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Formal education in astronomy in Latin America

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Abstract. We review the present situation of the formal education in astronomy in the Latin American countries. We have concluded that we can divide the countries into three categories according with the different development of the astronomical careers in astronomy.

Keywords. Education, astronomy, Latin American countries

1. Introduction

This paper has the purpose of identifying the present situation of formal education in Astronomy in Latin American countries. Previous work related to the subject may be found in Batten 2001 and Hearnshaw. In this publication of the Special Session on Astronomy for Developing Countries that took place in the XXIV General Assembly there were several papers that may help to understand the situation of the subject at the end of the century.

2. Information available

We have searched the WEB for those universities in the different Latin American countries that offer astronomy courses at undergraduate and graduate levels. We have found the following:

• **Argentina**: Three national universities offer astronomy courses. Also another two offer astrophysics courses at graduate and undergraduate level. There are four different PhD programs in astronomy and astrophysics among the national universities. We have found around 120 PhD in astronomy in Argentina.

• **Brazil**: The IAG at the University of Sao Paulo offers undergraduate and PhD programs. The Physics Institute at the University of Rio Grande do Sul offers an astronomy career (the only one in Brazil). Brazil has more the 200 PhDs in Astronomy working in the country.

• **Chile**: The University of Chile offers undergraduates studies in science and also a PhD program in Astronomy which takes advantage of an agreement with Yale university. The Pontificia Universidad Católica de Chile offers undergraduates studies in astronomy and physics and a Ph.D. program

• **Mexico**: The Instituto de Astronomía of UNAM (Universidad Nacional autńoma de México) offers master and PhD programs in sciences with specialization in astronomy The Universidad de Guanajuato offers undergraduates courses in physics and a PhD program in astrophysics. Also the Instituto Nacional de Astrofísica, Óptica y Electrónica offers PhD programs in astrophysics, astronomical instrumentation and computational astronomy.

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• **Venezuela**: The Universidad Simon Bolivar and the Universidad de Los Andes offer undergraduate studies in physics and also PhD programs. Additional studies in astronomy are generally taken at the instituto de Investigaciones en Astronomía (CIDA)

These five countries have closed the cycle for the production of astronomers at PhD level. They can provide their own PhD programs and they have a good number of PhD scientists and professors to keep the system running.

• **Uruguay**: the Universidad de la República offers studies in physics with specialization in astronomy, a small PhD program in physics is also offers.

• **Colombia**: This country offers a Magister study in Sciences-Astronomy.

• **Honduras and Central America**: The Universidad Autónoma de Honduras through the Observatorio Astronómico Centro Americano de SUYAPA offers Maestría (Masters) in astronomy and astrophysics to graduate students in physics or mathematics.

3. Social analysis

We have tried to relate the above results with certain social and economic parameters of the different countries. We have used for that purpose the concepts of: Gross Domestic Product (GDP) that is the value of all final goods and services produced within a nation in a given year and the Gross Domestic Product per-capita at purchasing power parity (PPP) that is the sum value of all goods and services produced in the country valued at prices prevailing in the United States and divided by the population. This is the measure most economists prefer when looking at per-capita welfare and when comparing living conditions or use of resources across countries. The data was taken from www.photius.com/rankings/index.html. From the same database we have taken the population for each country.

Finally we have used the quality of life index as defined at www.economist.com and the numbers of astronomers members of the International Astronomical Union as obtained from www.iau.org.fr.

Figure 1 shows that there is a good relation between the number of astronomers members of the International Astronomical Union and the logarithm of the GDP expressed

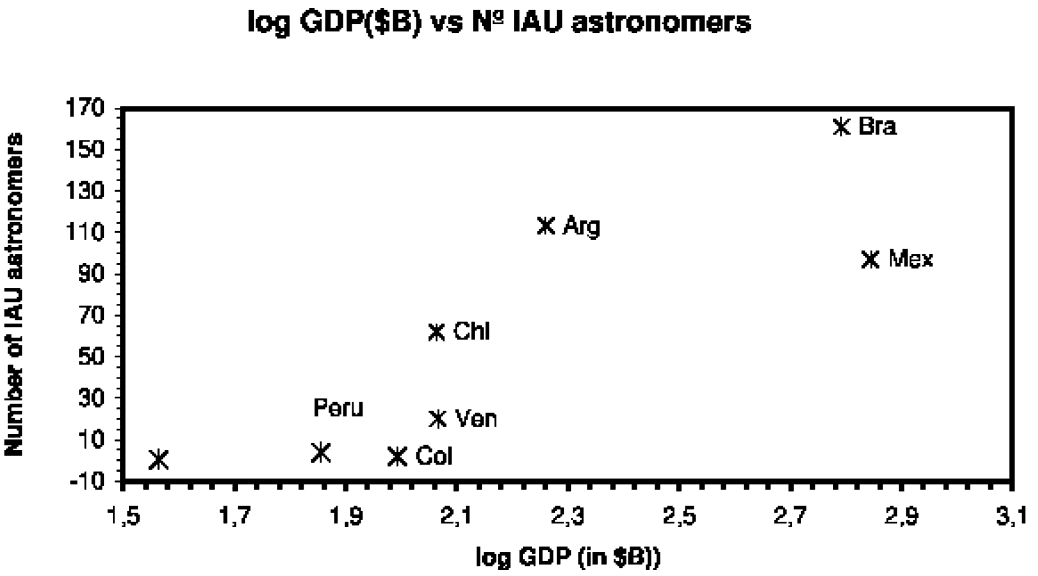

Figure 1. Relation between the number of IAU astronomers and the GDP

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in billions of US dollars. From this figure one may conclude that probably Mexico will require more astronomers members of the IAU according to the level of its GDP.

