STEM Education Research Seminar

Science Education Research Trends in Latin America

William Medina-Jerez
March 24, 2017

Latin America

- Latin America? Hispanic America?
- Countries in the Americas with linguistic affinities (Spanish and Portuguese)
- Territories of the Americas that were part of the Spanish Portuguese Empires
- All regions south of the United States (Anglophone, Francophone, Dutch-speaking Caribbean)
- Main languages: Spanish (60%), Portuguese (34%), and Indigenous Languages (6%) (Aymara, Guarani, Quechua).
- Main Religion: Roman Catholic
- A highly heterogeneous region

NORTH AMERICA
CENTRAL AMERICA
CARIBBEAN
SOUTH AMERICA

Goal

- To examine the science education research trends in Latin America (LA) vis-à-vis similar studies in the international science education community

This study is not intended as an exhaustive depiction of the science education research tradition in LA

I am curious about the small representation of LA in the global science education community—as measured by publications in international journals

Research Questions

- How did authors from Latin America contribute to publications in eight major science education journals during the 1998–2015 period?

- What were the research topics most commonly investigated in the contributions of Latin American science education researchers from 1998 to 2015?

- What types of research characterized the publication contributions of Latin American authors?
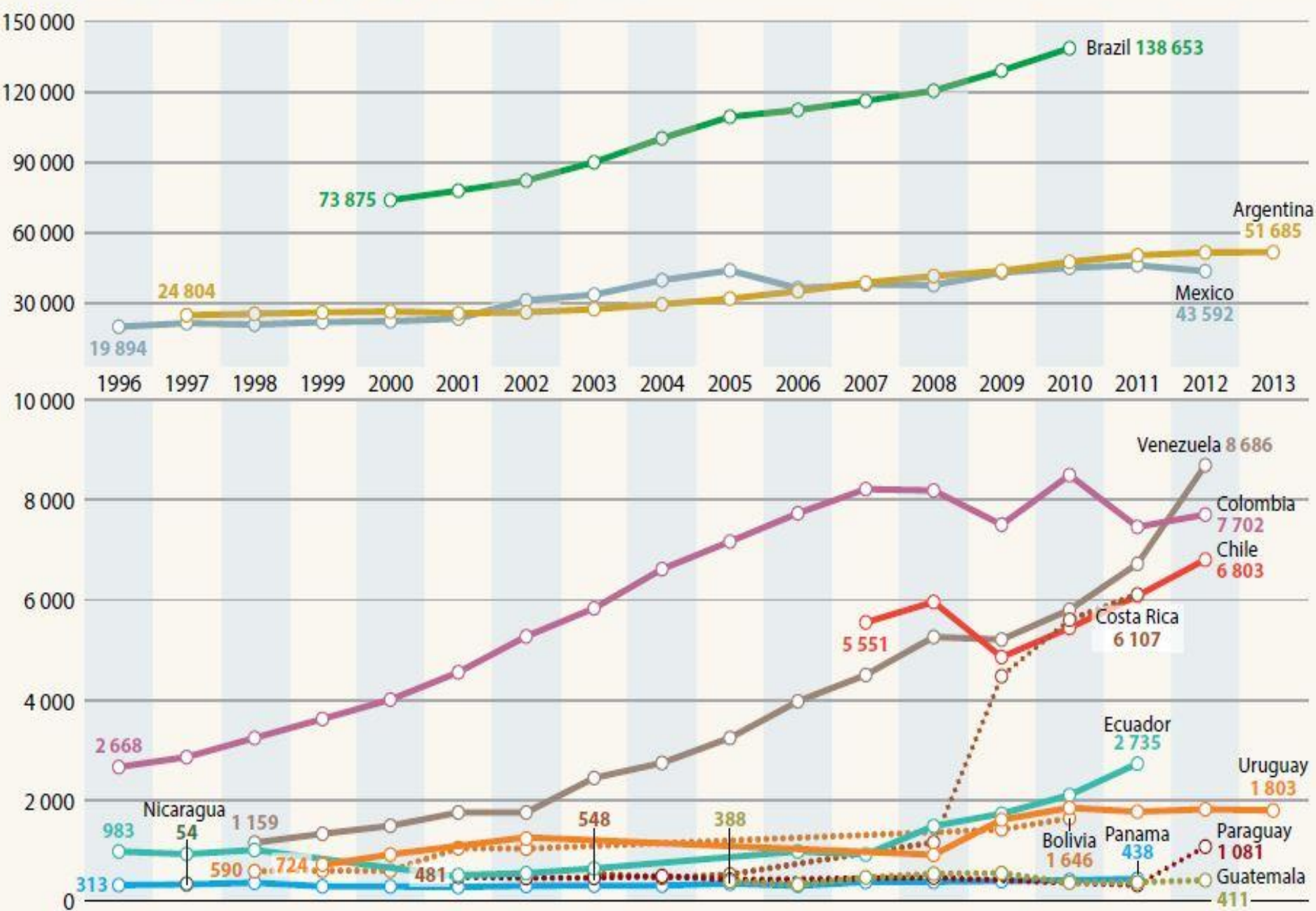
The Research Tradition in LA

