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RESEARCH ARTICLE

Science Education in the Technological System of Veracruz: A Gender Perspective

La enseñanza de la ciencia en el sistema tecnológico de Veracruz: una perspectiva de género
O ensino da ciência no sistema tecnológico de Veracruz: uma perspectiva de gênero

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ABSTRACT. Since the beginning, science activity has been conceived as a male-gender occupation. Despite the efforts to bring women into scientific research communities, there is still much to be done. In view of the foregoing, a study was conducted with the aim to identify, with a gender-based approach, the types of teaching and learning styles at the technological institutes in the state of Veracruz, Mexico. For that purpose, an instrument with closed-ended and multiple-choice items was applied to assess the teaching models used by teachers of those institutes. This exploratory, descriptive and ex post facto study covered 9 institutes and 396 students (55.8% men and 44.2% women) who were participating in a research project. Results showed that teachers, regardless of their gender, prioritize experiential learning through discovery, following the premises of meaningful learning and constructivism, therefore being necessary to reinforce the learning environments and teaching strategies they use, guiding them towards alternative models, mainly within the Science-Technology-Society approach.

Key words: science education, gender, learning, higher education

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RESUMEN. Desde sus inicios la actividad científica se ha concebido como una ocupación propia del género masculino. A pesar de los esfuerzos por incorporar a las mujeres en las comunidades de investigación científica, aún queda mucho por hacer. Con base en lo anterior, se realizó un estudio cuyo objetivo fue identificar y comparar, bajo una perspectiva de género, los tipos de enseñanza y aprendizaje que se desarrollan dentro de los Institutos Tecnológicos del estado de Veracruz, México. Para ello se aplicó un instrumento *ad hoc* con ítems cerrados y de opción múltiple, con el que se evaluaron los modelos didácticos que emplean los maestros dentro de estos planteles. El estudio, exploratorio-descriptivo y expost-facto, se realizó en 9 instituciones y 396 estudiantes (55.8% hombres y 44.2% mujeres) que participaban en un proyecto de investigación. Los resultados mostraron que los maestros, sin importar el género, privilegian el aprendizaje experimental por descubrimiento, atendiendo las premisas del aprendizaje significativo y el constructivismo, siendo necesario reforzar los escenarios de aprendizaje y las estrategias didácticas que emplean, orientándolos hacia modelos alternativos, principalmente en el enfoque Ciencia-Tecnología-Sociedad.

Palabras clave: enseñanza de las ciencias, género, aprendizaje, educación, superior.

RESUMO. Desde seus começos, a atividade científica foi concebida como uma ocupação própria do gênero masculino. Apesar dos esforços para incorporar as mulheres nas comunidades de pesquisa científica, ainda há muito a fazer. Com base no anterior, foi realizado um estudo cujo objetivo foi identificar, sob uma perspectiva de gênero, os tipos de ensino e aprendizagem desenvolvidos dentro dos Institutos Tecnológicos do estado de Veracruz, México. Para isso, foi aplicado um instrumento com itens fechados e de múltipla escolha, com os quais foram avaliados os modelos didáticos empregados pelos professores dentro destas instituições. O estudo, exploratório-descritivo e ex-post facto, contemplou 9 instituições e 396 estudantes (55.8% homens e 44.2% mulheres) que estavam participando em um projeto de pesquisa. Os resultados mostraram que os professores, sem importar o gênero, privilegiam a aprendizagem experimental através do descobrimento, atendendo as premissas da aprendizagem significativa e o construtivismo, fazendo necessário reforçar os cenários da aprendizagem e as estratégias didáticas utilizadas, orientando-os para modelos alternativos, principalmente no enfoque Ciência-Tecnologia-Sociedade.

Palavras-chave: ensino de ciências, gênero, aprendizagem, educação superior.

At the beginning of the twenty-first century, traditional science, of a Cartesian and experimental perspective, has maintained a strong connection to technology, from whose relationship an educational perspective that expresses itself in teaching models based on the discovery and empirical observation can be obtained. This condition acquires different nuances based on the educational level where it develops showing characteristics that belong to the intermediate, higher, or postgraduate level, or within universities, technology institutes or technology-oriented universities. It shall be considered that:

> ...a scientific theory is expressed from a model or system, designed to understand a complex reality. It is a system of specific scientific references and conventions which, when clearing their functioning attempt to reduce the complexity of a situation or reality, in these conditions operates some kind of cut oriented toward distinguishing, organizing and relating both objects and processes, whose organization and dynamic attempts to express (Ferrari, 2005, p. 97).

Science, intertwined with an hegemonic thinking that deepens its roots in an anthropogenic worldview, has reclaimed a disciplinary knowledge, elitist in a great way, depository of a sense of control and manipulation that could only be exerted by man. This position has been consolidated with the passing of time, making it one of the maximum traditions of Western thought, expressed in the clear excision between sciences and humanities, or between exact sciences and social sciences. In all the cases, the idea is to make a difference not only a universal knowledge assumed as true, but a set of knowledge that is validated by a dominant community, where gender sets the pattern to understand the reasons why there are areas predominantly male or female areas.

Within this interpretative framework, it is common to observe how certain disciplinary fields—such as education or psychology—have a marked feminine stamp, while physics, agronomy, medicine or chemistry are undertaken mostly by men (where a "traditional patriarchy" is lived, as called by Massó, 2004). While there is no a criterion to support this condition, the collective vision is the one that privileges its practical exercise. After all, in spite of the solid arguments that express a growing gender equality in science and technology (Bonder, 2004; Flores, 2013, Ordorika, 2015; UNESCO, 2014), there is still a stern debate around what to understand by that, particularly in the field of science and technology, where a growing interest by men for these activities is still observed, without there being enough studies to explain the reasons for that.

To this respect, Universia España (2015) reports a study by Andrei Cimpian, psychology professor of the University of Illinois, and Sarah-Jane Leslie, philosophy professor at the University of Princeton, which proposes that:

> Women are as able and analytical as men to compete in selective and competitive fields such as sciences, but are underrepresented because the members put an emphasis on the need for a brilliant mind as inherent for the profession and assume the lack of natural talent in women and limit their abilities to stand out. (p. 1).

While research published on the magazine *Science* (Leslie, Cimpian, Meyer, & Freeland, 2015) was based on a survey on more than 1800 American academics (professors, postgraduate students and postdoctoral researchers), from 30 disciplines in public and private institutions of different countries, the results are placed in a very short spectrum, which does not necessarily reflect what happens in Latin America. While these patterns are exported from research communities and networks that today nurture scientific activities in the international level, the coexistence and work rituals are those who consolidate these practices turning them into routine. Scientific and technological training or literacy of the new groups of researchers.

