research training, the integrity of the actors, among others with interest in publishing, authorship, prevention, and plagiarism control (Espinoza-Freire, 2020).

Currently, the educational policies of institutional accreditation show that the processes to achieve quality in university education are associated with the research practice, where the institutional purpose is to promote a research culture, thus increasing the scientific productivity of professors and students who meet the criteria to develop attitudes and facilitate the exchange of knowledge through productive research projects according to the institutional lines of research (Guerrero-Sosa et al., 2021). In other words,

professors and students are the ones who must pertinently conduct, consult, and apply the research in the development of the curricula (Bracho, 2012). In Latin America, this situation has become more acute. On the one hand, the number of scientific papers published in databases such as SCOPUS has been increasing over the last three years by an average of 7.7% (2017-2020) (Vázquez-Miraz & Posada-Llorente, 2020). However, the number of cited papers remains at a decreasing rate of 20.2%, i.e., the number of scientific papers published in Latin America has been growing, but their social impact has been decreasing. This situation has awakened the commitment of those who work in the higher education system. Universities are a space to foster and promote innovation processes and generate new knowledge through scientific, technological, and social research. The interest of universities in the Latin American region has been to improve the research skills of professors who have shown certain weaknesses in this area, affecting the practical research culture (Castro-Sánchez, 2021).

This accentuates the gap that stands in the way of the development of scientific production both in the research programs of universities as well as in publicly oriented organizations in these countries. Based on this perspective, the question posed by this research is: How is the research culture of professors in the digital era concerning science in Latin America? Therefore, the present study analyzes the Latin American research culture and the scientific production between 1996 and 2019 of professors in the digital era. For this purpose, 2,215 professors dedicated to research from 20 Latin American countries were surveyed.

The results show that there is a strong relationship between educational level and publications in indexed journals, showing that the higher the academic degree of the professor, the greater the interest in publishing in indexed journals. Likewise, the countries with the highest scientific production show a high level of total citations. However, countries with very low scientific production show a higher impact in terms of citations in the scientific community. Despite the complex systemic and structural crisis in the Latin American region, university professors have taken advantage of the benefits of the internet for self-training and improving research skills.

1.1. Research culture and the advancement of scientific knowledge

In an organizational environment, culture is not the only factor that influences managerial and work behavior (Velandia-Mesa et al., 2021). This behavior is influenced by different levels of culture, ranging from the supranational level (regional, ethnic, religious, linguistic) to the national, professional and organizational levels, down to the group level (De-Filippo et al., 2021). In recent years, research culture has been present in foreign policy debates on research and development among International Cooperation Agencies such as UNESCO (United Nations Educational, Scientific and Cultural Organization).

Since the 1998 World Conference on Higher Education, they have been stressing the topic of research for development. Since 1999, the World Bank has presented the problem of scientific knowledge as an essential element for the generation of wealth. Subsequently, UNESCO, at the World Conference on Science (1999-Budapest), pointed out that research processes must be accompanied by technological and intellectual investment from the economic sectors and the government in order to create a space for the generation of new knowledge.

Meanwhile, research culture, from the perspective of the epistemological foundations, dates back to the advancement of positivism and the rehabilitation of hermeneutics, providing an integrative approach to mixed methods (MM) approaches, allowing the merging of qualitative and quantitative perspectives during the research process as a unique method of producing knowledge in social sciences, which has changed the research landscape (Bolívar, 1995; Bagur-Pons et al., 2021). It should not only be a discourse, but a reflection approached from the structuring of intellectual capital (Guedes-Farias & deAndrade-Maia, 2020) in academic and scientific environments where human talent, technological infrastructure, and relational capital are articulated.

Scientific literature reports the discussion on the strengths of a research culture and its intellectual capital associated with educational and business organizations, research seed beds, and research groups dedicated to the production of scientific knowledge that provides answers to the new demands of the labor market (Fu et al., 2020).

In Latin America, the research culture attempts to articulate intellectual production with human and technological aspects, constituting a set of intangible capacities of diverse nature with different strategic implications (Limaymanta et al., 2020). Although Latin American countries share different cultural behaviors, it can be stated that the lack of cooperation and cohesion between researchers in the scientific processes characterize them (Guedes-Farias & de-Andrade-Maia, 2020). In this respect, institutions try to establish mechanisms to stimulate teamwork between national establishments and between countries through a set of invisible or intangible off-balance assets that allow this type of organization to function, thus creating value for itself and for society as a whole. These aspects of the research culture give hope for improving the impact on knowledge, intangibility, and value creation, which are relevant factors when defining institutional strategic capabilities (Oliveira-Filho, 2020).

1.2. Challenges for the research professor in the digital era

The world is facing the dizzying development of the digital era, one of its greatest challenges since its existence and professionalization (Briseño-Senosiain, 2021). Digital media such as the Internet, Google, social networks, and the various platforms that exist in the market have literally flooded humanity with information, especially university professors, forcing them to acquire and develop skills to and adapt to changes in the process of higher education that increase as time passes and they face increasing innovation every day.

This is how universities, as higher education centers, are the ones in charge of the task of knowledge management and where the teaching-learning activity of every strategy and practical theoretical resource is developed (Rodríguez & Espinoza, 2017), aiming to train quality professionals and contribute innovative and creative ideas that meet the needs of society and the labor market.

For this reason, the role of university professors and their role in the teaching-learning processes is essential; these processes must be based on the integration and execution of the competencies of higher education professionals in Information and Communication Technologies (ICTs) (Cruz-Rodríguez, 2019). These are defined as competencies that involve practical skills and knowledge, recognizing the use of new technologies as one of the most important—known as digital competence—which have been considered as strategic resources for training management and learning in the last decade.

