RESEARCH ARTICLE

Multidimensional Statistical Analysis Related to Educational Evolution in South America over the Last Fifty Years

Análisis estadístico multidimensional relacionado con la evolución educativa en Sudamérica en los últimos cincuenta años

Análise estatística multidimensional relacionada com a evolução da educação na América do Sul nos últimos cinquenta anos

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OPEN ACCESS

DOI: https://doi.org/10.18634/sophiaj.19v.1i.1266

Article information

Received: Deccember 2022
Revised: March 2023
Accepted: June 2023
Published: January-June 2023

Keywords: education; statistics; investment; GDP; budget; education; South America.

Palabras clave: educación; estadísticas; inversión; PIB; presupuesto; Sudamérica.

Palavras-chave: educação; estatísticas; investimento; PIB; orçamento; América do Sul

How to cite:
Restrepo Betancur, L. F. (2023). Multidimensional Statistical Analysis Related to Educational Evolution in South America over the Last Fifty Years. Sophia, 19(1). https://doi.org/10.18634/sophiaj.19v.1i.1266

Sophia-Education, volume 19 number 1. January/June 2023. Engliish version

ABSTRACT

Education is a fundamental factor for any citizen, regardless of age, race, creed or gender. The aim of this research was to evaluate different statistical variables associated with education in the different countries of South America over the last five decades. Multivariate techniques called MANOVA, cluster and canonical analysis were used to analyze the information. A high percentage of illiterate people belonging to the third age was found, mainly in the rural sector. Bolivia is the country with the highest percentage of GDP invested in education. Significant differences were found between nations in the following variables: gross domestic product, average number of students per teacher, literacy rate, percentage of students completing a cycle and educational life expectancy. It is concluded that the level of illiteracy has been decreasing significantly over the last few decades, making it possible to build a more equitable and inclusive society.

RESUMEN

La educación es un factor fundamental para cualquier ciudadano sin distingo de edad, raza, creencia y sexo. El objetivo de la presente investigación fue, evaluar diferentes variables estadísticas asociadas con la educación en los diferentes países de Sudamérica, en las últimas cinco décadas. Para el análisis de la información se emplearon las técnicas multivariadas denominadas MANOVA, análisis de clúster y canónico. Se encontró un alto porcentaje de personas analfabetas pertenecientes a la tercera edad, principalmente en el sector rural. Bolivia es la nación que mayor porcentaje del PIB invierte en educación. Se detectó diferencias significativas entre naciones en las variables: producto interno bruto, promedio de estudiantes por docente, porcentaje de alfabetismo, porcentaje de estudiantes que terminan un ciclo y esperanza de vida educativa. Se concluye que el nivel de analfabetismo se está reduciendo de manera notable en las últimas décadas, lo que permite construir una sociedad más equitativa e incluyente.

ISSN (electronic): 2346-0806 ISSN (print): 1794-8932

Conflict of interest:

The authors declare that they have no conflict of interest.

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RESUMO

A educação é um fator fundamental para qualquer cidadão, independentemente de idade, raça, crença e sexo. O objetivo desta pesquisa foi avaliar diferentes variáveis estatísticas associadas à educação nos diferentes países da América do Sul, nas últimas cinco décadas. Para a análise das informações, foram utilizadas as técnicas multivariadas denominadas MANOVA, cluster e análise canônica. Encontrou-se um alto percentual de idosos analfabetos, principalmente no setor rural. A Bolívia é a nação que investe o maior percentual do PIB em educação. Foram detectadas diferenças significativas entre as nações nas variáveis: produto interno bruto, número médio de alunos por professor, percentual de alfabetização, percentual de alunos que completam um ciclo e expectativa de vida escolar. Conclui-se que o nível de analfabetismo vem sendo reduzido significativamente nas últimas décadas, o que permite a construção de uma sociedade mais igualitária e inclusiva.

Introduction

In recent decades, Latin America has increased educational coverage mainly at primary level, so that the different nations of South America have rates of over 90% in the basic primary cycle; similarly, at secondary level, there has been an increase of around 15%. In the university cycle, unfortunately, the number of new places for students choosing to enter higher education has not been significant (Márquez, 2017). Neoliberal political models have resulted in higher education becoming a business, which is growing more and more every day, turning universities into commercial companies, with the repercussions of making the conditions under which teachers are employed precarious, both in economic terms and in terms of job stability. Likewise, the workload has increased, among many unfavorable factors for teachers (Díez, 2020). The neoliberal management system wants education to turn into participation and competition, where reports are presented and the state verifies the quality of the results achieved by the different educational entities, prioritizing the autonomy of each entity (Saura and Muñoz, 2016).