Tying women to a stereotype is part of the culture in which science is developed and fed as a social activity. This requires a greater and better approach with this phenomenon, searching to orient the forms in which this activity is conceived, giving opportunity to educational innovation, particularly in the area of didactic of science.

To this regard, Sánchez de Madariaga (2011), Director of the Women and Science Unit of the Ministry of Science and Innovation of Spain, states:

> In the last decades, gender studies have contributed to reveal and know areas of reality unexplored until now and also to reduce bias and errors in concepts and theories. In some cases, notably in the social sciences and humanities, they have already contributed to important reformulations of the disciplinary foundations of some fields of knowledge. In other fields, there is still a lot to do and, to move forward, it is necessary to foster cross fertilization among gender studies and the other areas of knowledge. Gender is a clear area of innovation in science and technology. (p. 3).

Two aspects to be highlighted from these statements. The first of these associated to the re-conceptualization of the disciplinary fields, over all educational, given the value it has for a better scientific literacy; the second linked to gender studies and the technological disciplinary field where the fostering of a holistic training is attempted in the student, based on the principles and foundations of scientific thinking, without a specific didactic to support these efforts. In spite of this educational deficit, there are those who report substantial advances around the gender equality in science and research, as expressed by Estébanez (2007), who states that:

> With 41% of women among the science and technology (S&T) staff, ten points over what happened a decade ago, Latin America is one of the regions of the world with a greater female participation in science. As part of this progress, regional universities are currently environments open to women in terms of training and work, for teaching and also for research and development (R&D). However, is it possible to assert that we are close to attaining equality in science? (p. 5)

These data may seem out of context, mainly if we take into account that in Latin America there is a visible delay in the scientific and technological field that has been widely documented (Bota, 2003; Casas, Corona, & Rivera, 2013; Herrera, 2015; Marín & Morales, 2010; Sánchez-Masi, 2015), which is associated to their educational systems and state policies (social, cultural, economic, among others). In any case, the work positions that it refers take place in the middle and low part of the occupational pyramid. Linked to that, it is worth considering that higher education does not end in university environments.

Based on the above, this study is inserted in the initiatives expressed in the European Commission for Gender Equality, backed by the European Union since 1999, where women participation in research is promoted together with the need to focus on gender studies within every research. Namely,

to approach the gender dimension of research implies that gender is considered a key analytical and explanatory variable in research. If the appropriate gender issues are not taken into consideration or are approached superficially, the research results will be biased and potentially tendentious. Thus, gender may be an important factor in quality research. To support this process, it is also essential to devote research resources to that which is gender-specific. (Ministry of Science and Innovation & European Commission Research & Innovation, 2011, p. 10)

With these foundations, regional studies shall be developed within the different educational levels and systems. Such is the case of the technological higher level in Mexico, where since 2004 an educational model oriented toward competency development is being promoted (Gamino-Carranza and Acosta-González, 2016), which does not include a gender equality approach within the scientific and technological training it promotes. This is what gives relevance to the design and development of this research, focused on the identification and comparison of the types of educational models with which, under a gender perspective, science is taught and learned in the higher technological education institutions in the state of Veracruz, guided by the hypothesis that there are no differences between genders.

METHOD

Design

The methodological perspective of this research was quantitative, characterized by "...the collection of data to prove the hypothesis, based on the numerical measurement and statistical analysis, in order to establish behavioral patterns and prove theories" (Hernández, Fernández, & Baptista, 2006, p. 5). Based on this, and searching for a rigorous process in data analysis, descriptive and parametric statistics was applied. Due to its thoroughness, the study was classified as descriptive-exploratory under an ex post-facto design.

Participants

The population under study comprised students involved in a research project–innovation or creativity--and were in the last semesters of an academic program during the 2014-2015 year, from one of the 27 institutions of the higher technological education system in the state of Veracruz, Mexico. The sample was made up of 9 technological schools (federal and state-owned) chosen at random, in which the instruments were applied to 396 students (55.8% male and 44.2% female, with ages ranging between 19 and 22 years, studying a technological program), through a non-probabilistic sampling, through the strategy called Expert Consulting, also known as Privileged Informants--students involved in a current or recent project that were in the process of scientific training under a professor—who made up the sample and under the so-called *Opportunity Criterion*—students that were in the classroom when the assessment instruments were applied. While this entails some bias, this ended up benefiting the results.

Instruments

The ad hoc instrument used in the research included problem-type questions (problem-strategy, problem-task, and multilevel problem) (Vera Giménez, 2013). The study included several analysis categories focused on identifying the teaching models used for the science teaching-learning process. The following dimensions were analyzed:

First dimension: development of comprehension skills for scientific texts (meta-cognitive knowledge and meta-cognitive skills). According to the propositions made by Cerchiaro, Paba, and Sánchez (2011), it is necessary to specify that "a good part of the difficulties that some students experience with reading is due to the lack of adequate processes (cognitive and meta-cognitive) that help them monitor and understand what they are reading" (p. 100). With this in mind, the student was asked to read a scientific text to assess this type of skills. Later, questions were created to measure the students' level of understanding under the following categories: *correctly explained, adequate, vague and unclear, omitted,* which were operationalized for their quantitative assessment under scaling, disaggregating them in numerical expressions, which ranged from lack of variable (*omitted* = 0) to its maximum expression (*correctly explained* = 3). This dimension is presented given that "the understanding of the sentences of a text [...] corresponds to a higher level that is the construction of the text meaning" (Jiménez-Rodríguez, 2004, p. 8). To this end, it is worth noting that:

> Understanding is, no doubt, the main objective of teaching and even if it is difficult to conceptualize epistemiologically what is that constitutes understanding regarding any area of knowledge, we could be able to notice it by the ability to operate based on some criteria, selecting information, strategies, algorithms, etc. adequately, for an individual purpose... (Siguenza & Sáez, 1999, p. 223).

As stated by Cerchiaro et al., (2011), there are currently multiple studies based on cognitive psychology, linguistics and education that seek to understand the mechanisms, variables and processes involved in the understanding of texts, as well as the cognitive strategies and skills generated by the teaching processes, which act as enablers of such understanding. This situation is not contemplated in this study, which tried only to find out if they had theses skills, in which case they would be qualified as scientific literates. The beginning focused on verifying if the students were in a condition to identify the theories and models implied in the educational practice of their professors.

