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Preferences for studying STEM careers among high school students in Arequipa (Peru)

Preferencias por estudiar carreras STEM en estudiantes de secundaria de Arequipa (Perú)

Arequipa (秘鲁) 高中生学习 STEM 专业的偏好

Предпочтения в изучении профессий в области STEM среди учащихся средней школы в Арекипе (Перу)

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Abstract

An investigation was carried out to determine the vocational preferences of 1159 students (764 males and 392 females) in the last two years of secondary school in the province of Arequipa (Peru) in the light of sociodemographic and family variables. The emphasis was directed to STEM (Science, Technology, Engineering and Mathematics) degrees and with the intention of knowing their specific distribution by areas of knowledge. The most relevant results show the existence of a preference for engineering degrees and where natural sciences did not merit significant preferences. In this scenario, it was found that men showed more interest in engineering compared to women. However, there was no difference in preference for natural science degrees between males and females. In addition, parochial school students are more likely to prefer natural science degrees over other degrees. These findings are discussed from an epistemological perspective based on critical realism, which proposes -among other aspects- the transcendental relevance of natural sciences and mathematics for the sustained, relevant and harmonious development of engineering.

Keywords: vocational preferences, technological development, scientific development, realistic epistemology, scientific planning.

Resumen

Se realizó una investigación para determinar las preferencias vocacionales de 1159 estudiantes (764 varones y 392 mujeres) de los dos últimos años de secundaria en la provincia de Arequipa (Perú) a la luz de variables sociodemográficas y familiares. El énfasis se dirigió a las carreras STEM (Ciencia, Tecnología, Ingeniería y Matemáticas) con la intención de conocer su distribución específica por áreas de conocimiento. Los resultados más relevantes muestran la existencia de una predilección por las titulaciones de ingeniería y las ciencias naturales no merecieron preferencias significativas. En este panorama, se encontró que los hombres mostraron más interés por las ingenierías en comparación con las mujeres. Sin embargo, no hubo diferencias en la preferencia por las carreras de ciencias naturales entre hombres y mujeres. Además, los estudiantes de escuelas parroquiales son más propensos a preferir las titulaciones de ciencias naturales frente a otras titulaciones. Estos hallazgos se discuten desde una perspectiva epistemológica basada en el realismo crítico, que propone -entre otros aspectos- la relevancia trascendental de las ciencias naturales y las matemáticas para el desarrollo sostenido, pertinente y armónico de la ingeniería.

Palabras clave: preferencias vocacionales, desarrollo tecnológico, desarrollo científico, epistemología realista, planificación científica.

Аннотация

Было проведено исследование для определения профессиональных предпочтений 1159 учащихся (764 юношей и 392 девушек) последних двух лет средней школы в провинции Арекипа (Перу) в свете социально-демографических и семейных переменных. Основное внимание было уделено профессиям STEM (наука, технологии, инженерия и математика) с целью выяснить их конкретное распределение по областям знаний. Наиболее значимые результаты показывают наличие пристрастия к инженерным степеням, а естественные науки не заслужили значительных предпочтений. На этом примере было обнаружено, что мужчины проявляют больший интерес к инженерному делу по сравнению с женщинами. Однако не было никакой разницы в предпочтении степеней в области естественных наук между мужчинами и женщинами. Кроме того, учащиеся церковно-приходских школ чаще отдают предпочтение степеням в области

естественных наук, чем другим степеням. Эти выводы обсуждаются с эпистемологической точки зрения, основанной на критическом реализме, который предлагает - среди прочих аспектов - трансцендентальную значимость естественных наук и математики для устойчивого, актуального и гармоничного развития инженерии.

Ключевые слова: профессиональные предпочтения, технологическое развитие, научное развитие, реалистическая эпистемология, научное планирование.

摘要

我们根据社会人口和家庭变量进行了一项调查，以确定阿雷基帕省（秘鲁）中学最后两年的 1159 名学生（764 名男性和 392 名女性）的专业偏好。研究重点为 STEM 专业（科学、技术、工程和数学），目的是了解其在知识领域的具体分布。最相关的结果表明，对工程学位和自然科学的偏好并不值得明显偏好。在这种情况下，人们发现男性与女性相比对工程学表现出更大的兴趣。然而，男性和女性对自然科学专业的偏好没有差异。此外，教会学校的学生更喜欢自然科学学位而不是其他学位。除其他方面外，这些发现是从基于批判现实主义的认识论角度讨论的，它提出了自然科学和数学对工程持续、相关和和谐发展的重要相关性。