- Low Investment in research as compared to investments in industrialized nations

Rank	Country	Human development index 2013	Research and development expenditure (% of GDP 2005–2010)	Population (Millions 2012)
Very high human development				
1	Norway	0.955	1.8	5.0
2	Australia	0.938	2.3	22.9
3	USA	0.937	2.8	315.8
40	Chile	0.819	0.4	17.4
45	Argentina	0.811	0.5	41.1
High human development				
59	Cuba	0.780	0.5	11.2
61	Mexico	0.775	0.4	116.1
62	Costa Rica	0.773	0.4	4.8
71	Venezuela	0748	N/A	29.9
77	Peru	0.741	N/A	29.7
85	Brazil	0.730	1.1	198.4
91	Colombia	0.719	0.2	47.6
Medium human development				
133	Guatemala	0.581	0.1	15.1

Adapted from the United Nations Development Programme (UNDP) (2013). Human Development Report 2013.

Figure 7.5: Researchers (FTE) in Latin America, 1996–2013

Brazil 138 653
73 875

Argentina 51 685
24 804

Mexico 43 592
19 894

1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

Venezuela 8 686
Colombia 7 702
Chile 6 803
5 551
Costa Rica 6 107
2 668
Ecuador 2 735
Uruguay 1 803
Nicaragua 54
1 159
548
388
Bolivia 1 646
Panama 438
Paraguay 1 081
983
590
724
481
Guatemala 411
313

The Research Tradition in LA (Con't)

- Research [university] model imported from Europe
- Funding of national/centralized centers [in some countries]
- Research and Development (R&D) inequalities
- Overreliance on government funding
- Brazil, Mexico, Argentina, and Mexico are home to 90% of scientists
- Research productivity doubled from 1997 (1.8%) to 2007 (3.4%)