Second dimension: identification of teaching models. Assessment made up of a questionnaire with multiple-choice questions to identify the teaching models (problem-based learning, experiential learning, and situated cognition) and the teaching-learning styles (transmission-reception, discovery, meaningful, and constructivist). Theoretical foundations of the learning theories were linked to the models applied in the technology institutes, supported by the classification and characterization by Villarruel-Fuentes (2014), and considering that the educational practice of science professors at the Veracruz technology institutes is based on the paradigm of the science learner and the student-researcher (Ruiz-Ortega, 2007).

The fact that the students identify teaching models developed by the science professors, in addition to allowing clarification of their educational practice, is also a feasible way to understand the image they have regarding science, their representations or perceptions, which could guide future research in terms of events linked to scientific literacy, its inclination or rejection toward research activity. As expressed by Durán-Hevia (2012): "...external factors impacting the construction and development of a certain image of science will probably be reflected on the different teaching models that the professor carries out inside the classroom" (p. 20).

Table 1
Categories selected to analyze the gender, teaching-learning, and didactic model relationships.

Comparative variable	Categories under assessment
Gender	**Reading and understanding of scientific text** The meanings in the reading of scientific texts Identification of not-evident contradictions in a text **Science teaching and learning** How does he/she teach? In what conditions does he/she teach? Where does he/she teach? What does he/she expect from the student? Assumptions from the professor when teaching **Teaching models:** How do you learn? Under what conditions do you learn? How does the professor intervene so that you learn? In what scenarios do you learn? How is teaching organized so that you learn? What strategies does the professor apply to promote your learning?

The following categories were analyzed:

With the purpose of measuring the dimensions on teaching models, when designing the items of the measurement instrument, the validity of the contents was applied by the method based on expert opinion characterized by "…expert assessment regarding the pertinence and sufficiency of the items…" (Prieto & Delgado, 2010, p. 70). Overall, five experts who perform research in social, human, and behavioral sciences provided their support. Validity was declared after three rounds of review of the instrument, when confirming that the items measured teaching and learning of science. Reliability of the internal consistency of the instrument was estimated with Cronbach's alpha, resulting on a 0.83 coefficient (very reliable).

Procedure

Research was coordinated by the academic group "Cultura Académica y Desarrollo Social Sustentable," from the Úrsulo Galván Technology Institute, located in the state of Veracruz, Mexico. The results presented correspond to a research project financed by Tecnológico Nacional de Mexico during the 2014-2015 period. The application of the instrument (reading of the text and questionnaire) was done considering voluntary participation and confidentiality of the information provided by participants. In order to identify the main trends characterizing teaching and learning of science through teaching models, from the main category of gender, statistical analysis of the data integrated the estimation of frequencies and percentages with the use of average separation testing.

For a greater level of thoroughness in the results, the statistical difference between the percentages obtained in each category was established, according to the variable under analysis, i.e., gender. The analysis implied use of the Z-test (proportion comparison) with a significance level of α = 0.05. The analysis of the data was performed under descriptive statistics with the SPSS (*Statistical Package for the Social Sciences*) software, version 20.

RESULTS

First level of analysis

Participation of students in research projects according to gender showed a superiority of the males, with 55.8%, a condition that confirms the trend observed internationally.

Assuming that a minimum level of scientific level is required to adequately identify teaching models, which in the best-case scenario is patent in the correct understanding of scientific texts, Table 2 shoes the results obtained when the students were asked to identify the implied meanings in a reading, as well as to recognize not-evident contradictions in a text.

Table 2

Frequency and percentage of the analysis of understanding, obtaining of meanings, and contradictions found through the reading of a scientific text

Reading of a scientific text	Categories				
	Omitted	Vague and unclear	Adequate	Correctly explained	Total
Understanding of the text					
Male	0 (0.0%)	123 (31.1%)	95 (24.0%)	3 (0.8%)	221 (55.8%)
Female	1 (0.3%)	77 (19.4%)	91 (23.0%)	6 (1.5%)	175 (44.2%)
Total	1 (0.3%)	200 (50.5%)	186 (47.0%)	9 (2.3%)	396 (100.0%)
Obtaining of meaning					
Male	17 (4.3%)	161 (40.7%)	40 (10.1%)	3 (0.8%)	221 (55.8%)
Female	9 (2.3%)	121 (30.6%)	39 (9.8%)	6 (1.5%)	175 (44.2%)
Total	26 (6.6%)	282 (71.3%)	79 (19.9%)	9 (2.3%)	396 (100.0%)
A contradiction is detected					
Male	6 (1.5%)	184 (46.5%)	24 (6.1%)	7 (1.8%)	221 (55.8%)
Female	2 (0.5%)	136 (34.3%)	31 (7.8%)	6 (1.5%)	175 (44.2%)
Total	**8 (2.0%)**	**320 (80.8%)**	**55 (13.9%)**	**13 (3.3%)**	**396 (100.0%)**

The evidence found for "understanding of the text" showed that this was predominantly "vague and unclear" for males (31.1%), while for females, the "adequate" understanding prevailed (23.0%).

It is worth noting that the "adequate" category was similar for both sexes (24.0% for males and 23.0% for women). A condition acknowledged as acceptable in terms of what is expected from a student of the higher technological level, especially because this category had the highest percentage.

In spite of these results, it is relevant that only 0.8% and 1.5% (male and female, respectively) were able to understand the text correctly (2.3% total), a situation that indicates a deep deficit in terms of meta-cognitive skills which are required for a correct scientific literacy. This first finding allows identifying a margin for improvement regarding the scientific training of students, which does not end up with the instrumental handling of instruments, but leads to complex and deep thought processes.

Regarding the obtaining of meanings, 71.3% of the answers was placed in the "vague and unclear" category, where men were who best expressed this condition (40.7%). Once again, the results showed problems at the time of explaining adequately the meanings of the reading (2.3% total). The similarity is strengthened when observing that 10.9% of men and 11.3% of women identified the meanings "adequately" and "correctly" (22.2% total). Mostly, they exhibited difficulties deciphering and understanding the meanings of the scientific reading, which is logical if aligned with the results obtained in understanding of text.

In perspective with the above, students were not able to identify the contradictions shown in the scientific text, with the "vague and unclear" category prevailing (46.5% for males and 34.3% for females). Both sexes appeared lacking regarding their ability to reflect and elucidate regarding the contradictions contained in a scientific text (less than 5% in both cases). This evidence highlights the need to restructure the curriculum and didactic proposal under which the students from the technology education system in Veracruz are educated, because, regardless of the sex, their superior thinking do not correspond to the demands of a scientific literacy.

An approach to the types of learning developed by the instructors within the Veracruz technological education sub-system (see Table 3), identified by the students based on their experience in research projects, revealed that the way how science is taught tilted in both genders toward the premises of meaningful learning (26.5% and 24.5% for males and females, respectively). The trends evidenced by men need to be highlighted, who associate this type of learning with discovery (14.4%), as well as what has been taught from transfer-reception (11.1%). This is not the case for women, who linked it preferably to the consequences of discovery (11.1%).