关键词：职业偏好、技术发展、科学发展、现实认识论、科学规划。

Introduction

Since the creation of the National Council for Science and Technology (CONCYTEC) in 1981, important promotion processes have been developed in response to the need for competitive funds, and access to specialized libraries and training spaces. However, since the enactment of the new University Law No. 30220 of 2014, a system of institutional licensing (universities) was implemented that considers scientific production, the existence of qualified researchers before the National Registry of Science, Technology and Technological Innovation (García Meza, 2019) and special conditions (bonuses and reduction of teaching load) for all scholars involved in the scientific and technological field. In this context, the country has managed to link research and university development in a system of implications; where failure to sustain scientific production or the required number of researchers (among other conditions or quality standards) is accompanied by measures such as the closure of universities (license suspension) (García Meza, 2019).

This has led to an increase in national scientific production. Thus, we have gone from a handful of universities (32 out of 143) with research (in amounts greater than zero) to 95 universities with scientific production in frank growth (Cervantes et al., 2019). In any case, these indicators (successful and favorable, by the way) lead us to think that in the renewed scheme of research, development and innovation (R&D&I) special interest has been given to technological studies and innovation (especially industrial and environmental) to the detriment of science itself (Montes-Iturrizaga, 2002, 2016). Moreover, and in view of the fact that this integrative denomination for understanding science and technology (R&D or R+D) is used to study government investment (GDP in science and technology) and production (published articles), it is difficult to determine what science, technology and engineering really are. This fact was already warned many decades ago by Bunge (2014a, 2014b), Montes-Iturrizaga (2002, 2016).

In addition, the government fund that has been financing research in Peru for 35 years has focused more on proposals in the field of engineering. It is also worth mentioning that the University Law itself, in several of its articles, confuses technological research and business incubators with basic research. What is worrying here is the almost imperceptible support for the natural sciences and mathematics under utilitarian prejudices that only give value to fields that solve practical problems, when the sciences are primarily concerned, in the first instance, with cognitive problems (Montes-Iturrizaga, 2014a). It could be added that, in this series of confusions, science is misjudged from the point of view of technologies and, therefore, is underrated for not directly solving practical problems (Bunge, 2014a; Montes-Iturrizaga, 2000).

In reference to the above, it could be thought that natural resources are little known and, to some extent, underrated, since they are not considered relevant for the development of the company's business (Lagos Figueroa, 2017; Lucena & Lee, 1995; National Agency for Research and Innovation, 2017). Therefore, behind these decisions, we see that the relationships and the transcendental importance of natural sciences for the development of technologies and innovations aimed at solving specific problems are ignored. Without properly consolidated natural sciences in a country, we will be cognitively dependent on science from other locations. Worse still, technological development itself at all levels would be harmed by not having rigorous knowledge to be able to construct its responses to the different challenges (Bunge, 2014a).

Therefore, this problem would explain the lack of interest in the study of natural sciences (physics, chemistry or biology) and formal sciences (mainly mathematics) in Latin America, the United States and most of Europe. This is probably a global problem that has put these sciences in check. However, developed countries have partially solved this problem thanks to the high prestige of their universities, which attract thousands of students from countries such as India, China and Latin America in general to study in fields such as physics, mathematics or chemistry (Ganguli & Gaulé, 2018; Gaulé & Piacentini, 2013; Okahana & Zhou, 2019). Thus, for example, at least two-thirds (approximately) of American scientists (physics, chemistry, and biology) were born outside the United States; they are mainly graduate students who chose not to return to their home countries (Ganguli & Gaulé, 2018).

On the other hand, it is worth mentioning that this study acknowledges the transcendental importance of technologies and engineering for social development and science itself (Lucena & Lee, 1995; Valencia Giraldo, 2004). This fact is undeniable and the great interest in STEM careers is praiseworthy; what is worrisome is the scarce interest in natural sciences and mathematics. This is a very complex phenomenon present in many countries such as Spain (Solbes et al., 2007), the United States (Widener, 2019; Grobart, 2013; Jiang et al., 2018; Manalansan et al., 2020), England (Higgins & Pethica, 2014) or France (Powell & Dusdal, 2017); and which would deserve qualitative methodological approaches interested in knowing the family, school and social influences, as well as those of the agencies in charge of promoting science and technology in the country.

This is in addition to other problems such as the little interest of women in studying STEM careers, gender stereotypes at home in the face of these inclinations, and the conviction of many young people that the choice of career should be made for the supposed expectation of economic retribution (rate of return) and not for a true vocation (Cai et al., 2017; García-Holgado et al., 2019; Hamilton et al., 2016; Montes-Iturrizaga & Franco-Chalco, 2021a, 2021b).