Conjecture: *Scholarly activity of LA science education researchers mirror that of their counterparts in the scientific disciplines*
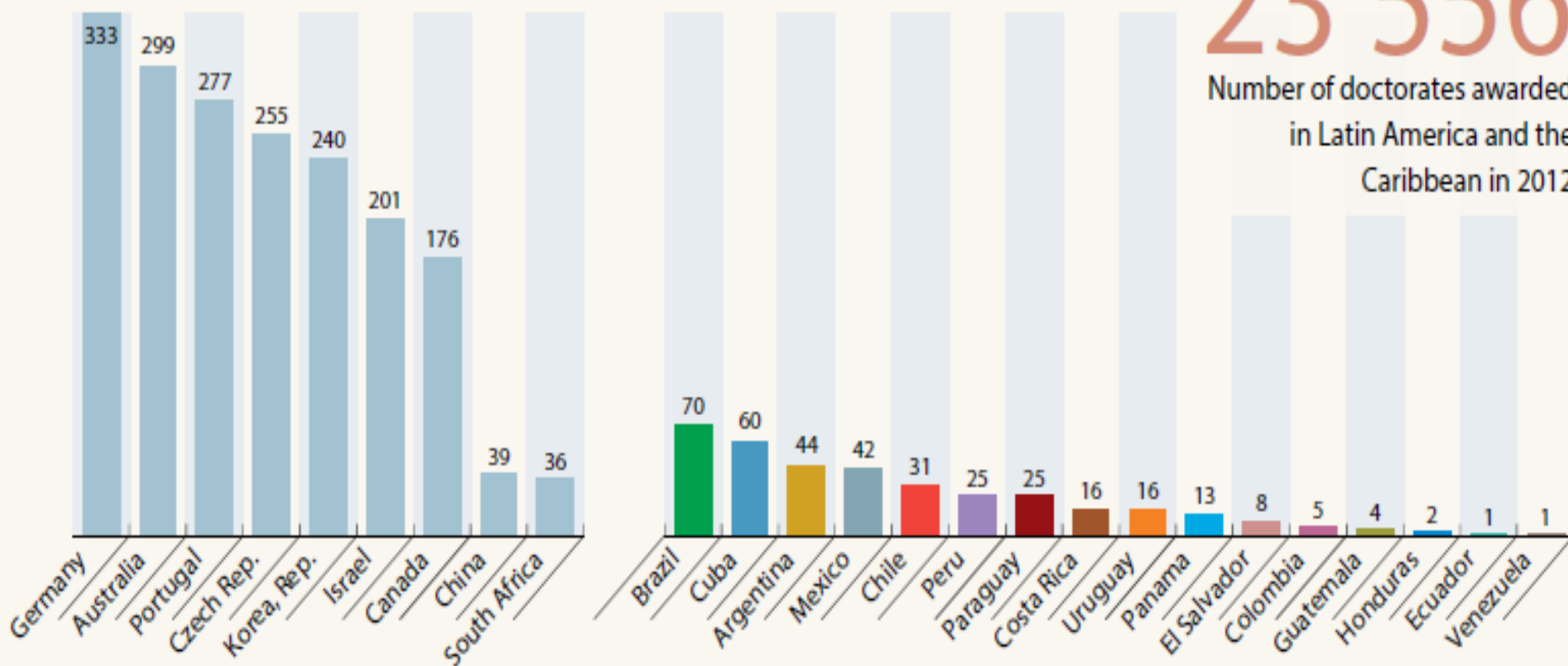
Brazil has the most PhD graduates per million inhabitants in Latin America

PhD graduates per million inhabitants, 2012
Countries outside Latin America are given for comparison

Country	Value
Germany	333
Australia	299
Portugal	277
Czech Rep.	255
Korea, Rep.	240
Israel	201
Canada	176
China	39
South Africa	36
Brazil	70
Cuba	60
Argentina	44
Mexico	42
Chile	31
Peru	25
Paraguay	25
Costa Rica	16
Uruguay	16
Panama	13
El Salvador	8
Colombia	5
Guatemala	4
Honduras	2
Ecuador	1
Venezuela	1

23 556

Number of doctorates awarded
in Latin America and the
Caribbean in 2012

UNESCO Institute for Statistics: for graduates

Science Education Research LA

Lorenz, K. M. (1978). Report of the first annual symposium of the Latin American science teachers association. *Science Education*, 62, 249–256.

-Report on the First Annual Symposium of the Latin American Science Teachers Association (APCAL)

- 14 LA countries

- Purpose: to discuss the status of science teaching in the participating countries, and to identify future research trends in science education in LA