Therefore, the continuous training of educational agents acquires great relevance today (Pozos & Tejada, 2018), even more so considering the challenges they have faced as a result of the global crisis, which has exposed their competencies in the research practice, confronting them to the new era without the necessary tools and knowledge to change from a face-to-face to a virtual paradigm.

This study considers professor professionalization as a current need that can be approached from a new technological and digital perspective. Currently, the professionalization of professors is a latent need for the higher education sector at the national and international levels it is necessary to pay attention to this aspect as it is essential for the updating and transformation of university professors (Rojas et al., 2016). This implies generating a training path with new studies and training methods for the development of teaching competencies needed in the 21st century, which should improve the functions of the professor, thus contributing to the acquisition of new skills and abilities in the new digital era.

2. Materials and methods

This study was carried out using a field research, non-experimental, cross-sectional design since the study variables were not manipulated and the data were collected once and then analyzed to obtain the results. In this regard, Hernández et al. (2020) state that in this type of design, the data collected at a single moment enable the description of the studied variables to analyze their impact on the units of analysis or participants, which, in this case, are the university professors surveyed for the research.

Regarding the unit of analysis, it was chosen through simple random sampling in five scientific events held by the International Center for Research and Development — ICRD (related to the construction of scientific articles virtually), for a total of 2,215 professors-researchers surveyed, stratified as follows (Table 1).

Table 1. Stratification of professors surveyed in Latin America (2020)

Latin American countries with publications in the JCR	Frequency	Percentage	Cumulative percentage
Peru	437	19.7%	19.7%
Bolivia	16	0.7%	20.4%
Colombia	182	8.2%	28.6%
México	104	4.7%	33.3%
Ecuador	12	0.5%	33.8%
Chile	104	4.7%	38.5%
Venezuela	56	2.5%	41%
Brazil	626	28.3%	69.3%
Panama	48	2.2%	71.5%
Honduras	75	3.4%	74.9%
Costa Rica	4	0.2%	75.1%
Dominican Republic	8	0.4%	75.5%
Argentina	111	5%	80.5%
Cuba	87	3.9%	84.4%
Uruguay	65	2.9%	87.3%
Puerto Rico	60	2.7%	90%
Nicaragua	70	3.2%	93.2%
El Salvador	81	3.7%	96.9%
Guatemala	69	3.1%	100%
Total	2,215	100%	

The data analysis process was developed in three phases.

Phase 1: The following research hypothesis system was determined:

- H0 (Null Hypothesis): There is no significant relationship between the research culture of professors in the digital era and scientific production and impact in Latin America.
- H1 (Alternative Hypothesis): There is a significant relationship between the research culture of professors in the digital era and scientific production and impact in Latin America.

The hypothesis testing for the relationship between the variable (categorical)=Research Culture of professors in the digital era and the variable (numerical)=Scientific production and impact in Latin America through citations, whose numerical data, according to the Kolmogorov-Smirnov normality test, are abnormal for a sample. Therefore, the chi-square goodness-of-fit test was used, which is based on the fit between the frequency of occurrence of the measurements in an observed sample and the expected frequencies obtained from the hypothetical distribution. The asymptotic significance level considered is 0.05. The contingency coefficient was considered to determine the strength of the relationship.

Phase 2: To determine the "Research Culture of professors in the digital era" variable, the data collection instrument was a questionnaire composed of 26 items, where beliefs and values about research, critical judgment of research, and research competencies were included. It was validated by five experts and pilot- tested to calculate its reliability; to this end, the Cronbach's Alpha coefficient was used to determine the reliability of the instrument, which was 0.93 (Very high).

The questionnaire presented two sections: 1) Characterization of the Latin American digital professor (single-choice answers). The items are related to teaching experience, work location, academic level of teaching, area of study, age range, gender, level of education, and publication in indexed journals; and 2) Research culture of the Latin American professor (3-point Likert scale).

Phase 3: To determine the "scientific production and impact" variable, the Latin American scientific production from 1996 to 2019 was considered based on the data collected from SJR. For this purpose, the following categories were explored: 1) Total documents, 2) Total citations, and 3) Self-citations. Likewise, the total population by Latin American country in the year 2019 was considered based on the global population clock (<http://www1.worldometers.info/>), which is calculated according to the World Population Prospects prepared by the Population Division of the United Nations (UN). To facilitate the interpretation of the results regarding population and scientific production, these are divided into 5 categories according to WorldOdometers. Population (Number of inhabitants in 2019 (WorldOdometers)): 1) less than 5,000,000 (Very low), 2) between 5,000,001 and 15,000,000 (Low), 3) between 15,000,001 and 35,000,000 (Medium), 4) between 35,000,001 and 100,000,000 (High), and 5) more than 100,000,001 (Very high). Scientific production (papers published in SJR (1996-2019)): 1) less than 20,000 (Very low), 2) between 20,001 and 100,000 (Low), 3) between 100,001 and 250,000 (Medium), 4) between 250,001 and 500,000 (High), and 5) more than 500,001 (Very high).

This made it possible to calculate the real impact of scientific publications through the indicator: citations per document. To this end, self-citations are subtracted from total citations in order to determine the real impact of the publications in other regions. This allowed generating discussions on the research culture of Latin American professors in the digital era and the impact on the generation of scientific knowledge.