Various studies have found that young people (80%) are faced with the situation of having to choose a technical, technological or university career when they finish secondary school or high school (80%). Thus, this decision would be based on an analysis (superficial or deep) in which parents often play an important role in terms of support or resistance (Montes-Iturrizaga, 2013, 2014b; Montes-Iturrizaga & Franco-Chalco, 2021b). In any case, the higher number of high school graduates who neither work nor study is higher in rural areas (13.9% vs. 18.2% in urban areas). In Arequipa, we find that this region has the third highest participation rate in higher education in Peru (38.4%) (Instituto Nacional de Estadística e Informática [INEI], 2019 -National Institute of Statistics and Informatics [INEI from its Spanish initials], 2019).

Likewise, it should be noted that preferences are to some extent structured by productive emphases, labor traditions and the existing labor supply (Grupo Propuesta Ciudadana, 2018; Montes-Iturrizaga & Franco-Chalco, 2021b; Nolazco & Figueroa, 2015). Thus, and, for example, in the city of Arequipa (where this study was carried out), agribusiness, public services, construction and mining activity stand out. In addition, the other regions adjacent to Arequipa also have foreign-owned mines of great importance in the local GDP. In any case, this last productive deployment (mining) generates a large supply of jobs directly and through contractor companies would be associated with the marked interest in engineering careers (Grupo Propuesta Ciudadana, 2018; Hoyos et al., 2019; Nolazco & Figueroa, 2015).

In this context, it would be expected that this interest in technological degrees would be accompanied by their respective share of degrees identified with the natural and formal sciences. However, it is worth mentioning that school psychology assumes that it is healthy for each young person to be able to apply for a university place in the degree that he or she really prefers and without conditioning associated with the supposed economic income or the rate of return once the degree is obtained. In addition, and in relation to the above, it is considered important to transmit to students the idea that in order to work in a certain degree and be successful (socially and economically) it is necessary to be good at what one does; and, therefore, it is rare to find someone like this in a degree that does not arouse more interest than monetary interest.

Therefore, from a perspective concerned with the personal fulfilment of future professionals, it is necessary to promote free decisions, without prejudice, stereotypes and economic reductionisms (Montes-Iturrizaga, 2013, 2014b, 2014c; Montes-Iturrizaga & Franco-Chalco, 2021b; Tovar, 2015; Santa Cruz, 2020). In this task, it has been found that parents often pressure their children to abandon their true vocation and study careers considered to guarantee higher salaries (Montes-Iturrizaga & Franco-Chalco, 2021a). In summary, and taking into account the authoritarian family styles still present in Peruvian families, it is likely that scientific careers (biology, mathematics, physics and chemistry) are the best option (Avolio et al., 2018; Santa Cruz, 2020; Mackenzie, 2016; Toche, 2017; Economic Commission for Latin America and the Caribbean, n.d.).

We have identified a series of research related to preferences for natural science and mathematics careers in young people who are about to finish high school. These studies, which are presented first and coincide with the one presented in this paper, correspond - for the most part - to the fields of psychology, sociology and anthropology. The other studies are of a more sociodemographic nature and offer us a quantitative view of the government figures on the number of university applicants in the statistical records of the National Superintendence of University Higher Education (SUNEDU).

In relation to the above, we have that a main variable that plays an important role in the way people choose careers is gender. In this way, stereotypes become evident and play a relevant role in the inclinations, preferences and concrete choices assumed by men and women. These investigations are projected in two recently published works in the Arequipa region where the existence of gender stereotypes that would keep women away from STEM careers in general, parental resistance and motivations based on economic interests, especially among men in state or public schools, were found (Montes-Iturrizaga & Franco-Chalco, 2021a, 2021b).

In the Latin American and North American spectrum, other studies tell us about the lack of interest in scientific and technological careers in general and especially among women, who prefer social and human sciences careers, perhaps because of stereotypes, family pressures and the influence of social communication (Basco et al., 2019; Caballero Wangüemert, 2016; García-Holgado et al., 2019; Comunidad Mujer, 2017; Martínez Méndez, 2015; Prieto-Echagüe, 2020; Sánchez Jasso et al., 2016; Vázquez-Alonso & Manassero-Mas, 2016).

In this context, the purpose of this research is to learn about vocational preferences regarding STEM careers; and from a gender perspective to distinguish vocational preferences towards natural sciences, engineering and other majors.