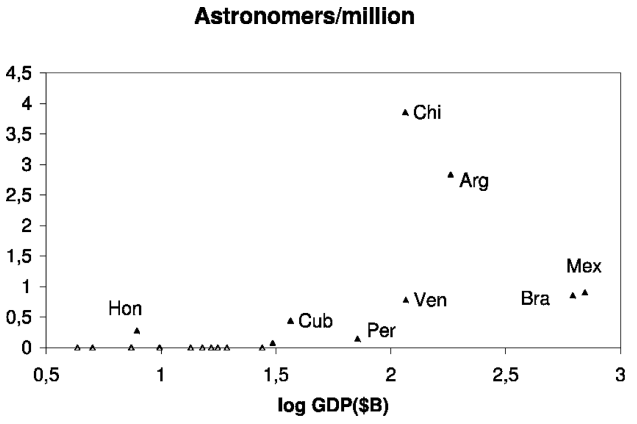

Figure 2. Number of IAU astronomers per millon habitants against the logarithm of the GDP in billions of US dollars

However if one takes into account the whole population in the statistics we see in Figure 2 the number of IAU astronomers per million inhabitants, against the logarithm of the GDP in billions of US dollars and in this case it seems that Chile and Argentina have more astronomers per million inhabitants than the general trend or probably one should say that Mexico and Brazil should increase their numbers of IAU astronomers.

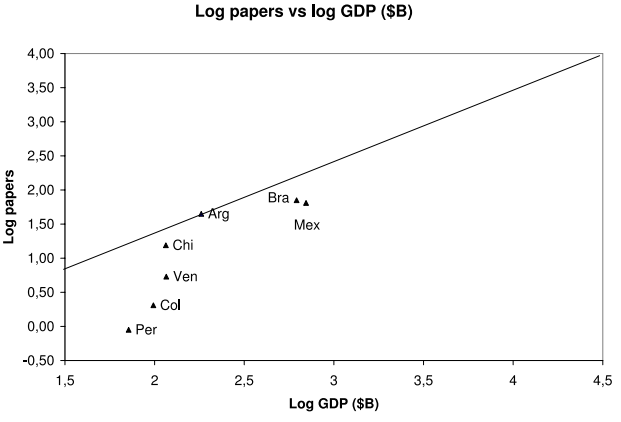

Figure 3. Logarithm of the weighted number of papers against the log of the GDP

Figure 3 shows the number of papers published in recognized scientific journals weighted by the impact of the journal against the GDP. There is a clear trend. The straight line corresponds to the line that adjusts the data for countries with more than 4 000 US dollars per capita as GDP. The data was taken from Abt 2004. It is clear that Peru, Colombia and Venezuela should increase their number of papers in recognized journals to keep the trend according to their GDP.

Finally we have checked the production of papers with the quality of life index because we think that probably a better life condition among the population favours the devotion

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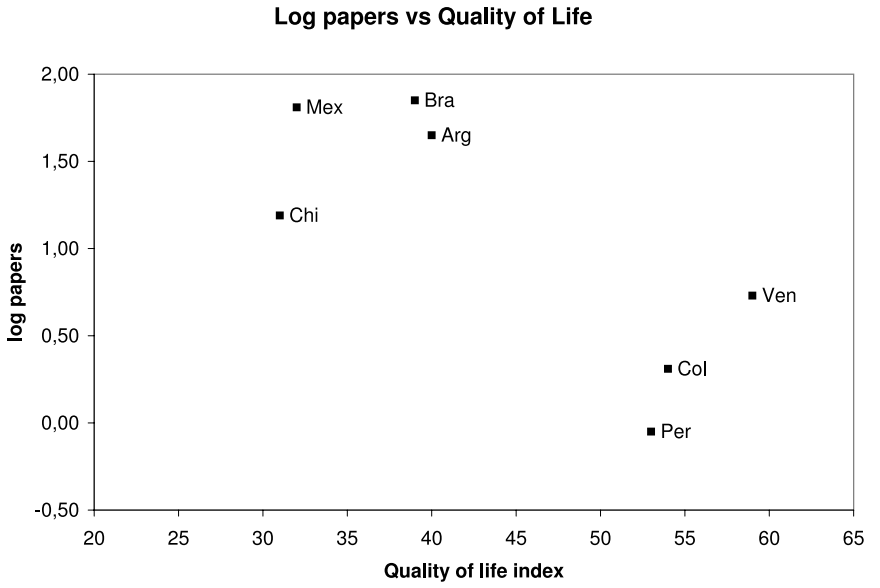

Figure 4. Log of the weighted number of papers against the quality of life index

to science for a larger portion of the population. Figure 4 shows clearly that the countries identified in the previous section as those that have closed the cycle of astronomers and PhD in astronomy production have better quality of life indexes than those who still need help to improve astronomy research and studies in their countries.

4. Conclusions

We conclude that only 5 countries in Latin America are in a position of producing their astronomers and PhDs in astronomy. Three of them (Brazil, Argentina and Mexico concentrate almost 90% of the PhDs in astronomy working in the region. We believe that Uruguay requires a little effort to boost professional education in astronomy. Colombia, Peru and Cuba will require moderate efforts jointly with Honduras for its Central America project. The rest of the countries will require moderate to strong efforts from the international community.

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