

Women and STEM disciplines in Latin America: The W-STEM European Project

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According to UNESCO, women account for a minority of the world's researchers; in 2013, only 28.4% of total persons employed in Research and Development were women, data confirming the gender disparity in science.

The Latin-American and the Caribbean region shows essential differences among countries. While some seem to have good numbers of women working in science, as a percentage of total researchers, such as Argentina, 52%; Venezuela, 56%; and Bolivia, 62%; others like Honduras, Mexico, Colombia, Ecuador and Chile achieve low rates with around 30%.

An additional important statement: although some science courses at the tertiary level see 50% or higher female participation in the Americas, this trend is generally restricted to the biological and life sciences. Participation rates for females in other science and engineering courses remain substantially and consistently less than males throughout the Hemisphere. For example in Brazil, female representation in tertiary level biological, medical and life sciences was an astonishing 70% in 2009, while for engineering and physics, including computer sciences, it was a mere 21% (Abreu, 2012).

According to Interamerican Network of Academies of Sciences IANAS, the percentage of young women studying STEM programs is much lower than men; and the reasons for this are several:

- Girls do not pursue science and technical studies at the same rate as boys, though there is variation by subject area and by country. Societal and parental attitudes toward boys' and girls' abilities play a role here, as does the access to resources.
- Quality of teaching materials can be poor, and perceptions that girls are less able to "do" science, are expressed in teaching pedagogy and curricula. This tends to influence interest and self-confidence in ability to successfully "do" S&T on the part of girls and boys (UNESCO, 2007) but affects girls most profoundly.
- Girls and boys experience differential access to technical and vocational education - In the majority of countries worldwide, young men are more likely than young women to enroll in vocational education, and young men are more likely than young women to graduate from secondary level certification programs (UNESCO, 2010).

Additionally, Latin-American students (young men and women) are pursuing careers more concentrated in the areas of humanities, social sciences, law and education; and much less in Science, Technology, Engineering, and Mathematics (STEM) disciplines (Ramírez-Montoya, 2017).

All this allows to anticipate that region could suffer not only from a lack of students in this discipline, but also a mismatch between the skills of future workers and the needs of the economy; as STEM disciplines are directly related to the needs of an advanced production system and with higher capacities to promote innovation and to improve productivity.

Moreover, the reality is that there exists a lack of information about what is happening with women and STEM disciplines in Latin-America. Several institutions recognize this as a severe problem, and they are trying to put in practice different approaches in order to attract women to STEM studies and retain them to finish their careers and do not drop out prematurely.

I have explored in detail a broad need analysis referred to the participation of Women in STEM in the Latin-America region. As pointed out this is a very complex problem in which necessarily call for actions from different actors, such as governments, private sector, families, as well the different levels of education (since childhood to higher education).

In order to make a substantial contribution, Higher Education Institutions (HEIs) need to focus on those needs and situations in which it has certain influence for making real progress, such as:

- A significant minority of women choose and access to STEM programs at the tertiary level. The lowest rates appear in science and engineering programs.
- Data is scarce, showing a need for analytical and systematic methods, which reflect actual participation of women in STEM at HEIs.
- Tertiary studies with a high math component such as STEM seem to be excluded from the studies options by girls in secondary schools.
- Lack of bridges between public policy and institutional actions led by HEIs.
- In this way, and aligned to the Erasmus + Capacity Building priority for improving management and operation of higher education, regarding access to and democratization of Higher Education, the W-STEM Project aims at Improving strategies and mechanisms of attraction, access and guidance of Women in Latin-American STEM Higher Education programs.

Europe shares similar problems about gender issues in STEM disciplines (García-Holgado, García-Peñalvo, Mena Marcos, & González, 2017; García-Holgado, García-Peñalvo, Mena Marcos, & González González, 2017; García-Holgado, Mena Marcos, García-Peñalvo, & González, 2018; González-González, García-Holgado, García-Peñalvo, & Mena, 2018; Verdugo-Castro, Sánchez-Gómez, & García-Holgado, 2018), which is stated in different university employability studies (Michavila, Martínez, Martín-González, García-Peñalvo, & Cruz Benito, 2018; Michavila, Martínez, Martín-González, García-Peñalvo, & Cruz-Benito, 2016; Michavila, Martínez, Martín-González, García-

Peñalvo, Cruz-Benito, et al., 2018). For this reason, and aligned to the Erasmus + Capacity Building priority for improving management and operation of higher education, in terms of access to and democratization of Higher Education, the project “Building the future of Latin America: Engaging women into STEM – W-STEM” is carried out from the early beginning of 2019 by a mixed consortium of European and Latin American partners, led by the GRIAL Research Group (García-Peñalvo, 2016; GRIAL Group, 2018) of the University of Salamanca (Spain).

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For achieving this primary objective, W-STEM project, will:

- Measure the gender equality in enrolment and retention rates in STEM programs - Natural sciences and mathematics; Information and communication technology and Engineering, manufacturing and construction- at undergraduate levels.
- Implement Universities’ policies, strategies and organizational mechanisms for improving attraction, access, and guidance at undergraduate levels in STEM programs.
- Promote STEM studies vocation and choice in girls and young women in secondary schools as well as guidance in the first year of the STEM programs.
- Develop an online training package for Higher Education Institutions to implement effective strategies to enhance attraction, access and guidance of Women in STEM programs.

The join-up strategy approach will guarantee to transform the actual situation in the partner HEIs. This Joint-Up strategy means that Institutions will work with the proper departments and sections involved in solving this specific challenge, communicating efficiently with each other and acting together purposefully and effectively.

Contents of the issue

The JITR 12(4) issues comprises nine papers. The first paper presents MixAR, a full-stack system capable of providing visualization of virtual reconstructions seamlessly integrated in the real scene (e.g. upon ruins), with the possibility of being freely explored by visitors, in situ.

In the paper entitled “A proposal of a Catalog of Gamification Patterns A Way to Improve the Learning Motivation” a catalog of gamification patterns that can be implemented those applications and games is proposed.

The next one explores the use of a simple, agile and low-cost technology to diagnose the initial situation of this logistical process in small pharmacies.

González-Pérez and Ramírez-Montoya make a study to provide the instruments and indicators that allow us to obtain empirical evidence of the experience of users of an institutional repository (García-Peñalvo, 2017) through the user-centered design methodology.

The fifth paper “The Incremental Artificial Immune System for Arabic handwritten Recognition” presents the recognition of Arabic manuscript names extracted from the register of names of the Tunisian national archive. In this study, the authors have used several techniques for extracting knowledge, coding and names recognition.

The next paper introduces a new advanced tri-layered segmentation and bi-leveled classifier based Hindi printed document classification system, which categorizes imaged documents into pre-defined mutually exclusive categories by using SVM (Support Vector Machine) and fuzzy matching at character and document classification, respectively.

Chen et al. build an online knowledge production structure based on the derivation of the extended program process of the R software package. They also studied the process of knowledge propagation and inheritance in the process of online knowledge production with the help of the dynamic complex network analysis method, thus providing a new perspective for knowledge discovery and technological innovation.

The paper “Real Time Scheduling Optimization” deals with Real Time embedded multiprocessors systems scheduling optimization using conventional and quantum inspired genetic algorithms.

Finally, Ryma and Mohamed-Khiredine propose an ontology mapping to solve an optimization problem. It aims at optimizing correspondences discovery between similar concepts of source and target ontologies. For better guiding and accelerating the concepts correspondences discovery, the paper proposes a meta-heuristic hybridization which incorporates the Hill Climbing method within the mutation operator in the genetic algorithm.

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