Methods

An anonymous survey to explore vocational preferences in light of personal, family and sociodemographic variables was designed and applied to 1155 students (66% male) in the last two years of secondary education (4th and 5th) in the province of Arequipa. This questionnaire was applied in urban schools (public and private) under informed consent given by the school principals and students. Therefore, the subjects responded freely and with prior knowledge of the purposes of this study. It should be noted that in this study (in the framework of a series of publications carried out this year) we have used some items such as gender (male and female); type of educational institution (public, private and parochial); and vocational preferences (What career would you study if you had the "total freedom" to choose?).

Specifically, this questionnaire contemplated short-answer questions (e.g., What career would you like to study if you had total freedom to choose? or What career would you really apply for?) that were coded into natural sciences, engineering, and other careers. The other questions were closed-ended questions such as gender, type of school, year of study, and whether or not their parents (mom and dad separately) agreed or disagreed with their authentic vocational preferences ("dream career").

It is important to note that the intention of this study was to reach all schools in the province of Arequipa. For this reason, formal letters were sent requesting the respective authorizations. In this case, each school that agreed to participate received a global report on the preferences of their students and possible parental tensions regarding certain professions.

The test has a theoretical and content validity determined by means of a judge-validation system. Also, since this test does not include additive items, it is not possible to determine reliability from a statistical point of view.

As for the statistical analyses, descriptive statistics were estimated for the frequencies and percentages of the degree of preference. Likewise, to test the association

between preferred degree with sex and type of educational center, two chi-square statistics were estimated. Finally, a multinomial logistic regression model was estimated to determine the probabilities of choosing a natural science or engineering degree over other degrees; the predictor variables were sex and type of educational center. Statistical analyses were performed with SPSS for Windows® software version 26.0, and R version 4.1.0.

Results

The first overall results (Table 1) show that the majority of preferences are for engineering degrees (18 majors) with 33.1% (n = 384). It is also revealing that only 1.6% (n = 18) were interested in natural science degrees such as biology, physics, chemistry, geology and others. In addition, it is worth mentioning that none of the students who participated in the study expressed a preference for the degree in mathematics, which is offered at the public university of the province (Universidad Nacional de San Agustín) free of charge, given the precept of gratuity of these public institutions. Finally, it is important to note that in the category "other degrees" we have grouped almost 60 from the areas of social sciences, human sciences, health sciences, armed and police forces, arts and technical studies such as mechanics, electricity and carpentry.

Table 1

Degrees preferred by the young in the sample

Degrees	*f*	%
Natural Sciences	18	1.6
Engineering	384	33.1
Other degrees	757	65.3

Table 2 shows the test of association between the sex variable and professional degrees. It is clearly perceived that men show a greater predilection for the natural sciences and engineering (this being more noticeable in the former). In the grouping we made around "other degrees", social sciences and human sciences predominate, which to some extents are fields mostly preferred by women and hence their predominance (80.1%), these results being statistically significant ($\chi^2 = 57.34$, df = 2, $p < .001$).

Table 2

Degrees preferred by the young in the sample according to the sex variable

	Men		Women	
Degrees	*f*	%	*f*	%
Natural Sciences	15	2.0	3	.8
Engineering	308	40.3	75	19.1
Other degrees	441	57.7	314	80.1

Table 3 shows the association between the type of educational center and the degree categories generated taking into account vocational preferences. Natural science degrees are preferred to a greater extent in private and parochial schools. This same tendency is also projected to engineering degrees. The opposite case is observed in the category "other degrees" where students from public schools are more oriented. These results were statistically significant ($\chi^2 = 11.37$, df = 4, p = .023).

Table 3

Degrees preferred by the young people in the sample according to type of educational center

	Public		Private		Parochial	
	f	%	*f*	%	*f*	%
Natural Sciences	4	.7	4	2.0	10	2.7
Engineering	117	30.4	71	34.6	135	35.5
Other degrees	402	69.0	130	63.4	225	60.8

Table 4 shows the logistic model predicting the odds of studying a natural science degree and an engineering degree versus other degrees by gender and type of school. For natural science degrees there is only a statistically significant difference between public and parochial schools, parochial school students are 3.55 more likely to study a natural science degree than other degrees (b = 1.27, OR = 3.55, z = 2.07, p = .038); there are no other differences between public versus private schools, nor by sex. On the other hand, there is a statistically significant difference between the odds of dreaming of studying engineering between men and women. Females are 66% less likely to dream of studying engineering than males (b = 1.09, OR = .34, z = -7.10, p < .001). There were no other differences between school type for these degrees.

