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IMPACT OF GENDER ON PREVIOUS EXPERIENCES OF SCIENTIFIC DISSEMINATION IN BOOKS AND MAGAZINES, FILMS, MUSEUMS, AND SCIENCE CENTERS ON THE CHOICE OF ENGINEERING CAREERS

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Abstract: Scientific outreach serves as a starting point for many young people, as it is part of the search to find their scientific vocation, where they have their first contact and captures the attention and interest of children and young students who in the future will have to make a decision about their professional training for the rest of their lives. For many, this first contact with real influence does not always occur directly in schools; it often happens beforehand through books, magazines, films, or museums where they can interact with or appreciate the scope of different areas in real life. The objective of the following study is to compare three perceptions obtained from university students enrolled in engineering programs at the Mexicali and Tijuana campuses of the Autonomous University of Baja California (UABC), Mexico. The analysis uses descriptive statistical techniques, and the variables compared are the students' perceptions of the importance of popular science books and magazines, science fiction or fantasy books or films, and museums or science centers during their previous school experience in choosing their engineering career. The method used for this study is descriptive and comparative, with the participation of 701 engineering students, 659 from the Mexicali campus, 42 from Tijuana, and 37 from the Institute of Agricultural Sciences. The study was conducted in two stages, the first in 2016 and the second in 2023. The results show the analysis of the comparison of the application of the perception of the three moments in which the survey was applied. In conclusion, the study assesses the knowledge of the factors that influence the vocation for science and activities that favor the development of scientific fields, mainly in girls and young women in basic, upper secondary, and higher education institutions in engineering.

Keywords: Higher education, vocation, science outreach, mathematics, engineering

Introduction

Science outreach is an important part of choosing and encouraging vocation, including access to information from the family environment to the mass media, which allows young people to learn about emblematic figures, who in turn develop their interest in the activities carried out by these figures and the discoveries that have been made around them (Stekolschik *et al.*, 2007). Therefore, scientific activities at pre-university educational levels are essential as they develop interest in different areas such as mathematics, science, and engineering, which encourages students to consider studying these subjects in the future. The familiarity they feel becomes the basis of their interest, which allows for a more pleasant integration into the scientific field, demonstrating its importance and practical application in everyday life (Adanur-Sönmez and Koçak, 2025). These activities become an extensive effort to improve education that supports the prior preparation of scientists, mathematicians, and engineers who are interested in these subjects from an early age. The goal is to find the maximum potential within institutions, while also providing them with better job opportunities in the future.

On the other hand, the impact of academic experiences during youth will somehow guide the focus on students' interests, but not all of these approaches occur directly in the school environment.

Extracurricular activities also contribute to the development of interests and curiosity in the activities they will pursue in the future, thus promoting scientific orientation in both men and women. These interests tend to differ between the two genders, with men tending to gravitate more towards engineering and technology, while women tend to be more interested in sciences such as biology and medicine (Godwin, *et al.*, 2017). Without a doubt, allowing children to experiment with their curiosity and interests promotes the growth of future scientists.

Currently, efforts are being made to close the gap between men and women participating in scientific fields, as, in line with the United Nations 2030 Agenda for Sustainable Development (2023), countries around the world must take measures to improve education and gender equality in this and other areas. However, the difference is still marked, with women being much less represented in these areas. One of the biggest obstacles currently facing the international community is the lack of opportunities given to certain social groups, reducing their access to and conditions for learning and limiting the opportunities for less privileged groups to develop their full potential, particularly in scientific and technological learning (Santos Ramos & Miguel Aguilar, 2021).

Latin America, for its part, presents the program *Building the Future of Latin America: Women in STEM*, which was created with the purpose of promoting and improving strategies, as well as mechanisms for attraction, access, and guidance that allow women to have access to a scientific education. The purpose is to ensure the quality, inclusiveness, and equity of education in around 10 countries within both European and Latin American universities, allowing for growth in less developed countries (Camacho *et al.*, 2021). In Mexico, although scientific dissemination is not widely recognized, institutional programs have been implemented that have helped to promote science in a more targeted manner. Monterrosas Martínez (2020) comments in his study that 97% of the science students surveyed were influenced by prior contact before choosing their career, mainly in books and magazines. Currently, technologies allow them to access this information more easily, both in terms of dissemination and support for their studies, mainly *YouTube.* However, Mexican universities are working to promote enrollment in scientific fields such as engineering within the framework of the United Nations 2030 Agenda for Sustainable Development (2023). To this end, they promote and carry out activities such as workshops, fairs, and exhibitions, among others, with the aim of increasing interest and, with it, the chances of entering university in these areas, influencing their scientific vocation.

Participation in scientific areas in pre-university school grades allows students to develop a vocation for scientific careers. Women's participation in these fields was not promoted until relatively recently, which has resulted in the integration of many women into academic and scientific fields. However, the lack of female role models continues to limit the vision of many in these fields. The integration of science and mathematics into the family, as well as participation in workshops or activities of this type, has served as a guide for many young women (Kager, 2015). Within different cultural activities, women show a greater liking or interest in museums and recrea-

tional activities with a scientific focus, while men tend to show more interest in activities related to video games (Vázquez-Alonso and Manassero-Mas, 2015). Furthermore, virtual simulation in scientific areas greatly supports increased learning among young people, and the use of these new technologies implies a series of significant changes for the younger generations. However, traditional teaching methods cannot be ignored. Rather, the combined use of these methods allows for a better understanding, interest, and motivation for the study of these types of subjects (Thisgaard & Makransky, 2017). Scientific activities are key to generating interest in these subjects, but social and cultural factors continue to divide along lines of gender and interests. Even so, young people who participate in and have access to scientific knowledge from an early age are more influenced by it, and their vocation often becomes scientific (Mansour, 2025). Based on previous research, the objective of this study is to compare the perceptions of students from different engineering programs on scientific dissemination and its influence on their vocation through three surveys obtained from university students belonging to engineering programs at the Mexicali and Tijuana campuses of the Autonomous University of Baja California (UABC), Mexico.