-Only six studies of diverse nature were presented

-Lack of theoretical underpinnings discouraged a comprehensive review

Research Trends in International Science Education

Study	Time Frame	Target Journals	Purpose
Eybe and Smith, (2001)	1991-1997	- International Journal of Science Education - Journal of Research in Science Teaching	To examine the quality research in chemistry education.
Tsai and Wen, (2005)	1998-2002	- International Journal of Science Education - Journal of Research in Science Teaching - Science education	To investigate the type of research in publications from different countries in three major journals from 1998 to 2002
Lee, Wu and Tsai, (2009)	2003-2007	- International Journal of Science Education - Journal of Research in Science Teaching - Science education	A follow-up study on the work done by Tsai and Wen (2005).
Chang, Chang, and Tseng, (2010)	1990-2007	- International Journal of Science Education - Journal of Research in Science Teaching - Science Education - Research in Science Education	To conduct a development trend analysis of science education research.
Lin, Lin, and Tsai, (2014)	2008-2012	- International Journal of Science Education - Journal of Research in Science Teaching - Science education	To reveal the status of science education research during the period 2008-2012

Review Methodology

Journal	Impact Factor	Total Issues	Total Articles
1. Journal of Research in Science Teaching*	3.162	179	915
2. Science Education*	2.825	109	758
3. International Journal of Science Education*	1.132	271	1,672
4. Research in Science Education*	0.806	84	166
5. Studies in Science Education	2.083	26	99
6. Journal of Science Education and Technology	1.214	94	845
7. Science & Education	0.634	126	933
8. Research in Science and Technological Education	0.278	45	303

The Social Sciences Citation Index (SSCI) in the 2014 Journal Citation Report
Journals used in previous studies

Review Criteria

Qualifying Criteria

- Empirical studies authored by LA researches between 1998-2015 in the identified journals
- Authors were affiliated to a LA research/education institution at the time of the study
- Individual or collaborated papers
- Papers in collaboration with colleagues from other LA or non-LA countries
- Research pertaining to educational settings in LA

Non-qualifying Criteria

- Editorials, letters to the editor, book reviews, acknowledgements, interviews, and book analyses

Gathered Data

1. Author's Nationality

Howard, Cole, and Maxwell's (1987) formula to calculate authorship order

$$\text{Score} = \frac{(1.5^{n-1})}{\sum_{i=1}^{n} 1.5^{n-1}}$$

n: Total number of authors

i: Author order

Example:

de Lima Tavares (Brazil), Jiménez Aleixandre (Spain), and Mortimer (Brazil)

Calculated scores: 0.47; 0.32; 0,21.

Contributed score to Brazil = 0.68

Gathered Data (Con't)

2. Research Type (Typology used in previous studies)

- Empirical research (Quantitative or Qualitative)
- Position paper
- Theoretical paper
- Review paper
- Other

Gathered Data (Con't)

3. Research Topic (Categories used in previous studies)

- Teacher education
- Teaching
- Learning-students' conceptions and conceptual change
- Learning-classroom contexts and learning characteristics
- Goals and policy, curriculum, evaluation, and assessment
- Culture, social, and gender issues
- History, philosophy, epistemology, and the nature of science
- Educational technology
- Informal learning