3. Analysis and results

3.1. Latin American research culture

With the information collected and processed, it is possible to characterize the digital-era teaching population in Latin America. 78% of the professors have less than 15 years of teaching experience (50% have less than 5 years). 91.9% of their academic practice is in undergraduate studies. As for the area of study, 31% are in the social sciences, 27.4% in business and technology, 25.4% in human sciences and education, and 14.2% in health sciences. The age group of digital-era professors is as follows: 38.9% are under 35 years old; 29.8% are between 35 and 44 years old; and 21.7% are over 45 years old. Regarding the professors' academic level, 69.8% have a bachelor's degree, 17.1% have a master's degree, and 6.3% have a doctorate (Carabantes-Alarcón, 2020).

Concerning Latin American research culture, 62.5% of the professors responded that they have never published in indexed journals, while 70.5% state that they have good practice in citing documents. 64.9% do not know how to use the research paradigm in relation to the object of study. 90.9% consider that they always use a research design in accordance with the objectives of the study. 77.4% do not know how to adequately use qualitative methods, 68.7% do not know how to adequately use quantitative methods, and 82.7% do not know the different ways of integrating mixed methods. 58.1% of professors-researchers state that they only receive research training occasionally.

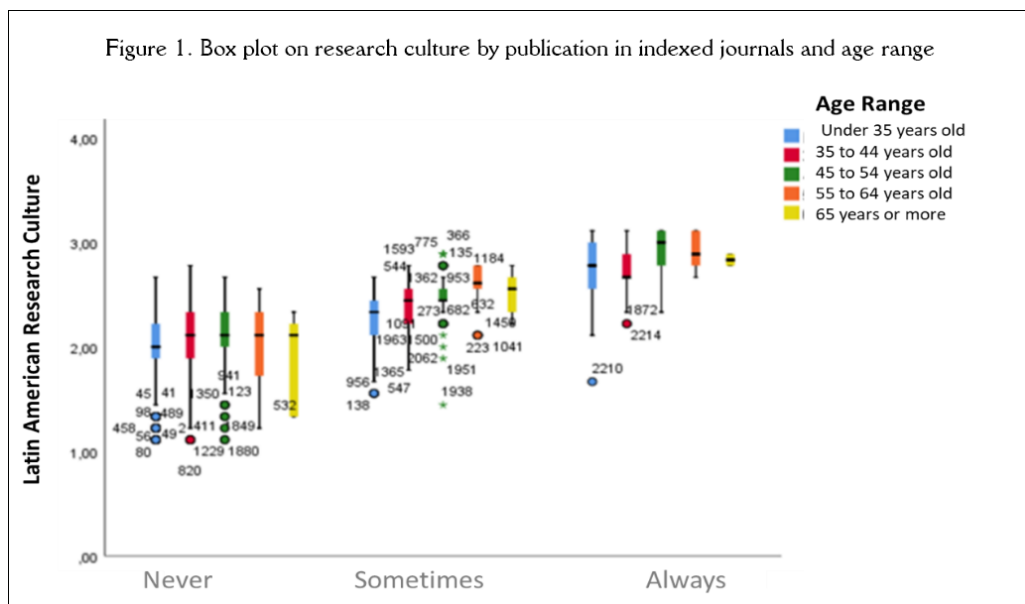


Figure 1 shows a relationship (Contingency Coefficient: 0.473 - Strong) between educational level and publication in indexed journals, showing that the higher the academic degree of the professor, the greater the interest in publishing in indexed journals. To Carranza-Esteban et al. (2020) and Guerrero-Casado (2017), the exercise of scientific research for professors in the digital era is fundamental for the development of science. The results of this research show that there is a significant group of professors with master's degrees who only publish scientific papers occasionally. Likewise, it is shown that the age group with the highest number of scientific publications is the 45 to 54-year-old group. However, between the ages of 35 and 44, Latin American research professors focus on teaching and extension activities.

Country	Population (2019)	Population category	Scientific production category	Documents	Citations	Self-citations	TOTAL citations
Brazil	212,559,417	Very high	Very high	1,027,748	8,249,466	3,974,976	12,224,442
Mexico	128,932,753	Very high	High	347,369	3,568,883	858,560	4,427,443
Colombia	50,882,891	High	Medium	114,495	994,178	182,309	1,176,487
Argentina	45,195,774	High	Medium	225,079	2,892,542	685,135	3,577,677
Peru	33,050,325	Medium	Low	29,732	410,882	48,810	459,692
Venezuela	28,435,940	Medium	Low	41,751	484,046	57,393	541,439
Chile	19,116,201	Medium	Low	163,593	2,041,116	462,718	2,503,834
Guatemala	17,915,568	Medium	Very low	3,614	57,623	3,795	61,418
Ecuador	17,643,054	Medium	Low	23,889	217,281	33,329	250,610
Bolivia	11,673,021	Low	Very Low	5,203	117,588	8,090	125,678
Cuba	11,326,616	Low	Low	41,945	300,193	63,170	363,363
Dominican Republic	10,847,910	Low	Very low	1,962	25,062	1,339	26,401
Honduras	9,904,607	Low	Very low	1,675	24,263	1,075	25,338
Paraguay	7,132,538	Low	Very low	2,796	39,233	2,523	41,756
Nicaragua	6,624,554	Low	Very low	1,916	33,435	2,290	35,725
El Salvador	6,486,205	Low	Very low	1,646	23,643	1,136	24,779
Costa Rica	5,094,118	Low	Very low	14,192	261,872	26,566	288,438
Panama	4,314,767	Very low	Very low	7,941	262,289	22,968	285,257
Uruguay	3,473,730	Very low	Low	21,262	334,210	44,456	378,666
Puerto Rico	2,860,853	Very low	Very low	17,995	411,510	22,110	433,620

Table 2 shows the Latin American population in 2019 and its relation to scientific production. Latin America is a continent with political, social, and economic weaknesses, so most of the countries in this region suffer from the same problems which prevent it from being a region with a high level of scientific production (Guerrero-Casado, 2017, Guerrero-Sosa et al., 2021). For the results of the present research, the Latin American population (20 countries studied) comprises a total of 633,470,842 inhabitants, a production of scientific documents indexed in Journal Citation Reports (JCR) in 2019 of 2,095,803 documents between 1996 and 2019, with a total volume of citations of 27,252,063, of which 23.86% are self-citations, leaving a real impact of 76.14% in other regions.

