

Participation of women in engineering and technology careers at the National Technological Institute of Mexico in the state of Oaxaca

Participación de las mujeres en las carreras de ingeniería y tecnología del Tecnológico Nacional de México en el estado de Oaxaca

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Abstract

This work presents an analysis of the participation of women in engineering and technology careers at the National Technological Institute of Mexico, [Tecnológico Nacional de México] (TecNM) in Oaxaca, the state has eleven federal and two decentralized technological institutions. Statistical data was obtained from the National Association of Universities and Institutions of Higher Education [Asociación Nacional de Universidades e Instituciones de Educación Superior] (ANUIES) from the period 2010 to 2021. The careers of the following subareas were considered: "engineering, manufacturing and construction" and "Information and communication technologies". To determine the influence of TecNM, the State University System of Oaxaca [Sistema de Universidades Estatales de Oaxaca] (SUNEO), the Autonomous University of Oaxaca Benito Juárez [Universidad Autónoma Benito Juárez de Oaxaca] and other universities with fewer students, both public and private. It was found that even when the total of student enrollment has increased at the state level, the difference in student enrollment between men and women has not changed much over the years, as well as the participation of women by discipline. The TecNM has the greatest influence in the academic training of female engineers in the state of Oaxaca, while in the Technology area it keeps up with other institutions.

Engineering, Technologic, Women

Resumen

El presente trabajo plantea un análisis de la participación de las mujeres en las carreras de ingeniería y tecnología del Tecnológico Nacional de México (TecNM) en Oaxaca, el estado cuenta con 11 tecnológicos federales y dos descentralizados. Se obtuvieron datos estadísticos de la Asociación Nacional de Universidades e Instituciones de Educación Superior (ANUIES) del periodo 2010 al 2021. Se consideraron las carreras de las siguientes subáreas: "ingeniería, manufactura y construcción" y "Tecnologías de la información y la comunicación". Para determinar la influencia del TecNM, se analizó el Sistema Estatal de Universidades de Oaxaca (SUNEO), la Universidad Autónoma Benito Juárez de Oaxaca y otras universidades con menos estudiantes, tanto públicas como privadas. Se encontró que aun cuando la matrícula total ha crecido a nivel estatal la diferencia de la matrícula entre hombres y mujeres no ha variado significativamente durante estos años, así como la participación de las mujeres por área del conocimiento. El TecNM tiene mayor influencia en la formación de ingenieras en el estado de Oaxaca, mientras que en el área de Tecnologías está a la par de otras instituciones.

Ingeniería, Tecnología, Mujer

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Introduction

The advance in the use of technology causes the demand for professionals in the areas of engineering and technology to increase, coupled with the fact that more women are sought in careers in Science, Technology, Engineering and Mathematics (STEM). To reduce the gender gap, it is important to analyze how their participation in these areas has changed in recent years.

The objective of this article is to analyze the participation of women in engineering careers at the Tecnológico Nacional de México (TecNM) in the state of Oaxaca, an institution that trains the majority of graduates in the country, has a presence in all states of the Mexican Republic through 254 schools, where there are "four Regional Centers for Optimization and Team Development [Centros Regionales de Optimización y Desarrollo de Equipo] (CRODE), an Interdisciplinary Center for Research and Teaching in Technical Education [Centro Interdisciplinario de Investigación y Docencia en Educación Técnica] (CIIDET) and a National Center for Research and Technological Development [Centro Nacional de Investigación y Desarrollo Tecnológico] (CENIDET)" (TecNM, 2023), in addition to 126 federal Technological and 122 decentralized.

The state of Oaxaca has eleven federal technology and two decentralized Institutions. The difference is that, in the former, the resources come directly from the federation and in the latter, it is the states that intervene with half of the resources.

To determine the incidence of TecNM in the training of female engineers in Oaxaca, other institutions that also teach engineering and that are described in the methodology were analyzed. To make a comparison of the disciplines that women are interested in, the National Pedagogical University [Universidad Pedagógica Nacional] (UPN) and the [Normales] which, although they do not train female engineers, do allow a comparison of the disciplines in which the students are trained in Oaxaca.