This predominant form of teaching is linked to its predisposition toward the assumptions that the professor adopts when teaching, where meaningful learning supported by constructivist assumptions appeared in general dominant, being higher in men (25.5% and 16.2%) than in women (23.5% and 13.6%).

Table 3

Frequency and percentages of the analysis of the type of scientific learning developed by the professors

Learning type questions	Categories				Total
	ATR	AD	AS	AC	
How does he/she teach?					
Male	44 (11.1%)	57 (14.4%)	105 (26.5%)	15 (3.8%)	221 (55.8%)
Female	22 (5.6%)	44 (11.1%)	97 (24.5%)	12 (3.0%)	175 (44.2%)
Total	66 (16.7%)	101 (25.5%)	202 (51.0%)	27 (6.8%)	396 (100.0%)
In what conditions does he/she teach?					
Male	48 (12.1%)	95 (24.0%)	16 (4.0%)	62 (15.7%)	221 (55.8%)
Female	28 (7.1%)	80 (20.2%)	11 (2.8%)	56 (14.1%)	175 (44.2%)
Total	76 (19.2%)	175 (44.2%)	27 (6.8%)	118 (29.8%)	396 (100.0%)
Where does he/she teach?					
Male	37 (9.3%)	107 (27.0%)	67 (16.9%)	10 (2.5%)	221 (55.8%)
Female	27 (6.8%)	76 (19.2%)	60 (15.2%)	12 (3.0%)	175 (44.2%)
Total	64 (16.2%)	183 (46.2%)	127 (32.1%)	22 (5.6%)	396 (100.0%)
What does the student request?					
Male	14 (3.5%)	94 (23.7%)	53 (13.4%)	60 (15.2%)	221 (55.8%)
Female	6 (1.5%)	71 (17.9%)	47 (11.9%)	51 (12.9%)	175 (44.2%)
Total	20 (5.1%)	165 (41.7%)	100 (25.3%)	111 (28.0%)	396 (100.0%)
Assumptions by the professor when teaching					
Male	19 (4.8%)	37 (9.3%)	101 (25.5%)	64 (16.2%)	221 (55.8%)
Female	7 (1.8%)	21 (5.3%)	93 (23.5%)	54 (13.6%)	175 (44.2%)
Total	**26 (6.6%)**	**58 (14.6%)**	**194 (49.0%)**	**118 (29.8%)**	**396 (100.0%)**

Note: ATR=Transfer-Reception Learning; AD=Discovery Learning; AS=Meaningful Learning; AC=Constructivist Learning.

These deductions are strengthened when observing that the environments where science is taught and what is required from the students to learn it, are guided in both genders toward meaningful learning generated by discovery; with a superiority in men (27.0% and 23.7% vs. 19.2% and 17.9%), based on meaningful learning (16.9% and 13.4% versus 15.2% and 11.9%).

Aimed at finding greater evidence regarding theoretical foundations to materialize teaching of science within the Veracruz technology education system, Table 4 shows the teaching models on which professors center their educational practice. In this case, the items were designed so that the students themselves could recognize the model applied by the professor in their activities. The main types of operable models in technology education were implemented, thus: (a) problem-based, (b) experimentation and (c) situated cognition.

Tabla 4

Frequency and percentages of the teaching models and learning of science analysis from the students' perspective

Questions on teaching models	Categories ABP	AEXP	COGSIT	Total
How do you learn?				
Male	48 (12.1%) [a]	119 (30.1%)	54 (13.6%)	221 (55.8%)
Female	40 (10.1%) [a]	95 (24.0%)	40 (10.1%)	175 (44.2%)
Total	88 (22.2%)	214 (54.0%)	94 (23.7%)	396 (100.0%)
Under what conditions do you learn?				
Male	117 (29.5%)	41 (10.4%)	63 (15.9%)	221 (55.8%)
Female	88 (22.2%)	31 (7.8%)	56 (14.1%)	175 (44.2%)
Total	205 (51.8%)	72 (18.2%)	119 (30.1%)	396 (100.0%)
How does the professor intervene so you learn?				
Male	90 (22.7%)	69 (17.4%)	62 (15.7%)	221 (55.8%)
Female	63 (15.9%)	52 (13.1%)	60 (15.2%)	175 (44.2%)
Total	153 (38.6%)	121 (30.6%)	122 (30.8%)	396 (100.0%)
In what scenarios do you learn?				
Male	79 (19.9%)	74 (18.7%)	68 (17.2%)	221 (55.8%)
Female	73 (18.4%)	51 (12.9%)	51 (12.9%)	175 (44.2%)
Total	152 (38.4%)	125 (31.6%)	119 (30.1%)	396 (100.0%)
How is teaching organized so you learn?				
Male	111 (28.0%)	87 (22.0%)	23 (5.8%)	221 (55.8%)
Female	88 (22.2%)	79 (19.9%)	8 (2.0%)	175 (44.2%)
Total	199 (50.3%)	166 (41.9%)	31 (7.8%)	396 (100.0%)
What strategies does the professor use to foster your learning?				
Male	59 (14.9%)	89 (22.5%)	73 (18.4%)	221 (55.8%)
Female	46 (11.6%)	71 (17.9%)	58 (14.6%)	175 (44.2%)
Total	105 (26.5%)	160 (40.4%)	131 (33.1%)	396 (100.0%)

Note: ABP=Problem-Based Learning; AEXP=Experiential Learning; COGSIT=Situated Cognition

The first thing that stands out is the use of the three models, which shows the consistency of the didactic activities being implemented in the technological institutions. In some way, the teaching of science is dealt with pertinence, given that the experiential, project-based learning is tightly linked to these operational forms of generating scenarios and conditions conducive to learning.

When reviewing the evidence found, a base line linking how students learn with the way they say teaching is organized, in addition to the strategies that the professors apply to support these processes. In this trilogy, the obvious was the experimental work performed by professors with their students, who regularly take part in experiment designs conducted by professors-researchers. To this end, both men and women were able to distinguish easily this didactic circumstance, which proved that 'how to learn' (30.1% and 24.0%) materializes in the strategies used within this model (22.5% and 17.9%), conceptual and operational affiliation native to the dominant forms of science teaching. Moreover, the deployment of these didactic tasks is observed, based on a situated learning (13.6% and 10.1% for how they learn and 18.4% and 14.6% for the strategies implemented by professors). With an organization of teaching based on the projects in which the students participated (28.0% and 22.2%).