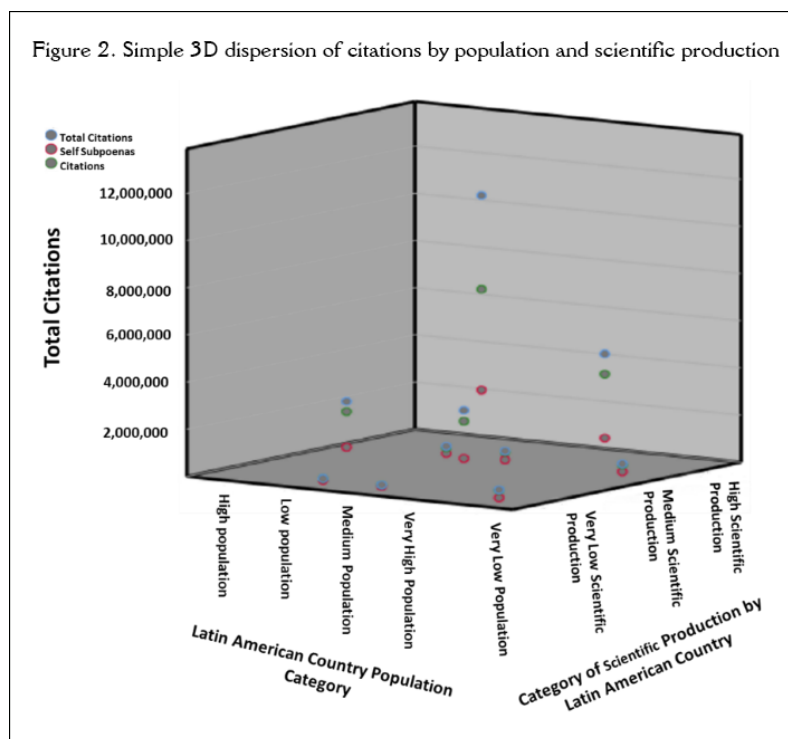


Figure 2 shows the grouped 3D dispersion of citations in relation to total citations and self-citations. It is shown that countries with medium and very high populations tend to have very low citations, high

self-citations, and a high H-index. Although Latin America is a very large area covering 46 countries, it has a relatively low weight in the world's scientific production, as well as a low impact (citations per document) when compared to developed regions (Hermes-Lima et al 2007, Chinchilla-Rodríguez et al., 2015; Bonilla et al., 2015). Specifically, the results show that countries with very low populations had an impact of 23.87% of citations on average per published document, while countries with low populations obtained 15.16% of citations on average per published document. Countries with medium populations obtained 12.59% of citations on average per published document, countries with high populations have 10.77% of citations on average per published document, and countries with very high populations have 9.15% of citations on average per published document (Figure 3).

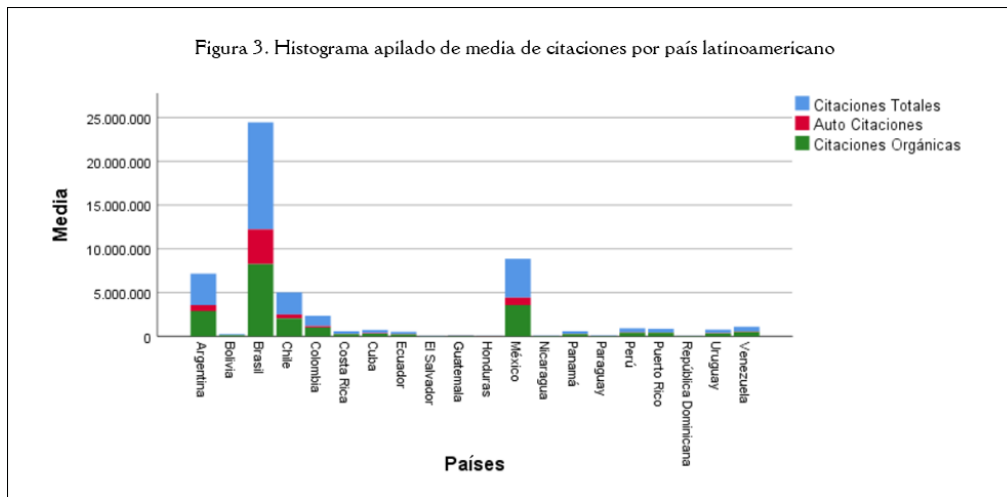
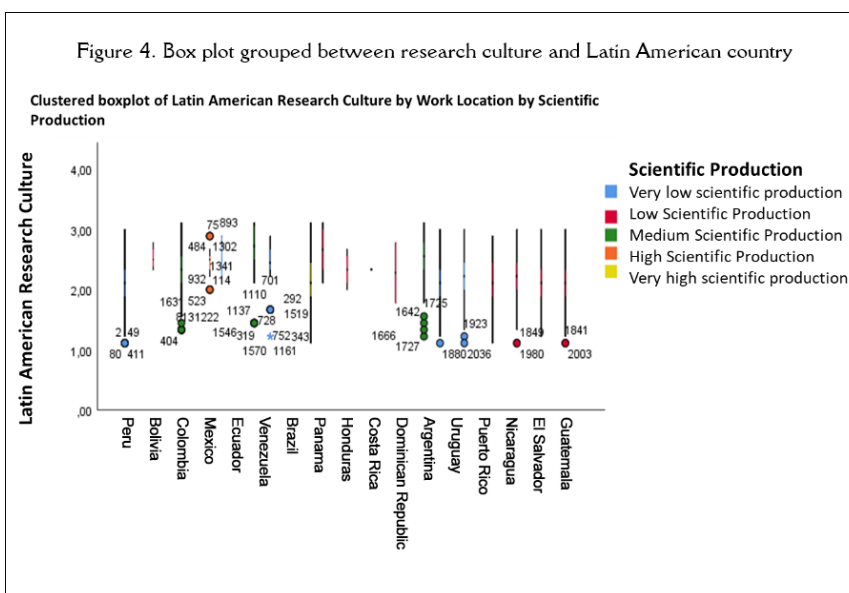