Education is a right, so the government must ensure that it provides the right quality standards for the population. Globalization has had an unfavourable impact on the marginal classes, especially in the population centers far from the capitals, where unfortunately they do not have the necessary and sufficient elements to provide quality education (Horbath and Gracia, 2016). The latter is related to students' desire to acquire new knowledge, teachers' ability to teach useful concepts for life and the achievement of goals and values associated with school management. Education is not a constant, as it evolves depending on the dynamics of society at any given time (Torche *et al.*, 2015). The relationship between each individual who lives in a country and the State must take education into account as a fundamental right, which makes it possible to articulate the research and cultural development of a nation, thus enhancing social transformation (Scioscioli, 2014). Developed countries with greater educational coverage reflect better economic conditions for their inhabitants and therefore a better quality of life (Gómez, 2014), which is why it is necessary to increase the access of a greater number of students to secondary education and make it easier for students to have the possibility of entering higher education (Unzué, 2019).

Education must be the basis for social inclusion, so that the population has real future opportunities (Pérez, 2017). Scientific research, creativity and innovation are fundamental to having guaranteed educational quality (Escribano, 2017), and for this reason middle and higher education should be boosted in order to improve the living conditions of the inhabitants, incorporating the knowledge acquired to provide solutions to the major problems existing in the different nations (De la Cruz, 2017). The right to education has been established in different treaties related to human rights and is the driving force behind the development of countries (Jaimes, 2016). There must be a constant evaluation of the study plans, in order to adjust them to the requirements

of society and thus be able to provide a higher level of training for students. This will serve as a tool to overcome the inequality that exists in society, mitigate poverty and unemployment, with the aim of having a more equitable, democratic and inclusive community (Avendaño and Guacaneme, 2016).

Educational level and economic stability are correlated with the quality of life of a country's inhabitants. Unfortunately, in South America there are large social gaps that have repercussions on the well-being of society. As a result of these gaps, the majority of the population does not have the opportunity to access higher education, which means that the inhabitants do not have an equal opportunity to access qualified positions, and are therefore condemned to low salaries, only being able to occupy low-profile jobs. The people most affected are linked to the rural sector, where there is a shortage of teachers, teachers with a lower level of preparation, fewer investment resources and schools with logistical deficiencies in computer equipment, classroom provision, internet connection, laboratory equipment, sports fields, among others (De la Cruz, 2017; Escribano, 2017). The rural population constitutes the largest percentage of inhabitants at orbital level, and therefore the gap between the countryside and large cities must be mitigated in order to achieve sustainable development (Peirano *et al.*, 2015).

Globalization has had a notable impact on education through the establishment of new technologies, the signing of agreements, academic exchanges, joint scientific research between university centers located in different parts of the world, access to information in real time and the transfer of scientific advances (Avendaño and Guacaneme, 2016). Technological development has had an impact on the way of communicating and accessing knowledge, turning the internet into a central hub of new opportunities, which is associated with innovation and research. ICT has had a significant impact on educational transformation, where the teacher plays a vital role in the transmission of new knowledge and therefore student learning (Hernández, 2017).

Education today is not exclusive to enclosed spaces such as schools; the implementation of ICT has given way to opening up education in different environments that are not necessarily traditional centers. Open education is fundamental in today's society, where, for example, television plays a leading role in bringing programs that enable people to be trained, complementing what is learned in schools (Martínez, 2009). Colombia was a world pioneer in disseminating educational programs through the most powerful radio station in Latin America, Radio Sutatenza, allowing the population to be linked to the education sector (Rodríguez, 2019). The articulation of the community makes it possible to generate bonds of mutual help, through which individuals recognize each other and generate different expectations, thus turning education into a point of reference for the community, which prioritizes the collective rather than particular aspects. This gives rise to participatory processes related to decision-making on different aspects associated with schooling. Teachers should strive to carry out competency learning, so that students can interact with society based on the knowledge acquired (Ramírez, 2017). University centers have within their objectives to train integrated people who respond effectively to the challenges that arise (Avendaño *et al.*, 2019).

In recent decades, the number of students enrolled in Higher Education Institutions has doubled, which has largely favored marginalized classes and has generated patterns of heterogeneity between nations; this is mainly due to both governmental and family financial factors (Unzué, 2018). A new concept related to education refers to the valuation of the person according to the degree of learning assimilated, which motivates the individual to seek to be better every day. Nowadays, most governments see education as a factor in future investment that will enable the nation to develop better (Molina, 2017). On the other hand, the community is currently being given greater consideration, as it provides fundamental elements that are incorporated into the educational process through interaction between teachers, students, families and the different agents that represent society (Ramírez, 2017).