Adapted from the research strands of the National Association for Research in Science Teaching (NARST)
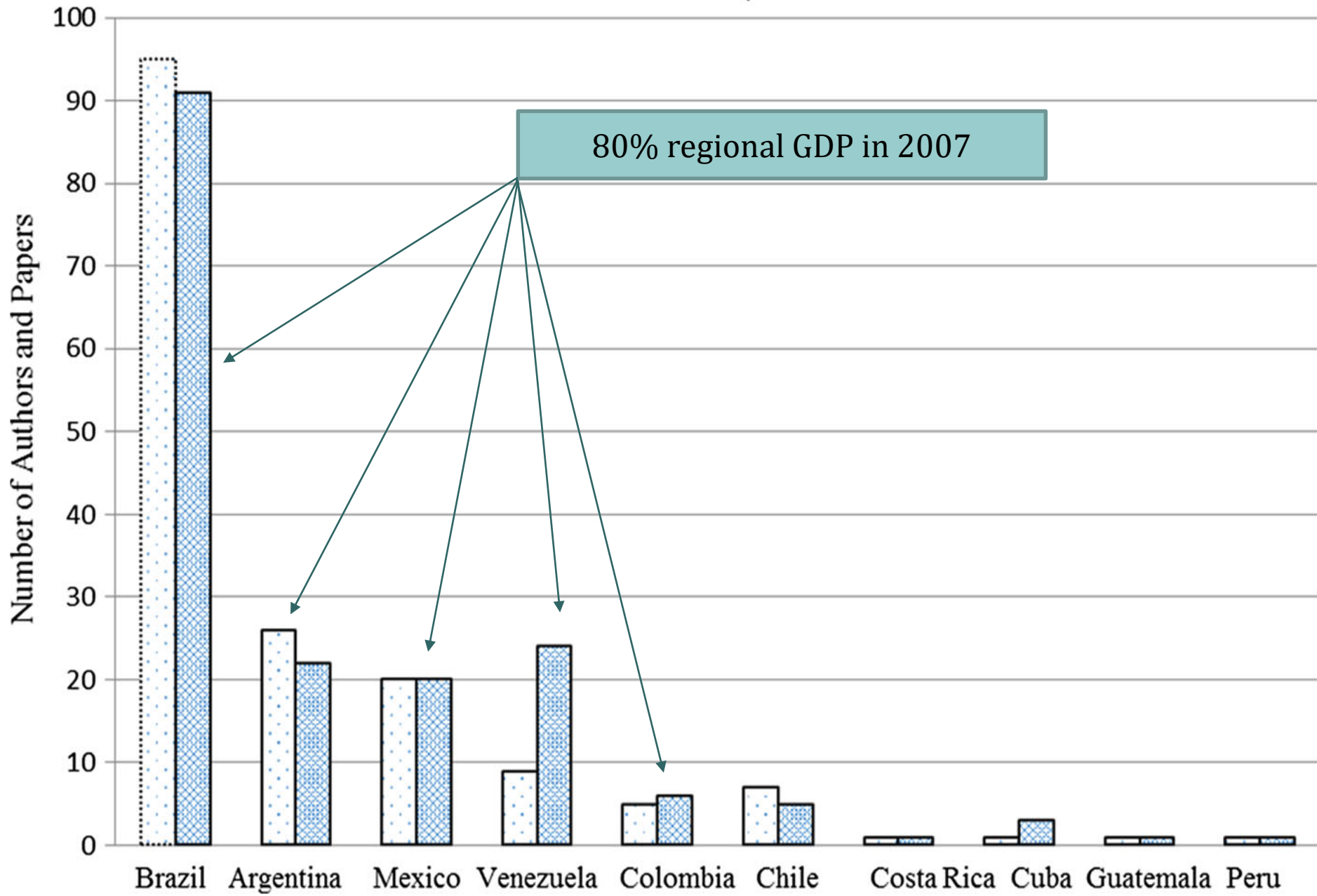
Results

- **Ten LA countries and 166 researchers were represented in the 159 reviewed articles** (Brazil, Mexico, Argentina, Venezuela, Chile, Colombia, Cuba, Peru,   Guatemala, and Costa Rica)

- The majority of the authors (90%) are from Brazil, Mexico, and Argentina
- The majority of the publications (90%) were produced in Brazil, Mexico, Venezuela, and Argentina
- Productivity of science education researchers resembles that of their counterparts in the scientific disciplines
- *Two* of the 159 surveyed papers resulted from collaborative work among authors from LAC

Productivity by Number of Authors by Country

Results (Con't)

Journal Country	Sc&Ed	IJSE	ScEd	JScEdTch	JRST	RISE	RScTchEd	StScEd	Score
Brazil	35.63	23.80	5.45	2	1.97	2.68	3.79	0.32	**75.64**
Venezuela	6.26	4	2.42	5.61	2	0	0	0	**20.29**
Mexico	9.6	3.93	1.77	0.28	1	1	0	0	**17.58**
Argentina	13.83	0.18	0	0	1	0	0	0	**15.01**
Colombia	0.0025	0.32	0	0.59	1	1	0	0	**2.91**
Chile	1	1.47	0	0	0	0	0	0	**2.47**
Costa Rica	0	0	0	1	0	0	0	0	**1.00**
Guatemala	0	1	0	0	0	0	0	0	**1.00**
Peru	0	0	0.6	0	0	0	0	0	**0.60**
Cuba	0.119	0	0	0	0	0	0	0	**0.11**