Background

When reviewing scientific articles related to the research topic, a wide variety of them was found, highlighting the work of the Merida Technological [Tecnológico de Mérida] and the one from the Benito Juárez University of Oaxaca [Universidad Autónoma Benito Juárez de Oaxaca] with an analysis of the indigenous woman. Observing the search carried out on the gender factors that may or may not favor the inclusion of women in higher education, the participation ratio of women with respect to men, especially in higher and postgraduate education. In a study on failure and study habits carried out at the Tecnológico de Oaxaca, he mentions that "when the degree in Computer Systems Engineering was recently opened, there was not a great difference between the number of men and women, currently those figures have changed and the percentage of women who register has decreased" (Valverde et.al, 2019) But no study was found referring to the participation of women in engineering careers at the Tecnológico Nacional de México in the state of Oaxaca. Being this institution where a considerable number of graduates are trained in the area of engineering and technology.

Theoretical framework

In the first place, it is necessary to define the term gender, according to Lemas cited by Loría and Villagómez, it represents the group of characteristics, beliefs, cultural perceptions that one has with respect to "what is proper", of men and "what is proper" of women, in each culture (2023, 174). That is to say, what is accepted as the duty of men and the duty of women.

Culturally, characteristics and tasks are assigned as belonging to women and others to men. Saltzman (1992) affirms that "The division of labor by sex is what underlies inequality." Bustos, cited by Briseño and Juárez, affirm that the greatest female participation occurs in "the social sciences, humanities, education and nursing; while enrollment in careers in the branches of science, technology, engineering and mathematics is higher than the male presence" (2019). Access to higher education does not seem to represent a problem in terms of access for men and women (Urrea et.al, 2022), the situation changes when analyzed by areas of knowledge, that is where the direction is seen.

In order to achieve gender equality, the ONU advocates for the inclusion of women in Science, Technology, Engineering and Mathematics (STEM). Despite the fact that women have achieved a higher education than men, in general they receive lower salaries than men (Midori, 2022).

De Garay & Del Valle (2012) affirm that the incorporation of women into higher education is notorious, however, "there are fields of knowledge such as the exact sciences and engineering where the presence of women is lower compared to men. (2012), for which they propose financing for women to study. To achieve innovation, the incorporation of women is necessary.

Methodology

For the research, the following hypothesis was raised: "the gender gap on the participation of women at the time of studying engineering has not changed in the last 10 years". and the "Tecnológico Nacional de México" has had a strong impact on the training of female engineers in the state of Oaxaca. Historical data was obtained from the official website of ANUIES (<http://www.anui.es.mx/informacion-y-servicios/informacion-estadistica-de-educacion-superior/anuario-estadistico-de-educacion-superior>), from the period 2010-2011 to the period 2020-2021, considering 10 years for this study. In the 2107 ANUIES yearbook, it is stated that there were inconsistencies with the data presented by the SEP and that they made the necessary adjustments to correct the inconsistencies presented in that year (ANUIES 2022).

Only the information on higher education in the state of Oaxaca was extracted from the yearbooks, by educational program and by institution in terms of enrollment, graduates, new entrants, separated by men and women.

The ANUIES classification was considered regarding careers by areas of knowledge: engineering and technology, for example, engineering in Business Management is not classified within engineering but within administration, so there are careers that even carry the name of the career the word engineering were not considered.

Using the engineering and technology classification, two sub-areas were considered: Engineering, Manufacturing and Construction, and Information and Communication Technologies.

After obtaining the data, they were classified by institution and by Educational System, they were grouped into: Federal Technological Institute of Oaxaca, Valle de Oaxaca, Tlaxiaco, Comitancillo, Pinotepa, Salina Cruz, Pochutla, Cuenca del Papaloapan, Tuxtepec, Istmo, Valle de Etla and two decentralized, the Higher Technological Schools of San Miguel el Grande and the in total as part of the TecNM.