The aim of this research is to evaluate and contrast the evolution of government investment in education in South America over the last fifty years and its impact on different educational aspects. The null hypothesis is that there are no statistical differences between nations and the alternative hypothesis is that at least one country differs from the others.

ISSN (electronic): 2346-0806 ISSN (print): 1794-8932

Methodology

A multidimensional descriptive study was carried out. For this research process, information was collected from the world's freely accessible platforms: ECLAC, UNESCO, UNICEF. A transposed matrix procedure was applied to the data, on the Excel 2010 version platform, in order to concatenate their export to the SAS University (2020) statistical package. The information was analyzed using the following statistical techniques: General Linear Model, multivariate analysis of variance (MANOVA) with canonical contrast of orthogonal type, determining by the method of maximum likelihood the significant Lambda value that allowed to establish the dimension of comparison between the nations of the south of the American continent, likewise the multivariate cluster technique was used, as well as frequency distribution of one-dimensional type.

The variables evaluated were gross domestic product (GDP), average number of students per teacher, percentage of literacy and illiteracy, percentage of students completing an educational cycle and educational life expectancy. Data transformation was used to validate the statistical assumptions associated with the methods used, based on the BOX-COX family. The statistical treatment of each of the variables is described below.

The GDP variable was expressed as an average percentage of the economic investment of each nation in South America in each of the decades evaluated. The percentage of illiteracy was expressed in both urban and rural areas for the different age groups using the geometric mean. The percentage of people finishing the different academic cycles and the average number of students per teacher were compared using Tukey's test of honesty based on a 95% confidence level. After carrying out the univariate analysis, the MANOVA technique was applied incorporating all the variables evaluated in the study, in order to contrast whether there is a statistical difference between the different nations of South America.

Results

When evaluating the gross domestic product (GDP) invested in education in the different countries of South America, it can be seen that it has increased over time in Bolivia, which is the nation that has allocated the largest amount of GDP over the last three decades. In general, a greater share of GDP has been allocated to education over the last thirty years in the different countries of the southern American continent, except for Venezuela, which decreased by one point in the current decade; Paraguay has remained constant over the last twenty years. It is worth noting that adequate economic investment makes it more likely that the education system can be offered to the public in an appropriate way, with more qualified teaching staff and an appropriate infrastructure. In this research, significant differences were found in the different time periods ($p<0.05$), where Bolivia has the best educational investment statistics, followed by Brazil. Paraguay and Peru have the lowest values of budget allocation to the education system (see table 1).

Table 1. GDP invested in education by country and decade

	Decade									
	70		80		90		2000		2010	
Country	1970 a 1979		1980 a 1989		1990 a 1999		2000 a 2009		2010 a 2019	
Argentina	1,8	d	1,7	d	3,3	c	4,3	c	5,4	c
Bolivia	4,5	a	4,7	a	5,2	a	6,4	a	6,9	a
Brazil	4,5	a	4,5	b	4,3	b	4,5	c	5,9	b
Chile	3,4	b	4,0	b	2,9	d	3,7	d	4,7	d
Colombia	2,3	c	2,5	c	4,2	b	4,1	c	4,6	d
Ecuador	2,1	c	5,4	a	1,9	e	2,8	e	4,9	d
Paraguay	2,2	c	1,4	d	3,2	c	3,4	d	3,4	e
Peru	2,0	c	2,5	c	3,3	c	2,9	e	3,4	e

Uruguay	2,3	c	2,6	c	2,5	d	2,5	f	4,7	a
Venezuela	3,9	b	4,2	b	4,0	b	4,7	b	3,7	e

Source: Own elaboration based on the General Lineal Model based on the information provided by the CEPALSTAT portal. Different letters indicate a significant statistical difference ($p<0.05$), the comparisons were made in each of the decades evaluated.

The average number of students per teacher, for the different educational levels, allowed us to detect a statistically significant difference in Chile and Uruguay ($p<0.05$), with respect to the other nations, in terms of the number of students per teacher, according to the results associated with the comparative analysis. In Bolivia and Uruguay there are more students enrolled per course in primary education, while in Chile, Colombia and Ecuador there are more students enrolled in primary education. It can also be observed that in Chile there are more students per course at secondary level. Uruguay and Paraguay are the countries with the lowest number of students per teacher at university level. In general, it can be seen that the number of students in the university cycle has not increased significantly in the different nations of South America over time (see table 2).