Figure 4 shows the different Latin American countries studied and categorized according to their scientific production (SJR documents): Countries with very high scientific production (Brazil), high scientific production (Mexico), medium scientific production (Argentina, Chile, Colombia), low scientific production (Cuba, Venezuela, Peru, Ecuador, Uruguay), and very low scientific production (Puerto Rico, Costa Rica, Panama, Bolivia, Guatemala, Paraguay, Dominican Republic, Nicaragua, Honduras, El Salvador).



Countries with the highest scientific production have a high level of total citations. However, countries with very low scientific production have a greater impact with citations in the scientific community (Chinchilla-Rodríguez et al., 2015; Bonilla et al., 2015, Guerrero-Sosa et al. 2021).

To determine the relationship between research culture and the level of scientific production, a Pearson's Chi-square test (221, 997th), Likelihood Ratio (241,001), and Linear-by-Linear Association (0.242) were applied. The results reflect an asymptotic significance (bilateral) of .000 with a moderate-low strength. This result rejects the null hypothesis and accepts the alternative hypothesis. In other words, there is a relationship between the research culture of professors in the digital era and scientific production and impact in Latin America (Castro-Sánchez, 2021). Figure 3 shows that when a country has an adequate research culture that promotes cooperation, collaboration, and cohesion, it is likely to produce scientific papers in indexed journals.

4. Discussion

The results show a clear relationship between the research culture of professors in the digital era and Latin American scientific production. These findings are consistent with those presented by Limaymanta et al. (2020) and Vázquez-Stanescu et al. (2020), who describe a new era of knowledge management stimulated by times of confinement and instability in the educational system, which constitutes a challenge for higher education institutions to guarantee stimulating scenarios for home-based research. One of the main findings of this research is that the Latin American region is characterized by a population of young professors with little experience, who generally work at the undergraduate level with a greater inclination towards the social sciences, with master's degrees, and only a few of them have published in indexed journals. Given the above, Figure 1 shows that professors focus on teaching and extension work.

However, those who publish have good practices regarding the writing and citation of scientific writing, despite not recognizing onto-epistemic aspects in the research processes, which confirms their lack of knowledge with regard to quantitative, qualitative, and mixed methodologies. Table 2 shows that 23.86% of the total citations are self-citations, with a real impact on other regions of 76.14%. The research culture reflected in this study reveals the weaknesses of Latin American society caused by the deficiencies in the research systems of each country. These results agree with those reported by King-Domínguez et al. (2020) and Vázquez-Stanescu et al. (2020), who consider that, despite the evident increase in indicators such as the number of citable documents, there has been a substantial decrease in the impact of scientific publications.

To González-Díaz et al. (2020), these scenarios are becoming increasingly complex due to the increasing administrative and academic workload that professors must face. This has led to situations of academic stress and a decrease in the quality of scientific production. Undoubtedly, Latin American countries with smaller populations and scarce budgets for research and development do not reach the expected levels of scientific production, with some exceptions in South America such as Chile, which, despite being a country with a medium-sized population, when compared to countries with high population densities, achieves high levels of scientific production. However, the main challenge for Latin American professors is to achieve high-quality levels in their scientific writings in order to impact the scientific community at the global level. According to the data collected in this research, countries such as Brazil, Mexico, and Argentina are the main producers of scientific knowledge in Latin America, establishing a balance in the self-citations of their scientific papers. Citations show the real impact of the science generated by a country in other regions of the planet. On the other hand, the research perspectives for the progress of Latin America in the 21st century lie in the planning of emerging ideas within public and private organizations, as well as organizations of a social nature, adopting innovative strategies in accordance with the challenging demands of the environment. For this reason, traditional organizations are incorporating mechanisms that provide answers to the world's research needs in order to become intelligent, proactive, dynamic, creative, and decentralized organizations, where competencies are the cornerstone for the achievement of strategic goals in all Latin American nations.

To Torres-Samuel et al. (2021) and Kumar et al. (2020), who present a critical discussion on Latin American research and development, the knowledge management of Latin American higher education

institutions is characterized by its low level in global impact indicators for the development of science. Likewise, Hermes-Lima et al. (2007) state that one of the central aspects of the deterioration of research in Latin America is the low investment towards activities associated with science, technology, and innovation, with an "investment of less than 8 billion dollars per year, which represents 2.3% of the global spending on the sector and the brain drain" (Vega-Muñoz et al., 2021: 23).

According to Torres-Samuel et al. (2020), Latin American countries invest less than 1% of their Gross Domestic Product (GDP) in research and development, except for Brazil, which invests more than half of the total investment in research and development in Latin America, followed by Mexico and Argentina.