Table 4

Multinomial logistic regression model predicting the odds of studying a natural sciences and engineering degree versus other degrees by gender and type of educational institution

	Natural Sciences vs others				Engineering vs others			
	b	*OR*	*z*	*P*	*b*	*OR*	*z*	*p*
Intercept	-4.20	.02	-7.71	< .001	- .38	.68	-3.52	< .001
Sex (Men vs. Women)	- .96	.38	-1.47	.140	-1.09	.34	-7.10	< .001
Type of School (Public vs. Private)	.91	2.48	1.25	.211	- .02	.98	.11	.917
Type of School (Public vs. Parochial)	1.27	3.55	2.07	.038	.06	1.06	.39	.696

Discussion

The results show the low preference for natural science (and mathematics) careers in a large sample of students who are about to graduate from secondary education in the province of Arequipa. Likewise, these findings are worrisome if we intend to achieve a harmonious development of science and technology in a specific territory (province, region or country) (Bunge, 2014a, 2014b; Montes-Iturrizaga & Franco-Chalco, 2021b). For, as noted in the previous pages, we find the interest in engineering valuable, but the possibility of not having scientists who can support the technologies is alarming.

In any case, we do not have a parameter or standard that tells us how many natural scientists and mathematicians are required in each country or subnational state, except for trends that tell us about a balance between scientists and engineers, such as in England, where there are more scientists than engineers (Montgomery et al., 2014).

On the other hand, our study continues to show little preference of women for science and engineering careers, which indicates to us that there are still prejudices, self-exclusion and sexist segregation in these disciplines; a fact that is repeated in most of Latin America (Tovar, 2015; Santa Cruz, 2020; Mackenzie, 2016; Cantero Riveros, 2016; García-Holgado et al., 2019; Prieto-echagüe, 2020). Likewise, regarding the type of school, we see that science is preferred to a greater extent by those who attend private and parochial schools (the same ones that have a lower pension or payment) compared to those who attend public institutions. Perhaps, given that those who attend public schools come from families with fewer resources, they may prefer careers with greater possibilities of obtaining a stable job in the state sector, such as the human and social sciences.

However, for future research, it will be necessary to explore from qualitative perspectives (interviews, focus groups and life stories) the thoughts, beliefs and stereotypes that could be behind the low preference for natural sciences and mathematics. Finally, we highlight the significant preferences for engineering careers in Arequipa, which are essential for economic and social development in every sense (Nolazco & Figueroa, 2015).

The latter is not questioned from any point of view and it is likely that these choices are triggered by the boom in Arequipa's productive vocations (mining, construction, industry and manufacturing in general) and the favorable action of the National Council of Science and Technology (CONCYTEC) (Grupo Propuesta Ciudadana, 2018; Montes-Iturrizaga & Franco-Chalco, 2021b). In this scenario, no decisive and balanced action has been taken to promote the natural sciences (and mathematics). In this context, it is likely that science fairs (at the school level) that take place in other scenarios can serve as a contribution for the country (Spanish Foundation for Science and Technology, 2018; Oppliger et al., 2019; García-Holgado et al., 2020). Perhaps, and this is only an explanatory hypothesis, the poor understanding of what science is and its confusion with technology could be important clues to clarify the problems encountered (Montes-Iturrizaga, 2002; Montes-Iturrizaga, 2016).

Finally, this research refers us to a complex problem associated with the low participation of women in STEM careers, which necessarily involves addressing gender inequality projected from families, the educational system and society (Tovar, 2015; Santa Cruz; 2020; Mackenzie, 2016; Villalba-Condori et al., 2018).

References

Agencia Nacional de Investigación e Innovación. (2017). *Claves para el desarrollo: más mujeres en ciencia, tecnología, ingeniería y matemáticas (STEM)*. https://www.anii.org.uy/upcms/files/listado-documentos/documentos/doc-stem-1-.pdf

Avolio, B., Chávez, J., Vílchez-Román, C., & Pezo, G. (2018*). Factores que influyen en el ingreso, participación y desarrollo de las mujeres en carreras vinculadas a la ciencia, tecnología e innovación*. Pontificia Universidad Católica del Perú y Consorcio de Investigación Económica y Social (CIES). https://cies.org.pe/sites/default/files/investigaciones/factores_que_influyen_en_el_ingreso_participacion_y_desarrollo_de_las_mujeres_en_carreras_vinculadas_a_la_cti_0.pdf

Basco, A. I., Lavena, C., & Chicas en Tecnología. (2019). *Un potencial con barreras: La participación de las mujeres en el área de Ciencia y Tecnología en Argentina*. BID. https://publications.iadb.org/es/un-potencial-con-barreras-la-participacion-de-las-mujeres-en-el-area-de-ciencia-y-tecnologia-en

Bunge, M. (2014a). *Memorias: Entre dos mundos*. Editorial Gedisa.