Table 2. Average number of students per teacher and country over time

Country	Decade	PJ	PRI	SEC	UNI	Country	Decade	PJ	PRI	SEC	UNI
ARG	70	20	19	8	12	ECU	70	33	37	15	18
ARG	80	20	20	8	12	ECU	80	26	33	16	22
ARG	90	19	19	11	15	ECU	90	18	28	12	15
ARG	2000	21	18	15	16	ECU	2000	17	23	14	20
ARG	2010	23	19	17	18	ECU	2010	21	24	22	16
BOL	70	44	28	25	18	PAR	70	29	29	9	8
BOL	80	44	26	24	21	PAR	80	29	26	10	8
BOL	90	42	25	21	20	PAR	90	20	23	13	9
BOL	2000	38	20	22	20	PAR	2000	26	28	12	10
BOL	2010	34	18	23	21	PAR	2010	24	24	18	11
BRA	70	28	28	13	12	PER	70	36	38	23	14
BRA	80	28	28	14	12	PER	80	31	34	22	18
BRA	90	26	26	12	13	PER	90	26	28	19	15
BRA	2000	23	23	17	15	PER	2000	24	24	17	15
BRA	2010	21	21	17	20	PER	2010	18	18	15	19
CHI	70	44	35	33	15	URU	70	31	23	25	12
CHI	80	23	34	30	14	URU	80	29	22	23	10
CHI	90	27	33	29	14	URU	90	28	21	16	8
CHI	2000	22	28	26	14	URU	2000	27	19	14	8
CHI	2010	27	20	20	15	URU	2010	26	12	13	7
COL	70	23	34	19	9	VEN	70	36	31	19	13
COL	80	25	30	20	9	VEN	80	27	26	19	13
COL	90	21	27	20	10	VEN	90	23	25	20	13
COL	2000	23	28	24	13	VEN	2000	24	25	21	14
COL	2010	27	25	26	16	VEN	2010	23	24	20	14

Comparative Analysis

Argentina	c	Bolivia	c	Brazil	b	Chile	a
Colombia	c	Ecuador	c	Paraguay	d	Peru	c
Uruguay	a	Venezuela	c	Different letters indicate difference			

Source: Own elaboration based on General Linear Model based on information provided by CEPALSTAT portal, PJ=pre garden PRI=primary, SEC=secondary, UNI=university. ARG=Argentina, BOL=Bolivia, BRA=Brazil, CHI=Chile, COL=Colombia, ECU=Ecuador, PAR=Paraguay, PER=Peru, URU=Uruguay, VEN=Venezuela.

ISSN (electronic): 2346-0806 ISSN (print): 1794-8932

When evaluating the percentage of literacy in the different countries that make up South America, it stands out that over time the literate population in both sexes is higher in the different nations evaluated. Argentina and Uruguay show favorable statistical differences compared to the other countries ($p<0.05$). In Brazil, Chile, Colombia, Venezuela and Uruguay, there is a slightly higher percentage of literacy among females compared to males. Bolivia stands out for having a literacy rate of 51.4% among females in the 1970s, compared to 89.5% in the current decade. A similar behavior occurs in Brazil, where the female population has had a higher percentage of literacy over time (see table 3).

Table 3. Literacy rate by country, decade and sex

		Decade				
Country	**Sex**	**70**	**80**	**90**	**2000**	**2010**
Argentina	Male	94,0	94,3	96,2	98,3	99,1
Argentina	Female	92,5	93,6	96,0	98,2	99,0
Bolivia	Male	75,8	80,0	82,2	94,9	96,7
Bolivia	Female	51,4	62,7	72,3	85,0	89,5
Brazil	Male	73,9	76,4	83,5	88,9	91,8
Brazil	Female	69,8	72,9	81,6	89,3	92,3
Chile	Male	90,4	91,5	94,6	97,6	98,6
Chile	Female	89,5	90,8	94,0	97,6	99,5
Colombia	Male	85,6	87,8	91,1	92,8	94,1
Colombia	Female	84,9	87,3	91,2	92,9	94,5
Ecuador	Male	83,5	86,8	90,5	93,2	94,4
Ecuador	Female	77,6	80,4	86,2	90,6	92,2
Paraguay	Male	93,4	87,9	94,1	96,4	96,9
Paraguay	Female	94,3	85,9	93,0	96,0	96,8
Peru	Male	87,5	90,1	92,9	94,0	97,0
Peru	Female	70,4	73,9	81,7	83,1	91,0
Uruguay	Male	93,4	94,8	96,2	97,6	98,1
Uruguay	Female	94,3	95,9	97,3	98,3	98,8
Venezuela	Male	84,6	86,5	90,7	94,8	96,0
Venezuela	Female	81,1	83,0	89,0	94,3	96,3

Comparative Analysis

Argentina	a	Bolivia	c	Brazil	c	Colombia c
Chile	b	Ecuador	c	Paraguay	b	
Uruguay	a	Peru	b	Venezuela	c	

Source: Own elaboration based on the General Lineal Model based on the information provided by the portal CEPALSTAT. Different letters indicate a significant statistical difference ($p<0.05$).