As for the investment in technology, innovation, and science in Latin American countries—except for Brazil and Mexico—it represents less than 0.5% of the GDP on average, while, in developed countries, it is between 2% and 3% of the GDP in most cases. This situation is exacerbated by the dependence on the state for funding research and development projects (Fu et al. 2020). On the contrary, in developed countries, investments in this sector are almost entirely made by private companies (Wouters et al., 2020). These institutions generate good prospects as they act by creating shared actions with their citizens, directing their efforts towards the search for efficiency with the commitment to contribute to the management of cooperation networks without excluding those that operate under social principles.

Despite this scenario, Latin American professors have improved the amount of scientific production indexed in databases with an impact factor thanks to cooperation networks, strategic allies, foreign researchers, sponsorships, and funding from independent research centers that share their technological communication platforms and contribute to the international cooperation of research projects (Valdés-Pérez, 2020). Guedes-Farias and De-Andrade-Maia (2020) and Limaymanta et al. (2020) note the importance of research for the development of modern science, where every effort by Latin American professors to publish high-impact scientific publications involves a sacrifice that ranges from socioeconomic and political conditions to lowering family expenses to pay for publication fees.

Hernández et al. (2020) emphasize that the articulation of public and private institutions with research and development groups is the main problem. In most Latin American universities, the research projects that are developed, in the best of cases, remain in the repositories of institutional libraries as bibliographic material with no impact on the scientific knowledge society.

5. Conclusions

Based on the objective of this research, which was to analyze the research culture of professors in the digital era concerning science in Latin America, it is considered that the work carried out has provided an interesting information infrastructure that will help to develop a more sustainable research culture for professors in Latin America. This situation generates good prospects that would facilitate policy initiatives to create research culture and investment in technology and innovation scenarios in these regions, which would demonstrate the great interest in research development through guidelines and regulations that bet on a rigorous, integrated, and, most importantly, supported exercise in which professors and students in the digital era take advantage of the benefits of research for their social, environmental, personal, and professional development.

This shows that Latin American professors in the digital era who participated in this research have faced economic, political, and social circumstances to adequately exercise their profession, to the point of obtaining a doctoral degree but not doing research, thus affecting good research practices and exposing a training gap in research competencies, interest in research, and management of skills for the new digital era. The findings of this study show a problem to be solved in this field of teaching. The problems that arise require a collaborator who is well acquainted with the scientific field in which he/she operates and who has a number of competencies and skills that, together with an innovative method, enable him/her to produce knowledge through the scientific research process.

Finally, and based on the results obtained from the analysis of the information, it can be said that the research culture of Latin American professors in the digital era shows a vertiginous interest in adapting to changes, generating communicative and investigative competencies necessary for research. In addition to meeting the aforementioned characteristics, professors in the digital era must know their field and must like it

in order to find their work fun and fascinating. According to the main findings of this research, it is estimated that universities articulated with the State and society should work in a coordinated manner to improve the research capabilities of their academic bodies and thereby the deconstruction and reconstruction of academic programs.

† Dedication

This work is dedicated to the memory of a young and promising researcher, Dr. Romel González-Díaz. He leaves us the task of promoting research culture throughout the world.

Author Contribution

Idea, A.A.D.; R.G.D.; Literature review (state of the art), R.G.D.; A.A.D.; Methodology, R.G.D.; A.A.D.; Data analysis, A.A.D.; Results, A.A.D.; R.G.D.; Discussion and conclusions, A.A.D.; R.G.D.; Writing (original draft), A.A.D.; R.G.D.; Final revisions, A.A.D.; R.G.D.; Project design and sponsorship, A.A.D.; R.G.D.

Funding Agency

Our research "Research culture of Latin American professors in the digital age" stems from the project "Research seed bed: An emerging strategy for the promotion of research in Latin America". It is currently in its second year of management and its objective is to promote research among Latin American professors and students by fostering science, technology, and research in Latin America. Supported by the International Center for Research and Development (ICRD) (Monteria, Colombia) and the Faculty of Business and Administration of the Autonomous University of Chile (Santiago, Chile).