Bunge, M. (2014b). *Parte A: Ciencias Sociales Básicas.* En *Las Ciencias Sociales en discusión: Una perspectiva filosófica*. Penguin Random House Grupo Editorial.

Caballero Wangüemert, M. (2016). Mujeres de ciencia: El caso del consejo superior de investigaciones científicas. *Arbor, 192*(778). https://doi.org/10.3989/arbor.2016.778n2003

Cai, Z., Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers & Education, 105*(2017), 1–13. https://doi.org/10.1016/j.compedu.2016.11.003

Cantero Riveros, B. (2016). *Inclusión del género en la enseñanza de las ciencias*. [Tesis Doctoral, Universidad Autónoma de Barcelona]. https://www.tesisenred.net/bitstream/handle/10803/385843/bcr1de1.pdf?sequence=1

Cervantes, L., Bermúdez, L., & Pulido, V. (2019). Situación de la investigación y su desarrollo en el Perú: reflejo del estado actual de la universidad peruana. *Pensamiento y Gestión*, *46*, 311–322. https://rcientificas.uninorte.edu.co/index.php/pensamiento/article/view/11774

Comisión Económica para América Latina y el Caribe. (n.d.). *Familia y políticas públicas en América Latina: Una historia de desencuentros* (I. Arraigada (ed.). División de Desarrollo Social de la CEPAL. https://repositorio.cepal.org/bitstream/handle/11362/2509/S0700488_es.pdf

Comunidad Mujer. (2017). Mujer y trabajo: Brecha de género en STEM, la ausencia de mujeres en Ingeniería y Matemáticas. *Serie Comunidad Mujer*, (42), 1–15. http://www.comunidadmujer.cl/biblioteca-publicaciones/wp-content/uploads/2017/12/BOLETIN-42-DIC-2017-url-enero-2018.pdf

Fundación Española para la Ciencia y la Tecnología. (2018). *Libro Verde Ferias de la Ciencia*. FECYT. https://www.fecyt.es/es/publicacion/libro-verde-de-las-ferias-de-ciencia

Ganguli, I., & Gaulé, P. (2018). *Will the U.S. keep the best the brightest (as Post-docs)? Career and location preference of foreing STEM PhDs.* En NBER Working Papers Series (Working Paper 24838). http://www.nber.org/papers/w24838

García-Holgado, A., Camacho Díaz, A., & García-Peñalvo, F. J. (2019). La brecha de género en el sector STEM en América Latina: una propuesta europea. *Cinaic*, 704–709. https://doi.org/10.26754/cinaic.2019.0143

García-Holgado, A., Deco, C., Bedregal-Alpaca, N., Bender, C., & Villalba-Condori, K.O. (2020). *Perception of the gender gap in computer engineering studies: a comparative study in Peru and Argentina*. IEEE Global Engineering Education Conference (EDUCON). https://ieeexplore.ieee.org/document/9125224

García Meza, O. (2019). Registro necesario. *Enfoque Semanal*, 2–4. http://cdn02.pucp.education/biblioteca/2019/10/14171706/puntoedu_renacyt.pdf

Gaulé, P., & Piacentini, M. (2013). Chinese graduate students U.S. scientific productivity. *The Review of Economics and Statistics, 95*(2), 698–701. https://doi.org/https://doi.org/10.1162/REST_a_00283

Grobart, F. (2013). Ciencia y tecnología en estados Unidos: crisis sistémico-estructural en los cimientos del capitalismo monopolista transnacionalizado. *Economía y Desarrollo, 149*(1), 117–138. http://www.econdesarrollo.uh.cu/index.php/RED/article/view/260

Grupo Propuesta Ciudadana. (2018). *Región Arequipa: ingresos y gastos generados por concepto de canon y regalías mineras*. http://propuestaciudadana.org.pe/wp-content/uploads/2018/02/Regi%23U00f3n-Arequipa-ingresos-y-gastos-generados-por-concepto-de-canon-y-regalías-mineras.pdf

Hamilton, M., Luxton-Reilly, A., Augar, N., Chiprianov, V., Gutierrez, E. C., Duarte, E. V., Hu, H. H., Ittyipe, S., Pearce, J. L., Oudshoorn, M., & Wong, E. (2016). *Gender equity in computing: International faculty perceptions & current practices* [Conference]. ITiCSE '16: Proceedings of the 2016 ITiCSE Working Group Reports, New York, United States. https://doi.org/10.1145/3024906.3024911