In terms of the percentage of students who finish primary school, there are significant statistical differences in favor of Argentina, Chile, Venezuela and Uruguay for both sexes, compared to the other southern American nations. Colombia, Paraguay and Peru have the lowest percentages for both sexes, without reaching 90%, as can be seen in Table 4. It is important to note that, in percentage terms, more women in Brazil, Chile, Colombia, Venezuela and Uruguay finish primary school.

Table 4. Percentage of people finishing primary school

		Decade				
Country	Sex	70	80	90	2000	2010
Argentina	Male	60,9	72,5	87,6	93,1	95,4
Argentina	Female	66,8	80,3	90,3	90,8	95,2
Bolivia	Male	48,5,	55,9	73,6	91,7	93,0
Bolivia	Female	42,7	52,1	70,4	97,5	94,4
Brazil	Male	38,3	45,7	63,8	84,1	95,9
Brazil	Female	42,9	44,7	49,4	78,7	91,2
Chile	Male	70,0	90,0	96,9	97,2	98,7
Chile	Female	71,8	96,1	99,1	99,3	99,4
Colombia	Male	38,8	51,9	58,2	75,3	83,9
Colombia	Female	39,4	56,0	66,2	85,6	87,8
Ecuador	Male	60,1	62,9	66,5	74,4	90,1
Ecuador	Female	55,8	64,4	77,7	79,8	90,5
Paraguay	Male	47,2	52,7	66,8	77,3	81,2
Paraguay	Female	43,1	53,7	71,6	80,8	84,4
Peru	Male	69,4	72,5	68,4	75,9	80,4
Peru	Female	61,3	68,1	83,3	84,5	84,6
Uruguay	Male	82,5	90,0	84,0	84,5	95,8
Uruguay	Female	90,5	93,7	93,2	93,6	99,4
Venezuela	Male	56,7	63,8	91,3	89,8	97,5
Venezuela	Female	62,9	74,6	90,5	91,8	91,9
		Comparative Analysis				
Argentina	a	Bolivia	d	Brazil	c	Colombia b
Chile	a	Ecuador	b	Paraguay	c	
Uruguay	a	Peru	b	Venezuela	a	

Source: Own elaboration based on the General Lineal Model based on the information provided by the portal CEPALSTAT. Different letters indicate a significant statistical difference ($p<0.05$).

The highest percentage of illiteracy in the different countries of South America is in the rural sector, where Bolivia stands out with 71.6% of women aged sixty and over having this condition. In general, older people have a higher percentage of illiteracy, as can be seen in Table 5.

Table 5. Percentage of illiteracy by age group, sex and region

			Age range in years				
Country	Sex	Zone	15-24	25-34	35-44	45-59	60 o +
Argentina	Male	Urban	1,1	1,3	0,6	0,9	1,6
Argentina	Female	Urban	0,5	0,5	0,6	0,8	1,9
Argentina	Male	Rural	1,6	2,4	3,1	5,2	9,8
Argentina	Female	Rural	1,3	2,7	3,4	4,8	9,7
Bolivia	Male	Urban	0,4	0,4	0,7	1,3	5,1
Bolivia	Female	Urban	0,4	0,9	2,1	5,3	19,4
Bolivia	Male	Rural	0,0	1,2	2,8	7,6	22,9
Bolivia	Female	Rural	1,2	4,3	12,6	25,7	71,6
Brazil	Male	Urban	1,0	1,8	3,5	6,3	15,0