References

- Bagur-Pons, S., Rosselló-Ramon, M.R., Paz-Lourido, B., & Verger, S. (2021). Integrative approach of mixed methodology in educational research. *Relieve*, 27(1), 1-21. <https://doi.org/http://doi.org/10.30827/relieve.v27i1.21053>
- Basso, F.G., Gonçalves-Pereira, C., & Porto, G.S. (2021). Cooperation and technological areas in the state universities of São Paulo: An analysis from the perspective of the triple helix model. *Technology in Society*, 65. <https://doi.org/10.1016/j.techsoc.2021.101566>
- Batista-Mainegra, A., Hernández-García, L., & González-Aportela, O. (2017). *Gestión integrada de procesos sustantivos en una universidad innovadora: Deber ser de la Extensión Universitaria*. Congreso Universidad. <https://bit.ly/3fo1111>
- Biscaro, C., & Giupponi, C. (2014). Co-authorship and bibliographic coupling network effects on citations. *PLoS One*, 9(6), e99502. <https://doi.org/10.1371/journal.pone.0099502>
- Bolívar, A. (1995). *El conocimiento de la enseñanza: Epistemología de la investigación curricular*. Universidad de Granada. <https://bit.ly/3zATcOC>
- Bonilla, C.A., Merigó, J.M., & Torres-Abad, C. (2015). Economics in Latin America: A bibliometric analysis. *Scientometrics*, 105, 1239-1252. <https://doi.org/10.1007/s11192-015-1747-7>
- Boyack, K.W., & Klavans, R. (2010). Co-citation analysis, bibliographic coupling, and direct citation: Which citation approach represents the research front most accurately. *Journal of the American Society for Information Science and Technology*, (12), 2389-2404. <https://doi.org/10.1002/asi.21419>
- Bracho, K. (2012). Cultura investigativa y producción científica en universidades privadas del municipio Maracaibo del estado de Zulia. *Redhecs*, 7(12), 50-69. <https://bit.ly/315rbuo>
- Briseño-Senosai, L. (2021). Los retos de la historia académica en la era digital. *Historia y Memoria*, 22, 161-195. <https://doi.org/10.19053/20275137.n22.2021.10907>
- Cai, X., Han, J., & Yang, L. (2018). Generative adversarial network based heterogeneous bibliographic network representation for personalized citation recommendation. In *IEEE Access*, volume 7 (pp. 457-467). <https://doi.org/10.1109/ACCESS.2018.2885507>
- Carabantes-Alarcón, D. (2020). Integridad académica y educación superior: Nuevos retos en la docencia a distancia. *Análisis Carolina*, 38, 1-13. https://doi.org/10.33960/AC_38.2020
- Castro-Sánchez, F.J. (2021). Culture, science and research: About the value of the cultural factors of science for university research managers. *Universidad y Sociedad*, 13, 131-136. <https://bit.ly/3rG8oXK>
- Chinchilla-Rodríguez, Z., Zacca-González, G., Vargas-Quesada, B., & Moya-Anegón, F. (2015). Latin American scientific output in public health: Combined analysis using bibliometric, socioeconomic and health indicators. *Scientometrics*, 102, 609-628. <https://doi.org/10.1007/s11192-014-1349-9>
- Criado-Dávila, Y.V., Sánchez-García, T.C., & Inga-Arias, M.A. (2020). Los semilleros de investigación como elemento de desarrollo de la cultura investigativa universitaria. *Conrado*, 16(S1), 67-73. <https://bit.ly/3xaFUqc>
- Cruz-Rodríguez, E.C. (2019). Importancia del manejo de competencias tecnológicas en las prácticas docentes de la Universidad Nacional Experimental de la Seguridad (UNES). *Revista Educación*, 43(1), 196-218. <https://doi.org/10.15517/revedu.v43i1.27120>
- De-Filippo, D., Sanz-Casado, E., Berteni, F., Barisani, F., Bautista-Puig, N., & Grossi, G. (2021). Assessing citizen science methods in IVRM for a new science shop: a bibliometric approach. *Hydrological Sciences Journal*, 66(2), 179-192.