In this last item, it is noteworthy how students, regardless of their gender, in practice opt for completion of the projects over their own situated cognition. This should be taken into consideration given that the professors may be prioritizing their own projects over the design of scenarios for learning, making it patent in the design and conduction of didactic tasks. What was also evidenced when reviewing the answers regarding the learning scenarios where students interact (19.9% and 18.4% for males and females), who weighed problem-based learning, together with experiential learning.

The above highlights the need to incorporate improvements within the didactic process intended to the achievement of a more situated learning so as to fully take advantage of the physical settings-–laboratories, workshops, greenhouses, fields—of the Veracruz technology education system.

Second level of analysis

In order to expand on the analysis above, below are the results obtained with each variable and category of analysis described, subjected to Z proportion testing, with a significance level of $\alpha = 0.05$. To achieve this, the data was grouped and the frequencies and percentages were estimated so that the total sum by gender (rows) completed 100%, under the statistical comparison assay they were subjected to.

Regarding understanding of the scientific text (see Table 5), the test showed a statistical difference for the "vague and unclear" category ($p < 0.05$), with statistical superiority for the male gender (55.7% of the total), over the female (44.0%), which signals a lesser difficulty in women when interpreting a text of that sort. Despite that, the "adequate" and "correctly explained" category did not show any statistical differences ($p > 0.05$) between genders, and the 52.0% of the total women who understood the scientific argument adequately was underscored. This confirms their greater ease to perform this meta-cognitive activity.

In general, the statistical analysis did not reveal any differences between categories-–obtaining of meanings and detection of contradictions--, when comparing them between genders, which is evidence

Table 5

Gender proportion comparison of understanding, obtaining of meanings, and contradictions found through the reading of a scientific text

Reading of a scientific text	Categories			
	Omitted	Vague and unclear	Adequate	Correctly explained
Understanding of the text				
Male (n = 221)	0 (0.0%)[a]	123 (55.7%)[a]	95 (43.0%)[a]	3 (1.4%)[a]
Female (n = 175)	1 (0.6%)[a]	77 (44.0%)[b]	91 (52.0%)[a]	6 (3.4%)[a]
Total (N = 396)	1 (0.3%)	200 (50.5%)	186 (47.0%)	9 (2.3%)
Obtaining of meaning				
Male (n = 221)	17 (4.3%)[a]	161 (40.7%)[a]	40 (10.1%)[a]	3 (1.4%)[a]
Female (n = 175)	9 (2.3%)[a]	121 (30.6%)[a]	39 (9.8%)[a]	6 (3.4%)[a]
Total (N = 396)	26 (6.6%)	282 (71.3%)	79 (19.9%)	9 (2.3%)
A contradiction is detected				
Male (n = 221)	6 (1.5%)[a]	184 (46.5%)[a]	24 (6.1%)[a]	7 (3.2%)[a]
Female (n = 175)	2 (0.5%)[a]	136 (34.3%)[a]	31 (7.8%)[a]	6 (3.4%)[a]
Total (N = 396)	8 (2.0%)	320 (80.8%)	55 (13.9%)	13 (3.3%)

Note: Each subscript letter indicates a gender sub-group; the categories with column proportions bearing different subscripts differ significantly among them in the level α < .05 for the proportion comparison testing

that proves that at least in the higher technology education level in Veracruz, the development of meta-cognition of the students is uniform, although lacking in terms of what it should be, which provides a window for continuous improvement.

Moving on with the analysis, below is an analysis of the answer obtained when comparing genders as a function of the theories that determine the teaching models for the learning of science (see Table 6); this is evidence of an equality in the interpretation that the students make of their scientific activities (Z proportions testing, α = 0.05).

It is advisable to emphasize that, regardless of gender, learning by discovery was expressed as the most recognized means, particularly with respect to the conditions in which the professor teaches, where he/she teaches, and what he or she demands from the students for that. Only regarding how he or she teaches (47.5% and 55.4% in men and women respectively) and the assumptions by the professor when teaching, the trend favored meaningful learning (45.7% and 53.1% for men and women). This confirms what was expressed above, thus validating the established inferences.

Table 6

Proportion comparison according to gender of the type of scientific learning implemented by professors

Learning type questions	Categories			
	ATR	AD	AS	AC
How does he/she teach?				
Male (n = 221)	44 (19.9%) [a]	57 (25.8%) [a]	105 (47.5%) [a]	15 (6.8%) [a]
Female (n = 175)	22 (12.6%) [a]	44 (25.1%) [a]	97 (55.4%) [a]	12 (6.9%) [a]
Total (N = 396)	66 (16.7%)	101 (25.5%)	202 (51.0%)	27 (6.8%)
In what conditions does he/she teach?				
Male (n = 221)	48 (21.7%) [a]	95 (43.0%) [a]	16 (7.2%) [a]	62 (28.1%) [a]
Female (n = 175)	28 (16.0%) [a]	80 (45.7%) [a]	11 (6.3%) [a]	56 (32.0%) [a]
Total (N = 396)	76 (19.2%)	175 (44.2%)	27 (6.8%)	118 (29.8%)
Where does he/she teach?				
Male (n = 221)	37 (16.7%) [a]	107 (48.4%) [a]	67 (30.3%) [a]	10 (4.5%) [a]
Female (n = 175)	27 (15.4%) [a]	76 (43.4%) [a]	60 (34.3%) [a]	12 (6.9%) [a]
Total (N = 396)	64 (16.2%)	183 (46.2%)	127 (32.1%)	22 (5.6%)
What does the student request?				
Male (n = 221)	14 (6.3%) [a]	94 (42.5%) [a]	53 (24.0%) [a]	60 (27.1%) [a]
Female (n = 175)	6 (3.4%) [a]	71 (40.6%) [a]	47 (26.9%) [a]	51 (29.1%) [a]
Total (N = 396)	20 (5.1%)	165 (41.7%)	100 (25.3%)	111 (28.0%)
Assumptions by the professor when teaching				
Male (n = 221)	19 (8.6%) [a]	37 (16.7%) [a]	101 (45.7%) [a]	64 (29.0%) [a]
Female (n = 175)	7 (4.0%) [a]	21 (12.0%) [a]	93 (53.1%) [a]	54 (30.9%) [a]
Total (N = 396)	26 (6.6%)	58 (14.6%)	194 (49.0%)	118 (29.8%)

Note: ATR=Transfer-Reception Learning; AD=Discovery Learning; AS=Meaningful Learning; AC=Constructivist Learning. Each subscript letter indicates a gender sub-group; the categories with column proportions bearing different subscripts differ significantly among them in the level $\alpha < .05$ for the proportion comparison testing Z.