Higgins, D., & Pethica, J. (2014). *A picture of the UK scientific workforce. Diversity data analysis for the Royal Society. Summary report*. The Royal Society. https://royalsociety.org/~/media/Royal_Society_Content/policy/projects/leading-way-diversity/picture-uk-scientific-workforce/070314-diversity-report.pdf

Hoyos, D., Aguinaga, V., Carranza, V., Ramírez, D., Valdivia, F., & Abanto, C. (2019). *Anuario Minero 2019 Perú*. Ministerio de Energía y Minas del Perú. https://www.gob.pe/institucion/minem/informes-publicaciones/1424993-anuario-minero-2019

Instituto Nacional de Estadística e Informática. (2019). Perú: *Indicadores de Educación por Departamentos, 2008-2018*. INEI. https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1680/libro.pdf

Jiang, S., Schenke, K., Eccles, J. S., Xu, D., & Warschauer, M. (2018). Cross-national comparison of gender differences in the enrollment in and completion of science, technology, engineering, and mathematics Massive Open Online Courses. *PLoS ONE, 13*(9), 6–13. https://doi.org/10.1371/journal.pone.0202463

Lagos Figueroa, J. (2017). El papel de la física en la formación profesional del ingeniero. *Revista Lumen Gentium, 1*(1), 91–96. https://doi.org/10.52525/lg.v1n1a9

Lucena, J., & Lee, G. (1995). Haciendo científicos e ingenieros para propósitos nacionales en USA: desde la guerra fría hasta la competitividad económica. *Historia Crítica*, (10), 29–38. https://doi.org/https://doi.org/10.7440/histcrit10.1995.02

Mackenzie, V. (2016). *Comunicación, género y profesión: la incidencia de mujeres sobre varones en la especialidad de "comunicación para el desarrollo" en la Pontifica Universidad Católica del Perú* [Tesis de Licenciatura, Pontificia Universidad Católica

del Perú]. Repositorio Institucional de la Pontificia Universidad Católica del Perú. https://tesis.pucp.edu.pe/repositorio/handle/20.500.12404/7188

Manalansan, E. B. R., Fogata, M. A., & Rogayan, D. J. V. (2020). Exploring Prospective Teachers' Reasons for Choosing General Science as a Specialization. *Journal of Science Learning, 3*(3), 149–155. https://doi.org/10.17509/jsl.v3i3.23493

Martínez Méndez, K. I. (2015). *Tienen sexo las profesiones. Hombres y mujeres en profesiones femeninas y masculinas, el caso de los enfermeros y las ingenieras mecánicas electricistas* [Tesis de Doctorado, Colegio de San Luis]. http://biblio.colsan.edu.mx/tesis/MartinezMendezKarlaIrene.pdf

Montes-Iturrizaga, I. (7 de diciembre de 2002). *Importancia del juicio de pares y el cumplimiento de estándares para las decisiones evaluadoras de los proyectos de investigación en C y T* [Conferencia]. I Encuentro de Investigadores En Sistemas Informáticos y En Sistemas de Control, Universidad Nacional de San Agustín, Arequipa, Perú.

Montes-Iturrizaga, I. (2013, March 16). Sobre la orientación vocacional. *Diario El Comercio*.

Montes-Iturrizaga, I. (2014a). Apreciaciones en torno a la propuesta de nueva Ley Universitaria. *Revista Signo Educativo, XIII*(227), 26–28.

Montes-Iturrizaga, I. (2014b, February 14). ¿Cómo decidir una carrera con responsabilidad? *La República*.

Montes-Iturrizaga, I. (2014c). ¿Cómo decidir una carrera con responsabilidad? *Revista Signo Educativo, XXIII*(225), 28.

Montes-Iturrizaga, I. (15 – 19 de noviembre de 2016). *Derechos humanos de los investigadores científicos: una propuesta desde la epistemología realista* [Conferencia]. Congreso Mundial de Juventudes Científicas, Lima, Perú. https://www.fissnet.org/jfiss/

Montes-Iturrizaga, I., & Franco-Chalco, E. (2021a). *Attitudes towards the choice of a professional career: a study in secondary education students from peru* [Conference]. 13th annual International Conference on Education and New Learning Technologies. https://doi.org/10.21125/edulearn.2021.1725

Montes-Iturrizaga, I., & Franco-Chalco, E. (2021b). *Women's preferences towards stem majors in Peru: a study from social stereotypes and parental resistance* [Conference]. 15th International Technology, Education and Development Conference. https://doi.org/10.21125/inted.2021.1820