ISSN (electronic): 2346-0806 ISSN (print): 1794-8932

Brazil	Female	Urban	0,5	0,9	2,3	5,5	13,8
Brazil	Male	Rural	2,9	7,3	17,7	26,5	39,7
Brazil	Female	Rural	1,3	3,7	11,4	21,2	41,1
Chile	Male	Urban	1,0	1,4	1,7	3,3	5,8
Chile	Female	Urban	0,9	1,0	1,7	3,1	6,8
Chile	Male	Rural	1,2	2,5	5,1	8,0	18,6
Chile	Female	Rural	1,3	2,6	3,7	6,5	19,0
Colombia	Male	Urban	1,0	1,5	2,0	3,4	9,2
Colombia	Female	Urban	0,6	0,8	1,7	3,3	10,8
Colombia	Male	Rural	2,0	6,4	9,5	16,3	29,6
Colombia	Female	Rural	5,2	3,9	7,3	14,6	30,0
Ecuador	Male	Urban	3,3	6,5	4,8	12,0	15,1
Ecuador	Female	Urban	3,9	6,3	7,6	14,9	25,2
Ecuador	Male	Rural	4,3	10,5	9,6	13,9	37,1
Ecuador	Female	Rural	2,3	5,5	11,7	24,3	48,3
Paraguay	Male	Urban	0,5	1,8	1,6	4,4	13,4
Paraguay	Female	Urban	1,6	1,3	2,2	4,7	19,5
Paraguay	Male	Rural	2,5	3,9	7,7	8,6	24,6
Paraguay	Female	Rural	2,2	2,4	6,9	15,4	37,3
Peru	Male	Urban	0,7	0,9	1,4	2,0	4,5
Peru	Female	Urban	1,1	1,4	3,1	6,7	19,3
Peru	Male	Rural	1,6	5,4	7,6	9,4	20,6
Peru	Female	Rural	2,4	11,1	19,7	33,5	62,1
Uruguay	Male	Urban	1,5	1,3	1,5	1,3	2,2
Uruguay	Female	Urban	0,8	0,5	0,7	0,8	1,6
Uruguay	Male	Rural	0,6	1,2	2,1	3,1	5,1
Uruguay	Female	Rural	0,3	1,4	0,4	1,0	3,0
Venezuela	Male	Urban	1,4	2,0	3,1	3,9	11,0
Venezuela	Female	Urban	0,8	1,2	1,9	1,4	14,8
Venezuela	Male	Rural	2,9	4,4	7,3	12,5	19,4
Venezuela	Female	Rural	6,2	3,9	6,9	11,7	17,8

Source: Own elaboration based on information provided by the CEPALSTAT portal.

Chile differs statistically from the other countries in terms of the percentage of students who complete primary and secondary education, while Argentina leads significantly in terms of the percentage of students who complete university. In terms of school life expectancy at primary level, Argentina, Chile, Ecuador, Paraguay, Peru and Uruguay lead the statistics. At secondary level, Brazil and Uruguay stand out. In terms of the university cycle, Argentina and Chile have the highest average years of schooling, as can be seen in Table 6. The most favorable statistics related to the percentage of people who finish university are in Argentina, and the lowest in Brazil and Uruguay.

Table 6. Percentage of people finishing school

Country	Primary		Secondary		University	
Argentina	95,3	b	62,0	b	23,0	a
Bolivia	93,7	b	65,1	b	14,0	b
Brazil	93,5	b	55,0	c	5,0	d
Chile	99,1	a	80,0	a	14,0	b

Colombia	85,9	c	61,2	b	11,2	c
Ecuador	90,3	b	58,0	c	14,0	b
Paraguay	82,8	c	55,2	c	7,0	d
Peru	82,5	c	75,0	a	17,0	b
Uruguay	92,5	b	49,0	d	5,0	d
Venezuela	94,7	b	67,0	b	17,5	b

Source: Own elaboration based on the General Lineal Model based on information reported by: Unicef and Unesco. Comparisons were made with data over time. Different letters indicate a statistically significant difference ($p<0.05$).

In terms of school life expectancy, Argentina, Chile and Uruguay have the best rates of permanence in the different academic cycles. Venezuela has the lowest statistics at secondary level, Brazil and Ecuador at university level. It should be noted that the problematic situation that Venezuela is going through has a significant impact on the dropout of the student population (see table 7).

Table 7. School life expectancy

Country	Primary		Secondary		University	
Argentina	6,6	a	6,5	b	4,5	a
Bolivia	5,9	b	5,5	b	.	.
Brazil	5,6	b	7,1	a	2,4	c
Chile	6,0	a	6,0	b	4,3	a
Colombia	5,7	b	5,8	b	2,9	c
Ecuador	6,2	a	6,1	b	2,5	c
Paraguay	6,3	a	5,9	b	.	.
Peru	6,4	a	5,3	c	3,5	b
Uruguay	6,5	a	7,2	a	3,1	b
Venezuela	5,8	b	4,4	d	.	.

Source: Own elaboration based on the General Lineal Model based on information reported by: Unicef and Unesco.

The multivariate analysis of variance, which was carried out with all the variables evaluated in this research, allowed us to detect highly significant differences between the nations; Chile stands out as the nation in South America with the best statistics in the field of education (see table 8).