SUNEO includes its 18 campuses from the Universities: Tecnológica de la Mixteca (Huajuapán), del Mar (Puerto Escondido, Puerto Ángel, Huatulco and Cd. de Oaxaca), del Istmo (Tehuantepec, Ixtepec and Juchitán), del Papaloapan (Tuxtepec and Loma Bonita), from the Sierra Sur (Miahuatlán), from Sierra Juárez (Ixtlán), from La Cañada (Teotitlán), NovaUniversitas (Ocotlán, San Jacinto and Juxtlahuaca), UNCOS (Pinotepa Nacional) and UNICHA (Chalcatongo de Hidalgo).

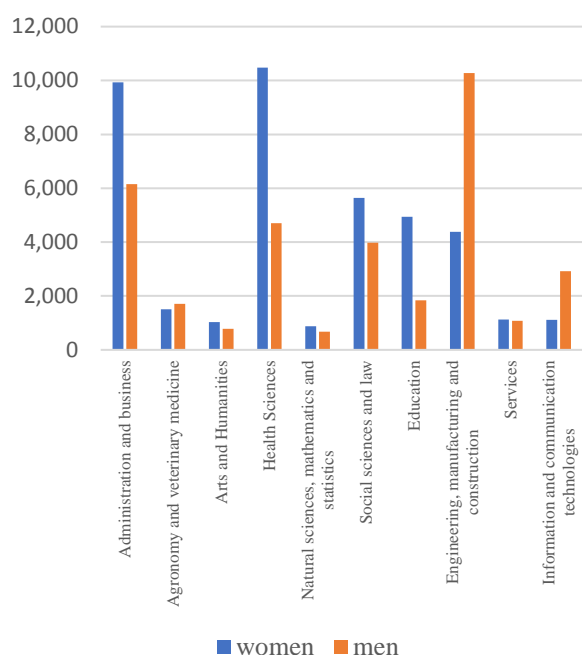
Likewise, the Autonomous University Benito Juárez de Oaxaca (UABJO) was considered with all its sub-sites, the National Pedagogical University (UPN), the Normal and others, universities with fewer students, both public and private, were classified.

The basic statistics by career were carried out, to identify the difference between men and women by career according to the area of knowledge through the years, later the enrollment in terms of careers related to engineering and Information Technology was analyzed. The number of programs by educational system was also analyzed.

Results

Graph 1 shows that at the state level, men focus mostly on engineering, manufacturing, and construction areas, which coincides with Bustos cited by Briseño and Juárez (2019). Where the difference is almost twice that of health sciences, social sciences, or education, it is important to mention that Information and Communication Technologies are close to health sciences (see graph 1).

Students by discipline and sex in Oaxaca.



Graph 1 Students by discipline and sex in Oaxaca
Own Elaboration with data from ANUIES

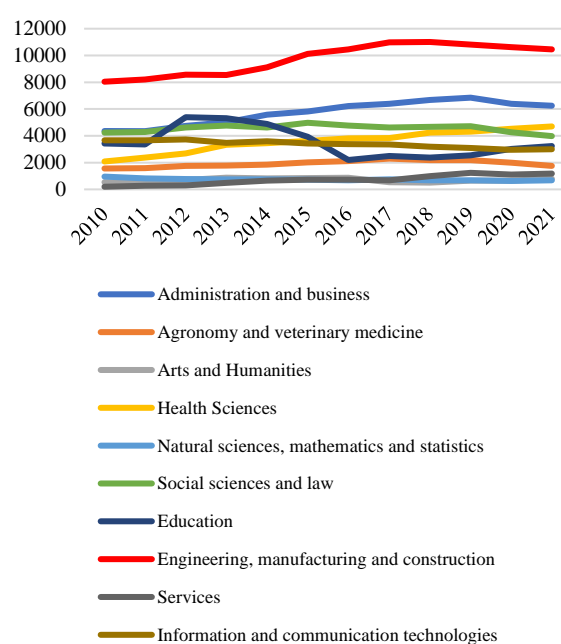
Regarding the higher level student population in 2021, compared to women, it was found that they were mostly in administration and business, health sciences, and education, which is also in accordance with Bustos cited by Briseño and Juárez (2029), see graph 2 and graphic 3.

This difference in terms of preferences between men and women in relation to the discipline they study is observed in graphs 3 and 4. Graph 3 shows that from 2010 to 2021 the number of women has grown slowly, which is not yet proportional to that of men, but there are small advances.