Montgomery, J., l Nurse, P., Thomas, D. J., Tildesley, D., & Tooke, J. (2014). *The culture of scientific research in the UK*. Nuffield Council on Bioethics. https://www.nuffieldbioethics.org/assets/pdfs/The-culture-of-scientific-research-report.pdf

Nolazco, J. L., & Figueroa, T. (2015). *Impacto de la dinámica en la industria minera sobre el desarrollo regional de Arequipa: Un análisis de género.* [Proyecto Breve (PB) Arequipa A1-T4]. Consorcio de Investigación Económica y Social. https://cies.org.pe/sites/default/files/investigaciones/informe_final_pb_nolazco_y_figueroa.pdf

Okahana, H., & Zhou, E. (2019). *International Graduate Applications and Enrollment Fall 2018*. Council of Graduate Schools. https://cgsnet.org/Data-Insights/

Oppliger, L. V., Nuñez, P., & Gelcich, S. (2019). Ferias Científicas como Escenarios de Motivación e Interés por la Ciencia en Estudiantes Chilenos de Educación Media de la Región Metropolitana. *Información Tecnológica, 30*(6), 289–300. https://doi.org/http://dx.doi.org/10.4067/S0718-07642019000600289

Powell, J., & Dusdal, J. (2017). Science Production in Germany, France, Belgium, and Luxembourg: Comparing the Contributions of Research Universities and Institutes to Science, Technology, Engineering, Mathematics, and Health. *Minerva,* 55, 413–434. https://doi.org/https://doi.org/10.1007/s11024-017-9327-z

Prieto-Echagüe, V. (2020). Desigualdad de género en las carreras STEM en el Uruguay. Construyendo cultura y registros: la experiencia en Institut Pasteur de Montevideo con In Mujeres (Uruguay*). Revista Cuestiones de género: de la igualdad y la diferencia*, (15), 143–163. http://revpubli.unileon.es/ojs/index.php/cuestiones-degenero/article/view/6171

Santa Cruz, M. K. (2020). *Estereotipo de género frente a las carreras universitarias en estudiantes de una universidad privada de lima metropolitana* [Tesis de Bachiller, Universidad San Ignacio de Loyola]. Repositorio Institucional de la Universidad San Ignacio de Loyola. https://repositorio.usil.edu.pe/items/ce36017f-f89f-40bd-b10e-1805f3f0007a

Tovar, T. (2015). *Recomendaciones de política de igualdad de género en educación* (2ª edición). Red Nacional de Educación de la Niña, Florecer. https://www.gcedclearinghouse.org/sites/default/files/resources/170050spa.pdf

Sánchez Jasso, A. K., Rivera Gómez, E., & Velasco Orozco, J. J. (2016). Desigualdades de género en ciencia, el caso de las científicas de la UAEMéx. *Cuadernos Intercambio sobre Centroamérica y El Caribe, 13*(2), 83-110. https://doi.org/10.15517/c.a.. v13i2.26691

Solbes, J., Montserrat, R., & Furió, C. (2007). Desinterés del alumnado hacia el aprendizaje de la ciencia: implicaciones en su enseñanza. *Didáctica de Las Ciencias Experimentales y Sociales,* (21), 91–117. https://ojs.uv.es/index.php/dces/article/view/2428/1973

Toche, F. (2017). Los estereotipos. *Perú 21*. https://peru21.pe/opinion/fatimatoche-estereotipos-82082

Valencia Giraldo, A. (2004). La relación entre la ingeniería y la ciencia. *Revista Facultad de Ingeniería Universidad de Antioquia,* (31), 156–174. https://revistas.udea.edu.co/index.php/ingenieria/article/view/344524

Vázquez-Alonso, Á., & Manassero-Mas, M.-A. (2016). La voz de los estudiantes de primer año en seis países: evaluación de sus experiencias en estudios superiores científico-técnicos. *Ciência & Educação (Bauru), 22*(2), 391-411. https://doi.org/http://dx.doi.org/10.1590/1516-731320160020008

Villalba-Condori, K. O., Castro Cuba-Sayco, S. E., Guillen Chávez, E. P., Deco, C., & Bender, C. (2018). Approaches of learning and computational thinking in students that get into the computer sciences career. In F. J.García-Peñalvo (Ed.), Proceedings TEEM'18. Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality (Salamanca, Spain, October 24-26, 2018) (pp. 36-40). https://doi.org/10.1145/3284179.3284185

Widener, A. (2019). Science in the US is built on immigrants. Will they keep coming? *C&EN Global Enterprise, 97*(9), 35–40. https://doi.org/10.1021/cen-09709-cover