Table 8. Multivariate analysis of variance

MANOVA			
Test	Value	F	p-value
Wilks' Lambda	0,008	33,1	<,0001
Pillai's Trace	2,574	25,5	<,0001
Hotelling-L. Trace	11,08	37,8	<,0001
Roy's Greatest Root	5,630	79,5	<,0001

Canonical Analysis							
Argentina	c	Bolivia	c	Brazil	b	Chile	a
Colombia	c	Ecuador	c	Paraguay	d	Peru	c
Uruguay	a	Venezuela	c	Different letters indicate difference			

Source: Own elaboration based on the General Lineal Model, using multivariate analysis of variance (MANOVA) with orthogonal canonical contrast, based on information reported by Unicef, Unesco and Cepal.

ISSN (electronic): 2346-0806 ISSN (print): 1794-8932

Discussion

Education is considered to be the foundation of society because it brings economic wealth, social prosperity and political stability. Economic and social status depends on the education obtained by the individual as it contributes to the individual's ability to manage a better quality of life. The main objective of education is to educate individuals within society, to prepare and qualify them to work in the economy, as well as to integrate people into society and teach them moral values. Education in society prepares young people for adulthood, so that they can form the next generation of leaders. Students must be equipped with the necessary knowledge and skills to participate effectively as a member of society and contribute to the development of shared values and a common identity (Fazilah *et al.*, 2012).

Evolution of education in South America

At the start of the 1990s and the beginning of the new millennium, major changes took place in the education system in South America in Chile, Ecuador, Argentina, Bolivia and Colombia. Higher education centers have undergone the greatest transformation, prioritizing research as a central focus (Soto *et al*., 2017). Education is correlated with the dialectic and social events, in which the economic factor has a significant impact. Although there is heterogeneity within each nation, it is between countries that there is the greatest divergence, since government policies and budget allocation play a predominant role in marking the gaps, especially in those populations with marked levels of poverty; moreover, it is important to note that investment in education has not been associated with the evolution of GDP. In addition, the Gini coefficient of income distribution is around 0.5 in the first decade of the new millennium in Latin America (Escribano, 2017).

The Declaration of Lima, Peru, made in 2014, indicates that the different nations of the region are pushing for universal, high-quality education, with greater investment associated with GDP, and also seeks to take into account IT development through the implementation of new technologies. This is in order to incorporate knowledge with a sense of globalization and sustainable development, which also implies that teachers have a status that guarantees their job stability and good economic recognition (Eslava, 2015).

In recent decades, the nations of Latin America have implemented a series of reforms in their education systems which have had a major impact on secondary education, becoming a transformational axis. The decade of the eighties is considered lost, because it is the term used to describe the period of crisis suffered by this region, at the same time as new democracies were beginning (Ruiz, 2016). Successful educational reforms derive from action, in which factors such as participation, flexibility, the adoption of complex systems and social cohesion are related to transformations that can last longer and be effective (Salazar and Ordóñez, 2016). Educational reforms are carried out in order to make adjustments that allow the different programs to be aligned with reality, affecting school systems (Velasco, 2016).

There is currently a transformation in the way people access education, in which virtuality has gained ground in different countries over the last decade, generating a new educational culture that is being recognized and supported by different entities, both private and governmental. This practice allows the collective sense to take precedence over the individual, articulating the teacher, the student, the family and their social environment, in different activities related to the educational team and actions outside of it (Ramírez, 2017). The big difference between nations is the possibility of accessing new technologies; in the case of Uruguay, every student enrolled at primary level is guaranteed a free laptop, unlike Paraguay, where there is one computer for every one hundred and thirty enrollees (Escribano, 2017). Distance education has advantages related to being able to access education regardless of where you are located, since all that is required is connectivity. In addition, it can offer more time alternatives, making it easier for students to work, with interactive materials that are easy to access and generally free of charge (Yong *et al*., 2017).

Coverage at the primary level has increased significantly in the last period in Latin America, with rates above 90 percent. At the secondary and university level, there has been a small percentage improvement. However, there

is a great deal of heterogeneity between different nations with regard to the allocation of resources to education (Márquez, 2017). Higher education is associated with an index of social development, noting that access to university centers is correlated with a series of complexities, including the inclusion of the entire population, in order to be able to access greater job opportunities, which have repercussions on the quality of life (Unzué, 2019).

In Latin America there are large economic gaps between nations and between the population of each country in general, which has repercussions on the budget allocations dedicated to education and other factors related to state policy. There are major challenges, including: expanding coverage at primary and secondary level, restructuring technological education and significantly increasing access to higher education; and linking the less privileged classes to the education system, especially indigenous people and people living in remote areas. This will allow for social equity in education, and for it to be compatible with the different processes of globalization (Lorente, 2019).