Similar results were observed when identifying the teaching models implemented by professors (see Table 7), where the students, regardless of gender, showed analogous appreciations (expressed by the statistical equality). Apparently the work dynamics led to the integration of learning communities, where the students managed to assimilate as a whole the sense and direction of the activities proposed by their professors.

When reviewing the percentages found, it could be seen that when they were asked how they learn, once again the development of predominantly experimental models was observed (53.8% and 54.3% for men and women), in problem-based learning conditions (52.9% and 50.3% for men and women). With respect to the process of mediation exerted by the professors, their intervention for the learning was identified within both models (experiential problem-based), with a trend in favor of the problem-centered model (40.7% and 36.0% for men and women).

Regarding the scenarios where students learn, the percentages were uniform, distributed among the three types of models, without any statistical differences between genders, as already stated. This is an indicator that the professor diversifies the settings used when teaching science and technology. It highlights that the strategies used by professors—according to the students—are predominantly experimental (40.3% and 40.6% for men and women), with perspectives aligned with situated cognition

Tabla 7

Comparison according to gender of didactic models and learning of science from the perspective of students.

Questions on teaching models	Categories		
	ABP	AEXP	COGSIT
How do you learn?			
Male (n = 221)	48 (21.7%)[a]	119 (53.8%)[a]	54 (24.4%)[a]
Female (n = 175)	40 (22.9%)[a]	95 (54.3%)[a]	40 (22.9%)[a]
Total (N = 396)	88 (22.2%)	214 (54.0%)	94 (23.7%)
Under what conditions do you learn?			
Male (n = 221)	117 (52.9%)[a]	41 (18.6%)[a]	63 (28.5%)[a]
Female (n = 175)	88 (50.3%)[a]	31 (17.7%)[a]	56 (32.0%)[a]
Total (N = 396)	205 (51.8%)	72 (18.2%)	119 (30.1%)
How does the professor intervene so that you learn?			
Male (n = 221)	90 (40.7%)[a]	69 (31.2%)[a]	62 (28.1%)[a]
Female (n = 175)	63 (36.0%)[a]	52 (29.7%)[a]	60 (34.3%)[a]
Total (N = 396)	153 (38.6%)	121 (30.6%)	122 (30.8%)
In what scenarios do you learn?			
Male (n = 221)	79 (35.7%)[a]	74 (33.5%)[a]	68 (30.8%)[a]
Female (n = 175)	73 (41.7%)[a]	51 (29.1%)[a]	51 (29.1%)[a]
Total (N = 396)	152 (38.4%)	125 (31.6%)	119 (30.1%)
How is teaching organized so that you learn?			
Male (n = 221)	111 (50.2%)[a]	87 (39.4%)[a]	23 (10.4%)[a]
Female (n = 175)	88 (50.3%)[a]	79 (45.1%)[a]	8 (4.6%)[b]
Total (N = 396)	199 (50.3%)	166 (41.9%)	31 (7.8%)
What strategies does the professor use to foster your learning?			
Male (n = 221)	59 (26.7%)[a]	89 (40.3%)[a]	73 (33.0%)[a]
Female (n = 175)	46 (26.3%)[a]	71 (40.6%)[a]	58 (33.1%)[a]
Total (N = 396)	105 (26.5%)	160 (40.4%)	131 (33.1%)

Note: ABP=Problem-Based Learning; AEXP=Experiential Learning; COGSIT=Situated Cognition Each subscript letter indicates a gender sub-group; the categories with column proportions bearing different subscripts differ significantly among them in the level $\alpha < .05$ for the proportion comparison testing Z.

(33.0 and 33.1% for men and women respectively), *organized* around problems (50.2% and 50.3% for men and women).

The students showed only divergences (p <0.05) between genders at the time of identifying situated cognition within the professors' activities (10.4% and 4.6% for men and women), although their implementation within the organization of activities was scarce.

DISCUSSION

It is worth mentioning that the number (44.2%) of young female students who participated in research projects concurs with the findings reported by Estébanez (2007) for Latin America, which signals to the efficacy of the inclusion policies implemented by the Technology Education System of Veracruz. Apparently there is also a clear interest of women to explore the scientific activities within the educational settings, which is added to the facilities found within the institutions, a condition that contradicts Sanz (2005), who reports that "female students suffer some discrimination in science and technology classes and courses because, according to cultural stereotypes, this types of courses are typically for males" (p. 61).

As a result of that, the expectations women have when they enter a technology institute in the state of Veracruz increase their chances of attaining higher living standards, associated to their training in the field of scientific research. Regarding this particular topic, Mendieta-Ramírez (2015) points out that:

> ...to the extent that more women start taking higher education courses in universities or higher education institutions, it would be expected for them to access or be in a position to access the research field as a livelihood. (p. 109)

With regard to the understanding, obtaining of meaning, and contradictions identified through the reading of a scientific text, as well as to the types of learning developed by professors within the technological subsystem, the findings express an educational practice supported by symbolically meaningful didactic tasks, which acquires importance to the extent that it is the student him or herself who discovers the relationship between the known knowledge and the knowledge to be learned.

Authors such as Bueno and Brophy (1995) and Bruner (1980) put an emphasize on the fact that discovery-oriented teaching procedures equip the students with alternatives to manipulate objects and transform them by direct action, as well as to promote activities that lead to search, exploration, and analysis. In their words, these didactic options, besides increasing the students' knowledge of the topics presented, are also able to stimulate their curiosity, supporting them in the development of strategies to learn how to learn, which must lead them to discover knowledge by themselves, in diverse situations.

These forms of education exhibited in the technological system bear a close relationship to the results obtained when asking them about the conditions in which the professor teaches science, where 24.0% of men and 20.2% of women identified scenarios linked to the discovery processes, native to project-based experimental work; which are recurrent contexts within the technological education institutions. Together with this, students identified didactic actions from their professors that are inclined toward a constructivist learning (15.7% and 14.1%), in other words, there was a predisposition to guide teaching toward the production of "variations in the conceptual structures through two processes called ´progressive differentiation´ and ´integrating reconciliation´" (Tünnermann, 2011, p. 24), characteristic of Piaget's postulates. It is thus assumed the operation of a change process in the conceptual structures of students of the technology system, which, while not being affected by gender, is motivated by the professors' didactic interventions.

Although Ausubel severely criticized discovery learning, mostly for the teaching of sciences, this disqualification is associated to the relationship it had with the rote learning process, which is devoid from any meaning. Which is contrary to what has been clearly stated in this study.