To understand this behavior, graph 3 shows where the educational programs by institution or institutions that offer them in this category are presented: UPN, Normal schools, SUNEI, UABJO, and other institutions.

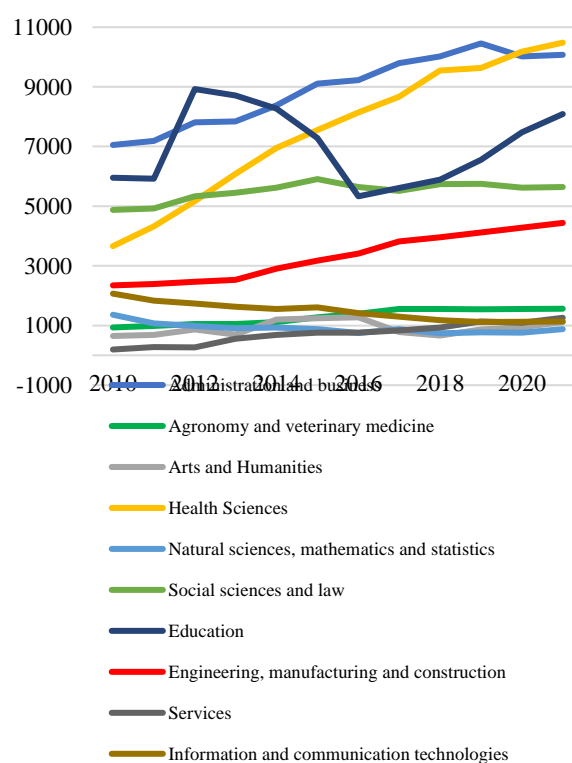
Graph 4 shows that there is a great variety of educational programs, especially in other institutions that include both public and private institutions, in the area of Engineering and Technology, in the state of Oaxaca.

Enrollment in the state of Oaxaca by area of knowledge per year (men)

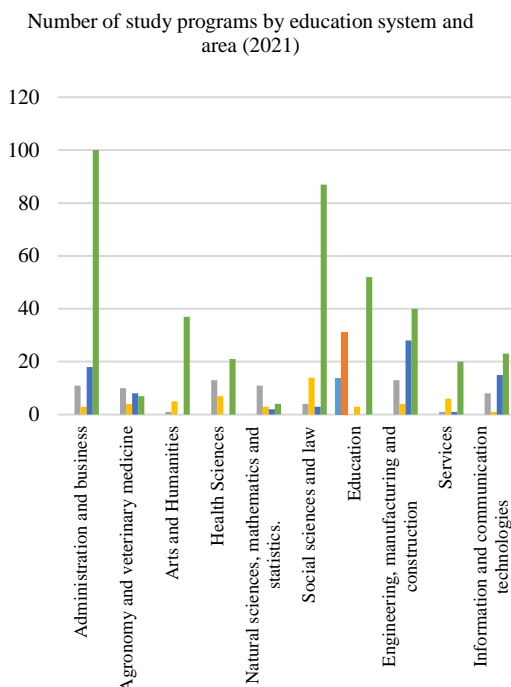


Graph 2 Enrollment in the state of Oaxaca by area of knowledge per year (men)

Enrollment in the state of Oaxaca by area of knowledge per year (women)



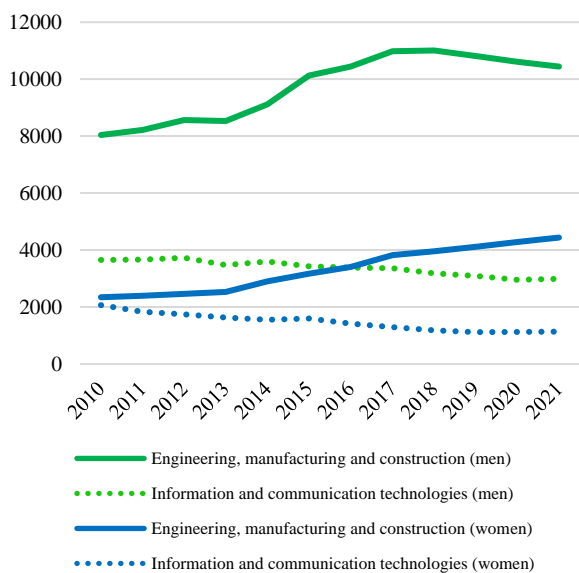
Graph 3 Enrollment in the state of Oaxaca by area of knowledge per year (women) from 2010 to 2021



Graph 4 Number of study programs by education system and area (2021)

When analyzing Engineering and the Information Technology area separately, it is observed that even though there is an increase in the number of students per year, there has been more in men than in women, see graph .5.