- <https://doi.org/10.1080/02626667.2020.1851691>
- Espinach-Rueda, M. (2017). Agenda 2030 del desarrollo sostenible promulgada por la Organización de las Naciones Unidas. *Ágora De Heterodoxias*, 3, 50-67. <https://bit.ly/3rCKb4G>
- Espinoza-Freire, E.E. (2020). El plagio un flagelo en el ámbito académico ecuatoriano. *Revista Universidad y Sociedad*, 12(3), 407-415. <https://bit.ly/3rEVRfR>
- Fu, Y.C., Baker, D.P., & Zhang, L. (2020). Engineering a world class university? The impact of Taiwan's world class university project on scientific productivity. *Higher Education Policy*, 33(3), 555-570. <https://doi.org/10.1057/s41307-018-0110-z>
- González-Díaz, R.R., Acevedo-Duque, A., Salazar-Sepúlveda, G., & Castillo, D. (2021). Contributions of subjective well-being and good living to the contemporary development of the notion of sustainable human development. *Sustainability*, (6), 13-13. <https://doi.org/10.3390/su13063298>
- González-Díaz, R.R., Guanillo-Gómez, S.L., Vegas-Ochoa, J.C., & Cachitari-Vargas, E. (2021). Teaching accompaniment in Colombia's official educational institutions. *Education*, 10, 376-383. <https://doi.org/10.18421/TEM101-47>
- González-Díaz, R.R., Vásquez-Llamo, C.E., Hurtado-Tiza, D.R., & Menacho-Rivera, A.S. (2020). Plataformas interactivas y estrategias de gestión del conocimiento durante el Covid-19. *Revista Venezolana de Gerencia*, 25(4), 68-81. <https://bit.ly/3x0IPBP>
- Guedes-Farias, M.G., & De-Andrade-Maia, F.C. (2020). Proposition of scientific observatory for popularization of science. *Informação e Sociedade*, 30, 1-19. <https://doi.org/10.22478/ufpb.1809-4783.2020v30n3.53866>
- Guerrero-Casado, J. (2017). Producción científica latinoamericana indexada en Scopus en el área de las ciencias agropecuarias: Análisis del período 1996-2016. *Idesia*, 35(4), 27-33. <https://doi.org/10.4067/S0718-34292017000400027>
- Guerrero-Sosa, J.D.T., Menéndez-Domínguez, V.H., & Castellanos-Bolaños, M.E. (2021). An indexing system for the relevance of academic production and research from digital repositories and metadata. *Electronic Library*, 39, 33-58. <https://doi.org/10.1108/EL-06-2020-0160>
- Hermes-Lima, M., Santos, N.C.F., Alencastro, A.C.R., & Ferreira, S.T. (2007). Whither Latin America? Trends and challenges of science in Latin America. *IUBMB Life*, 59(4-5), 199-210. <https://doi.org/10.1080/15216540701258751>
- Hernandez, R., Fernandez, C., & Baptista, P. (2014). *Metodología de la investigación*. Editorial Mc Graw Hill.
- Hernández, R.M., Marino-Jiménez, M., Forton, Y.R., & Sánchez, N. (2020). Research in university students: Real needs for the implementation of a formative research program. *Academia*, (pp. 154-176). <https://doi.org/10.26220/aca.3445>
- Kalhor, B., & Mehrparvar, F. (2020). *Rankings of countries based on rankings of universities*. <https://doi.org/10.2139/ssrn.3585226>
- Kumar, S., Pandey, N., & Tomar, S. (2020). Veinte años de Latin American business review: Una visión bibliométrica. *Latin American Business Review*, 21(2), 197-222. <https://doi.org/10.1080/10978526.2020.1722683>
- Limaymanta, C.H., Zulueta-Rafael, H., Restrepo-Arango, C., & Álvarez Muñoz, P. (2009). Bibliometric and scientometric analysis of the scientific production of Peru and Ecuador from VWeb of Science. *Informacion, Cultura y Sociedad*, 43, 31-52. <https://doi.org/10.34096/ICS.143.7926>
- Olaya, E. (2017). Efecto del gasto en investigación y desarrollo en el ingreso de los establecimientos de Ecuador. *Revista Vista Económica*, 3(1), 7-18. <https://bit.ly/3j0FbTP>
- Oliveira-Filho, J.D.S. (1989). A bibliometric analysis of soil research in Brazil. *Geoderma Regional*, 23, e00345. <https://doi.org/10.1016/j.geodrs.2020.e00345>
- Powell, J.J.V. (2020). Comparative education in an age of competition and collaboration. *Comparative Education*, 56(1), 57-78. <https://doi.org/10.1080/03050068.2019.1701248>
- Pozos, K.V., & Tejada, J. (2018). Competencias digitales en docentes de Educación Superior: Niveles de dominio y necesidades formativas. *RIDU*, 12(2), 59-87. <https://doi.org/10.19083/ridu.2018.712>
- Rodríguez, R., & Espinoza, L.A. (2017). Trabajo colaborativo y estrategias de aprendizaje en entornos virtuales en jóvenes universitarios. *RIDE*, 7(14), 103-126. <https://doi.org/10.23913/ride.v7i14.274>
- Rojas, M.M., Moreno, G.A., & Rosero, C.A. (2016). Plataformas y herramientas educativas como parte del PLE del Docente. Caso asistente digital para planeación curricular ConTIC. *INGE CUC*, 12(1), 99-106. <https://doi.org/10.17981/ingecuc.12.1.2016.11>
- Strauka, O. (2020). The Impact of constitutional replacements on the quality of democracy in Latin America. *Politologija*, 99(3), 93-128. <https://doi.org/10.15388/Polit.2020.99.4>
- Torres-Samuel, M., Stanescu, C.L.V., Luna-Cardozo, M., Vilorio, A., & Crissien, T. (2020). Eficiencia técnica de la investigación y desarrollo, ciencia y tecnología, educación e innovación en países Latinoamericanos. *Revista Ibérica de Sistemas e Tecnologías de Informação*, 29, 582-594.
- Torres-Samuel, M., Torres, M.E., Hurtado, J., Lugo, A.L.V., & Solano, D. (2021). Contribution of research and development to the efficiency of social progress in Latin America. In *International Conference on Marketing and Technologies, ICMarkTech 2020* (pp. 71-79). Springer. https://doi.org/10.1007/978-981-33-4183-8_7
- Trabadela-Robles, J., Nuño-Moral, M.V., Guerrero-Bote, V.P., & De-Moya-Anegón, F. (2020). Análisis de dominios científicos nacionales en Comunicación (Scopus, 2003-2018). *Profesional de la Información*, 29, 2003-2018. <https://doi.org/10.3145/epi.2020.jul.18>
- Valdés-Pérez, M.G. (2020). Visibilidad de la producción de conocimiento. *Controversias y Concurrencias Latinoamericanas*, 11, 353-363. <https://bit.ly/3yc6vEH>
- Vázquez-Miraz, P., & Posada-Llorente, M.R. (2020). Implementación de un plan anual de metas para la mejora de la producción científica en una universidad colombiana. Aspectos positivos y negativos. *Revista General de Información y Documentación*, 30, 457-471. <https://doi.org/10.5209/rgid.72821>

- Vázquez-Stanescu, C.L., Luna-Cardozo, M.L., Torres-Samuel, M., Bucci, N., Silva, A.V., & Crissien, T. (2020). Scientific production and positioning of universities according to SIR IBER ranking 2013 to 2019, Latin American case. *Revista Ibérica de Sistemas e Tecnologías de Informação*, (pp. 570-581). <https://bit.ly/374hYKH>
- Vega-Muñoz, A., González-Gómez-Del-Miño, P., & Espinosa-Cristia, J.F. (2021). Recognizing new trends in brain drain studies in the framework of global sustainability. *Sustainability*, 13(6), 3195-3195. <https://doi.org/10.3390/su13063195>
- Velandia-Mesa, C., Serrano-Pastor, F.J., & Martínez-Segura, M.J. (2021). Assessing education research training: Scale design and validation. *Revista Electrónica Educare*, 25(1), 35-54. <https://doi.org/10.15359/ree.25-1.3>
- Villacorta, S.P., Sellés-Martínez, J., Greco, R., Oliveira, A.M., Castillo, A.M., & Arias-Regalía, D. (2020). Laigeo and its contribution to the improvement and spreading of geosciences education in Latin America and the Caribbean: Accomplishments and goals. *Serie Correlacion Geologica*, 35(2), 67-76.
- Wouters, O.J., Mckee, M., & Luyten, J. (2020). Inversión estimada en investigación y desarrollo necesaria para llevar un nuevo medicamento al mercado. *JAMA*, 323(9), 844-853. <https://doi.org/10.1001/jama.2020.1166>