Based on the understanding that the teaching conditions are subordinated to the scenarios where the educational action takes place--mainly under project-based approaches--, the results made it clear the professors' preference for the experiential model, understood as that which "offers a unique opportunity to connect theory and practice" (Romero-Ariza, 2010, p. 90). Mainly if it is assumed that the student must face the challenge of responding to a reality that is expressed under diverse situations. Faced with that, experiential learning consolidates "in it meaningful, contextualized, transferable, and functional knowledge which fosters its ability to apply what has been learned" (Romero-Ariza, 2010, p. 90).

An important part of this model approach is supported by the need to conceive the student as an observer, who gets a hold of reality from his or her abilities to consciously and reflectively apprehend what surrounds them, in this case, the means and forms of professional expression. On this matter, Fernández-Rodríguez (2009), based on the premises of the research-action postulated by John Elliott, maintains that:

> For the practical purpose of Professional Training, the education is no more than the permanent search for information within the system-observer. Carrying out second-order research or establishing reflection processes on our practice, is no more than the need for the "information to circulate"; it is information which makes possible the existence of the subject in the reflective organizations, and of an object (the learning of the professional practice) that becomes accessible to us. In sum, "implementing observant positions" is the necessary condition. Developing processes through which said observation platforms can send information to the system, is the sufficient condition. (p. 40)

It is a professionalism model that is current within the higher technological education system in Veracruz, coinciding in a great deal with the premises of the educational model being deployed at this moment within the education institutions that are part of the National Technological Institute of Mexico.

To close up, the statistical equality found in the Z proportion testing (α=0.05) has several interpretations. The first of them indicates the homogeneity with which the predominant types of learning are expressed in the Veracruz technological system, which are identified equally by men and women. The second one is linked to the fairness with which the education process develops within the technological education system in Veracruz, a situation that is aligned with the ideas expressed by Vázquez-Cupeiro (2015), who states that "promoting diversity through the equitable participation of men and women is not, therefore, a question solely of social justice but also of leveraging talent, socioeconomic development and competitiveness" (p. 193). A condition that speaks of the congruence with which the educational model is deployed in its scientific and technological aspect within the higher education system.

These results are opposed to the ideas highlighted by Beirute, Chacón, Fonseca, Garita, and Solano (2007), who assert "the existence of a feminist epistemology that postulates that women have other ways to reach knowledge of nature and people" (p. 10).

CONCLUSIONS

A comprehensive review of gender studies within the scientific and technological activities lets us appreciate a persistence in denoting the inequity with which the scientific activity of women is carried out, mainly their absence in command posts of scientific associations (Osborn, 2008). Based on the latter, a demystification of the central role played by since old times has been attempted. Under biological, social, anthropological, and even psychological perspectives, the evidences have shifted in their interpretations toward the correct performance of women in universal scientific contributions, or, toward the mental abilities they have to pursue these activities. The theoretical foundation regarding these aspects is clear and deep, but is not enough for women to recover spaces of professional performance within the scientific field. Consequently, it is necessary to consolidate their education within the academic spaces, particularly in the higher level.

On this base, the results found in this study enable us to infer a proposal of equitable scientific and technological training in the technological institutes of Veracruz, Mexico. A condition that is not affected by students' gender, who distinguished a model approach guided toward the experimental work, focused on problem solving, with references to situated cognition.

The evidence showed how the professors privilege learning by discovery, paying attention to the premises of meaningful learning and constructivism. Although this is notable, it shall be emphasized that, regardless of gender, it is necessary to prop up the learning scenarios and the didactic strategies towards meaningful learning, with greater contributions from constructivism, guiding them toward models that are an alternative to experiential discovery learning. In other words, guiding them towards theoretical and conceptual and methodological approach aligned with the foundations of the Science-Technology-Society approach, where the alternatives allow to think about a more integral and inclusive science, supported by inter-discipline and trans-discipline.

In addition to that, the role played by those professors who teach science is to be highlighted because they express an educational practice that is consistent with international demands. It still needs to be determined whether they performance is adequate, in terms of the literacy required asked for in the field of science and technology, or if they operate unconsciously, impelled by their experience and disciplinary training. This will make it possible to know to what extent the professors' training and updating efforts are yielding satisfactory results within the technological system of Veracruz.

An aspect to be enhanced is the need to abandon the rhetoric that underlines the absence of women in scientific studies programs (Vázquez-Cupeiro, 2015), assuming that there are non scientific academic programs in the higher education level. The fact that the curricular foundation of the study programs, in this case the technological ones, are structured on a scientific base is being ignored. For that, it is necessary to recognize the multiple expressions of science, breaking down the traditional prejudice that locates it within the empirical-analytical positivist paradigm. The results referred here are an example of this situation, since the study programs taken by the students are placed in the fields of economics-administrative, engineering, sea and biological sciences (agronomy, forestry, biology, among others).

Finally, it is of the utmost importance to make a point that scientific training of men and women is a *conditio sine qua non* sine qua non could be an harmonic development of societies, without which it would be virtually impossible to think about an economic growth derived from a cultural progress. At least in the Western World, this assertion is part of the vision of progress that defines the course state policies.

REFERENCES

Beirute, T., Chacón, M., Fonseca, A., Garita, N. & Solano, L. (2007). La naturalización de la diferencia: el vínculo ciencia y género. *Reflexiones*, *86*(1), 9-27. Recuperado de https://goo.gl/GP3YB3

Bonder, G. (2004). *Equidad de género en ciencia y tecnología en América Latina: Bases y Proyecciones en la Construcción de Conocimientos, Agendas e Institucionalidades*. Recuperado de https://goo.gl/7DO4e8

Bota, A. (2003). El impacto de la biotecnología en América Latina: espacios de participación social. *Acta Bioethica*, *9*(1), 21-38. doi: https://dx.doi.org/10.4067/S1726-569X2003000100003

Bruner, J. (Ed.) (1980). *Investigación sobre el desarrollo cognitivo*. Madrid: Pablo del Río.

Casas, R., Corona, J. M. & Rivera, R. (2013). *Políticas de Ciencia, Tecnología e Innovación en América Latina: entre la competitividad y la inclusión social*. Trabajo presentado en la Conferencia Internacional LALICS 2013: Sistemas Nacionales de Innovación y Políticas de CTI Para un Desarrollo Inclusivo y Sustentable, Río de Janeiro, Brasil. Recuperado de https://goo.gl/8amw3z

Cerchiaro, C. E., Paba, C. & Sánchez, L. (2011). Metacognición y comprensión lectora: una relación posible e intencional. *DUAZARY*, *8*(1), 99-111. Recuperado de https://goo.gl/9zaMNJ

Comisión Europea. (1999). *Mujeres y ciencia: movilizar a las mujeres en beneficio de la investigación europea* (Comunicación de la Comisión Europea). Bruselas: Autor.