Science Education Research Productivity (1998-2015)

	Latin American Countries		Non-Latin American Countries	
Rank	Country	Score	Country	Score
1	Brazil	75.64	USA	2,518.06
2	Venezuela	20.29	UK	524.59
3	Mexico	17.58	Australia	463.97
4	Argentina	15.01	Canada	249.60

Research Productivity by Journal

- Brazilian authors received two of the three highest scores (35.63 in *Science & Education* and 23.80 in the *IJSE*)

- The third highest score was for Argentine authors (13.83 in the *Science & Education*)

- Brazilian authors contributed most of the publications to the target journals

- Venezuelan authors contributed most of the publications to the *Journal of Science Education and Technology* and *Journal of Research in Science Teaching*

- Seventy-one percent of the reviewed papers were published in *Science & Education* and *IJSE*

Research Productivity by Research Type

- Empirical studies (57%) was the most common type of research

- The majority of these papers were qualitative

- Other common research types include: Review (20%), and Position (14%)

- LA authors, like their international counterparts, published primarily Empirical studies

Research Productivity by Research Topic

- LA researchers were focused on topics that ranges from HPNOS (31%) to Learning-Student Conceptions (22%), and Teaching (19%)

- The HPNOS were published in the *Science & Education* journal and the Learning-Student Conceptions and Teaching papers appeared in the *IJSE*

- Other common research types include: Review (20%), and Position (14%)

- LA authors, like their international counterparts, published primarily Empirical studies

Conclusions

- The productivity of Brazilian researcher was exceedingly higher that that of their LA counterparts
- Notable research productivity differences in the region (intra-regional and international)
- Most of the reviewed papers were empirical and addressed the HPNOS
- There is a lack of collaboration among LA researchers (27:2)
- Research in LA depends on each country's investment capacity

Future Studies

- Conduct similar/periodical studies to keep the field in check
- Take a broader approach including publication in Spanish and Portuguese to produce a more comprehensive examination of the issue
- Investigate research trends in light of the research and education infrastructure in each country

Still, why the small participation of LA science education researchers in the international community?
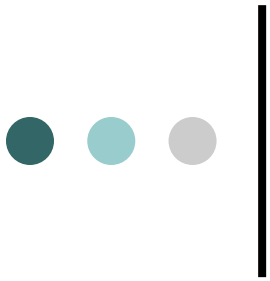
- There are no easy answers
- Latin American countries have not recognized that **research leads to progress** and economic prosperity
- Research means that it has to be **peer reviewed** and that requires journals that are indexed
- **Poor policies**: Emerging economies direct the scarce resources they have to the preparation of **scientists** (usually abroad) and to financing **scientific research**, not seeing that this is a poor policy if you do not invest in science education and science education research/development at the same time
- The main cause is the **language barrier** followed by our **research tradition** (the "didáctica"), from continental Europe, which is misunderstood and certainly not appreciated in the Anglo scene
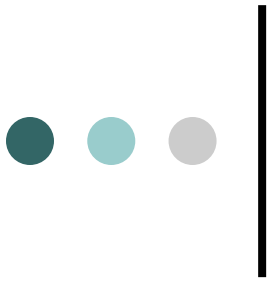
- **Our papers** are usually too "difficult" for the standard journals in the field, because (a) they are literal translations of the convoluted and florid originals in Spanish or Portuguese, and b) their theoretical frameworks are too far away from Anglo interests and traditions. Many of these participants do not make it to the "big" (?) conferences due to these two barriers
- Latin Americans publish much more frequently in **European journals** than in US/Canadian journals. **In Europe, English is a second language** for all of us and we share the research tradition