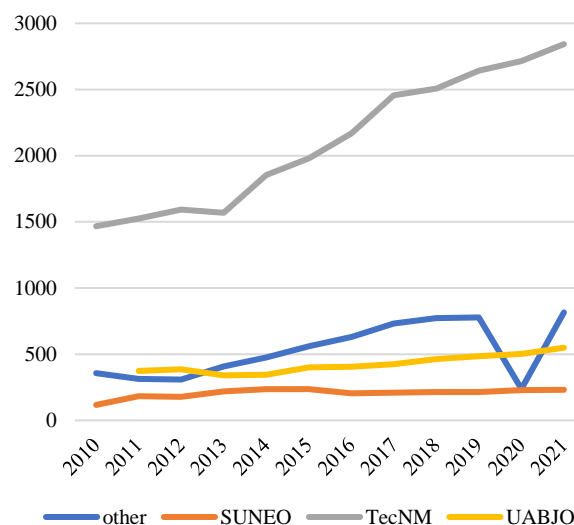
Men and Women in Engineering and Technology by Year



Graph 5 Men and women in engineering and technology by Year, from 2010 to 2021

When comparing how the enrollment of women enrolled in engineering, manufacturing and construction has grown by educational system: TecNM, SUNEEO, UABJO and other universities, it is observed that it is at TecNM where the majority of female engineers in the state of Oaxaca are trained (see graph 6).

Women enrolled in Engineering, Manufacturing and Construction by Educational System in Oaxaca, from 2010 to 2021

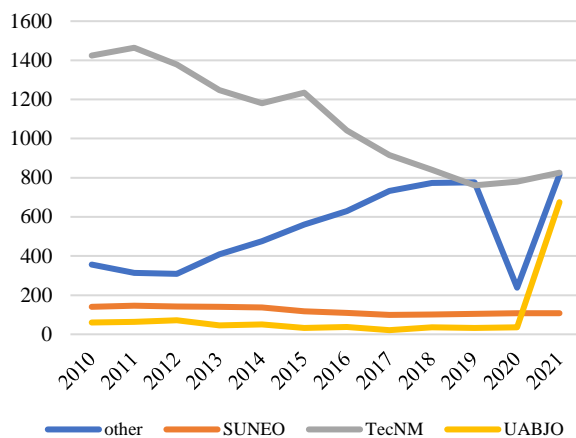


Graph 6 Women enrolled in Engineering, Manufacturing and Construction by Educational System in Oaxaca, from 2010 to 2021

Regarding the careers in the area of Information and Communication Technologies from 2010 to 2018, the TecNM trained the majority of these students, in 2019 it was on a par with others (which were grouped public and private with less than 2,000 students) institutions, in 2020 enrollment in these other institutions dropped significantly, possibly due to the pandemic.

From 2019 to 2021 the TecNM was maintained despite the pandemic, during 2021 a rebound was observed in the UABJO (see graph 7).

Women enrolled in Information and Communication Technology careers by educational system in Oaxaca from 2010 to 2021



Graph 7 Women enrolled in Information and Communication Technology careers by educational system in Oaxaca from 2010 to 2021

Financing

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Conclusions

It was found that the ratio of men to women in STEM areas is not proportional, despite the fact that the federal government has widely emphasized the need to incorporate more women into these areas, which demand more professionals every day.

The TecNM has been the one that has had the greatest impact on the training of female engineers (which according to the AUIES classification is Engineering, Manufacturing and Construction), in the state of Oaxaca.

Regarding the Technology area, initially the TecNM was where more women were trained, but gradually its enrollment has decreased considerably and by 2021 it has approximately the same enrollment as the public and private institutions that were classified as others in the study.

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