Durán-Hevia, J. (2012). Modelos didácticos de la enseñanza de las ciencias en una escuela municipalizada y una escuela particular pagada, un estudio de casos desde las teorías didácticas (Tesis de maestría, Universidad Academia de Humanismo Cristiano). Recuperada de https://goo.gl/Uxd2sD

Estébanez, M. E. (2007). Género e investigación científica en las universidades latinoamericanas. *Revista Educación Superior y Sociedad*, *12*(1), 1-26. Recuperado de https://goo.gl/UeQFVD

Fernández-Rodríguez, E. (2009). Aprendizaje experiencial, investigación-acción y creación organizacional de saber: la formación concebida como una zona de innovación profesional. *REIFOP*, *12*(3), 39-57. Recuperado de https://goo.gl/4UoLTU

Ferrari, L. E. (2005). Acerca de los silencios críticos de la ciencia. Contribuciones de las epistemologías feministas a las relaciones entre ciencia, sociedad y género. *Subjetividad y Procesos Cognitivos*, *7*, 90-104.

Flores, J. (11 de junio de 2013). Ciencia: Avances en la equidad de género. *La Jornada*. Recuperado de https://goo.gl/KXNnlO

Gamino-Carranza, A. & Acosta-González, M. G. (2016). Modelo curricular del Tecnológico Nacional de México. *Revista Electrónica Educare*, *20*(1), 1-25. doi: http://dx.doi.org/10.15359/ree.20-1.10

Good, T. & Brophy, J. (1995). *Psicología Educacional Contemporánea*. México: Mc Graw-Hill.

Hernández, R., Fernández, C. & Baptista, P. (2006). *Metodología de la investigación* (4ª ed.). México: Mc Graw-Hill.

Herrera, A. (2015). *Ciencia y política en América Latina*. Buenos Aires: Biblioteca Nacional.

Jiménez-Rodríguez, V. (2004). *Metacognición y comprensión de la lectura: evaluación de los componentes estratégicos (procesos y variables) mediante la elaboración de una escala de conciencia lectora (escola)* (Tesis doctoral). Recuperada de http://biblioteca.ucm.es/tesis/psi/ucm-t27494.pdf

Leslie, S. J., Cimpian, A., Meyer, M. & Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science*, *347*(6219), 262-235. doi: http://dx.doi.org/10.1126/science.1261375

Marín, A. & Morales, J. J. (2010). Modernidad y modernización en América Latina: una aventura inacabada. *Nómadas. Revista Crítica de Ciencias Sociales y Jurídicas*, *26*(2), 1-20. Recuperado de https://goo.gl/d6kpo3

Massó, E. (2004). Género y ciencia. Una relación fructífera. *Gazet de Antropología*, *20*, 1-10. Recuperado de https://goo.gl/1zjc5U

Mendieta-Ramírez, A. (2015). Desarrollo de las mujeres en la ciencia y la investigación en México: un Campo por cultivar. *Agricultura, Sociedad y Desarrollo*, *12*(1), 107-115. Recuperado de https://goo.gl/ENhXVi

Ministerio de Ciencia e Innovación & European Commission Reasearch & Innovation (Eds.) (2011). *Manual El Género en la Investigación*. Recuperado de https://goo.gl/ejbDI7

Ordorika, I. (2015). Equidad de género en la Educación Superior. *Revista de la Educación Superior*, *44*(174), 7-17. Recuperado de https://goo.gl/zxEtsK

Osborn, M. (2008). Cómo lograr la equidad de género en ciencia. *SEBBM*, *158*, 10-14. Recuperado de https://goo.gl/wBA35b

Prieto, G. & Delgado, A. R. (2010). Fiabilidad y validez. *Papeles del Psicólogo*, *31*(1), 67-74.

Romero-Ariza, M. (2010). El aprendizaje experiencial y las nuevas demandas formativas. *Revista de Antropología Experimental*, *10* (Especial Educación 8), 89-102. Recuperado de https://goo.gl/VknKzJ

Ruiz-Ortega, F. J. (2007). Modelos didácticos para la enseñanza de las ciencias naturales. *Revista Latinoamericana de Estudios Educativos, 3*(2), 41-60. Recuperado de https://goo.gl/L5rhkR

Sánchez de Madariaga, I. (2011). Prólogo. Una herramienta para la innovación de género en la investigación científica. En Ministerio de Ciencia e Innovación & European Commission Reasearch & Innovation (Eds.), *Manual El Género en la Investigación* (pp. 3-4). Recuperado de https://goo.gl/ejbDI7

Sánchez-Masi, L. (2015). *Ensayo sobre una política alternativa para el desarrollo latinoamericano* (Banco de Desarrollo de América Latina Documento de Trabajo N° 2014/06). Recuperado de https://goo.gl/ddk55I

Sanz, V. (2005). Una introducción a los estudios sobre ciencia y género. *Argumentos de Razón Técnica*, *8*, 43-66. Recuperado de https://goo.gl/Lxq22o

Siguenza, A. F. & Sáez, M. J. (1990). Análisis de la resolución de problemas como estrategia de enseñanza de la biología. *Enseñanza de las ciencias*, *8*(3), 223-230. Recuperado de https://goo.gl/ZNCn5y

Tünnermann, B. C. (2011). El constructivismo y el aprendizaje de los estudiantes. *Universidades*, *48*, 21-32. Recuperado de https://goo.gl/xRVKL8

UNESCO. (2014). *Igualdad de Género: Patrimonio y creatividad.* Buenos Aires: Autor. Recuperado de https://goo.gl/7d3TJO

Universia España (19 de enero de 2015). *EDUCACIÓN. Confirman un motivo que aleja a las mujeres de la ciencia.* Recuperado de https://goo.gl/SYoISH

Vázquez-Cupeiro, S. (2015). Ciencia, estereotipos y género: una revisión de los marcos explicativos. *Convergecia: Revista de Ciencias Sociales*, *22*(68), 177-202.

Vera-Giménez J. (2013). *Introducción al aprendizaje basado en problemas. Una guía para el alumnado (2012-2013)*. Valladolid: Universidad de Valladolid. Recuperado de https://uvadoc.uva.es/bitstream/10324/1524/1/ABP.pdf

Villarruel-Fuentes, M. (2014). Modelos educativos: didáctica para la enseñanza de las ciencias. *REDHECS Revista Electrónica de Humanidades, Educación y Comunicación Social*, *9*(18), 294-314. Recuperado de https://goo.gl/VlFJVE