There are two types of equity in education, the first is defined horizontally and the other is perceives vertically:

Horizontal equity implies that the resources allocated to each school zone should be similar in terms of infrastructure, funding, type and qualification of teachers, number of pupils per teacher and should have an equivalent expenditure per pupil regardless of the socio-economic level, education and wealth of the target population. This equity is called *equal treatment of equals*. While vertical equity consists of giving more to those school zones in which the cost of living is higher, additional resources must also be provided to make compensatory efforts such as improving the cultural capital of students or correcting social disadvantages, which is known as unequal treatment of the unequal (De la Cruz, 2017: 166).

Globalization has had an impact on the cultures of different nations, on the economy, on the way of governing and on education. The latter is affected by multiple variables in which the directives, teachers and students of the different levels lack a critical culture that addresses the problems associated with neoliberalism, especially those negative aspects that go against the educational model. The greatest weapon of citizens is writing and reading, because it is capable of developing people's ability to manage information and therefore make decisions (Avendaño and Guacaneme, 2016). Current education generally trains people to fit into systems, leaving aside aspects of interest related to the preservation of the planet (Calderón *et al*., 2017).

Increasing investment in education is vital in South America, so that its inhabitants can be much more competitive in today's globalized world. Nowadays, it is necessary to implement training in digital skills, so that it is a major reason for social inclusion, with the aim that students have the opportunity to access knowledge and thus promote advanced digital skills, allowing the individual to be competitive and improving their quality of life in the near future. It should be noted that the investment per student is linked to the allocation of GDP that each government considers to promote education. Latin America provides a sixth of what Western Europe provides per student (Escribano, 2017).

This research highlights the efforts of the different nations of South America to expand educational coverage, mainly at primary level, and also shows that the level of illiteracy has been reduced, especially in the capital cities. Governments must close the gaps between the rural and urban sectors, according to the statistics derived from this study. On the other hand, the percentage of people accessing higher education and completing university studies is very low, with statistical differences between nations. GDP investment is only increasing over time in Bolivia, while in Venezuela it has decreased by one percentage point over the last decade.

One of the threats or obstacles is the political situation and the presence of illegal groups in certain countries in South America. In Colombia, the presence of paramilitaries, guerrilla groups and other armed groups has had an impact on student dropout, especially in rural areas (Avendaño *et al*., 2020). In Venezuela, around 65 percent of students have not enrolled due to factors such as lack of money to pay for studies, demotivation due to

ISSN (electronic): 2346-0806 ISSN (print): 1794-8932

lack of job opportunities, migration and ongoing protests (Albarrán, 2019). In Bolivia, an investigation determined through the application of structural equations that economic and family factors are the components that have the greatest impact on student dropout in that country (Poveda, 2019).

Conclusions

The cluster analysis based on the canonical multivariate technique allowed us to detect a statistically significant difference, in which Chile and Uruguay present the best data related to different aspects dealt with in this article, which are associated with various educational aspects in South America. Brazil is in third place and Paraguay occupies the last position. It should be noted that economic investment in education must be a priority for a State in order to guarantee adequate development and a better quality of life for its inhabitants.

Argentina, Bolivia, Colombia, Ecuador, Peru and Venezuela present similar statistics over time with regard to economic investment in education, average students per teacher, percentage of illiteracy, percentage of people finishing the different academic cycles and educational life expectancy. The above was based on the results derived from the canonical cluster analysis.

This research highlights Bolivia as the nation in South America that has invested the most GDP in education over the last two decades, at over 6%; on the other hand, Venezuela, Peru and Paraguay are the countries with the lowest investment in recent years.

This study shows that the percentage of literacy is higher than 90% in the nations evaluated in this study. The highest percentage of illiteracy is in the rural sector, in people of the third age, where Bolivia, Brazil and Peru provide the highest statistics. The level of illiteracy has been falling significantly over the last few decades, making it possible to build a more equitable and inclusive society.
The female sex has a slightly higher percentage of literacy than the male sex in the following countries: Chile, Colombia, Brazil, Venezuela and Uruguay. The biggest difference in literacy between the sexes is in Peru, where males outnumber females by 6%.

Paraguay, Peru and Colombia are the countries where the lowest percentage of students finish primary school. Chile and Peru are the countries where the highest percentage of the student population finishes secondary school and Uruguay is the country with the lowest percentage associated with the baccalaureate cycle. At university level, Argentina has the best statistics for people finishing tertiary education (23%), while Brazil and Uruguay have the lowest percentage (5%).

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