Method

This study used a non-experimental, descriptive, and comparative analysis of engineering students at the Mexicali and Tijuana campuses, with a total of 701 participants in 2016. In addition, 37 students were surveyed at the Institute of Agricultural Sciences in 2023. The comparison was made at two points in time in 2016 and 2023. and analyzed using descriptive statistical techniques with absolute and relative values. The variables compared were the importance of popular science books and magazines, the importance of science fiction or fantasy books or films, and the importance of museums or science centers during previous school experience in choosing a career in engineering.

The analysis is descriptive and comparative, applying descriptive statistical techniques to the variables and perceptions of engineering students at the Mexicali and Tijuana campuses in the areas of engineering in 2016 and at the Institute of Agricultural Sciences in 2023. The Mexicali Campus had a total of 23,071 students at the time of the questionnaire, with a total of 4,380 in the Faculty of Engineering alone. On the other hand, the Tijuana Campus had a population of 21,946 students, considering only the Faculty of Chemical Sciences and Engineering with 2,683 in 2016. In addition to this, another survey was conducted in 2023 within the Institute of Agricultural Sciences, which had a total of 763 students out of the total population of 24,576 students at the Mexicali Campus. The comparison was made at three points in time in 2016 and 2023 and analyzed using descriptive statistical techniques with absolute and relative values. The variables compared are teacher feedback, the importance for teachers of learning, and the importance of what was learned in the course, according to the students' perception during their university life so far in the different engineering-focused degree programs at UABC.

The data was collected through three different questionnaires designed by experts in the fields of engineering and adminis-

tered to engineering students in Mexicali and Tijuana. The questionnaire was created in Google Forms and, to administer it, an open invitation was sent to the students' institutional email addresses, resulting in the participation of 738 students. As shown in Table 1, the groups are distributed as follows: 659 students in the Faculty of Engineering in Mexicali, with 498 men and 161 women; 42 students in the Faculty of Chemical Sciences and Engineering in Tijuana, of whom 25 were men and 17 were women; and 37 students at the Institute of Agricultural Sciences in Mexicali, with 27 men and 10 women. The variables and items that contained similarities in the formulation of the questions addressed to the students were compared. In addition, the SPSS statistical package was used to generate the results tables with a descriptive analysis.

Data analysis and collection

The data was collected using three different questionnaires designed by experts in the field of engineering and administered to engineering students in Mexicali and Tijuana. Variables and items that were similar in the formulation of the questions asked of the students were compared. In addition, SPSS software was used to generate the results tables with a descriptive analysis.

Results

The results obtained in this research are presented below, where they are analyzed through tables corresponding to the variables of student perception of the importance of (1) popular science books and magazines, (2) science fiction or fantasy books or films, and (3) science museums or centers during their previous school experience for choosing their engineering career at the Mexicali and Tijuana campuses of the UABC.

Participating students		n	%
Perception UABC 2016 Mexicali Campus	Female	161	22
	Male	498	67
	Total	659	89
Perception UABC 2016 Tijuana Campus	Female	17	02
	Male	25	03
	Total	42	06
Perception UABC 2023 Agricultural Sciences Mexicali	Female	10	01
	Male	27	73
	Total	37	5
Total		738	100%

Table 1. Total number of participating students by gender.

Source: Own elaboration, 2025.

The first variable analyzed in Table 2 is students' perception of the importance of popular science books and magazines in their choice of degree program at the Autonomous University of Baja California (UABC). The results for the Mexicali Campus show a greater emphasis on "very important" followed by "important," predominantly among men. The Tijuana Campus shows the perception of "very important" followed by "important" among men, while women show a tie for "neutral," "important," and "very important." At the Institute of Agricultural Sciences, the result is "very important" for both men and women, followed by "neutral."

As shown in Table 3, science fiction and fantasy books and films are important to engineering students when choosing their career. Therefore, at the Mexicali Campus, women report this statement as neutral, while men consider it important. At the Tijuana Campus, there is equal data for important and very important for both men and women. Meanwhile, the ICA is neutral for men, while women lean toward not important, with the use of science fiction or fantasy books and movies being less important or relevant in their career choice, unlike the previous results.

On the other hand, Table 4 shows students' perceptions of the importance of museums or science centers in their choice of an engineering career, with the results showing neutral importance at the Mexicali Campus, followed by important for women and unimportant for men. At the Tijuana Campus, important stands out, followed by very important for men and neutral for women. The results obtained by the ICA show that women perceive it as important and men as neutral, followed by important, in accordance with the statement by Vázquez-Alonso and Manassero-Mas (2015), who mention that women tend to feel more influenced by museums and activities of this nature.

Student perception of the importance of popular science books and magazines in choosing their career		Not important		Not very important		Neutral		Important		Very important	
		n	%	N	%	n	%	n	%	n	%
Perception UABC 2016 Mexicali Campus	Female	28	17.4	20	12.4	41	25.5	40	24.8	32	19.9
	Male	44	8.8	70	14.1	145	29.1	150	30.1	89	17.9
	Total	72	10.9	90	13.7	186	28.2	190	28.8	121	18.4
Perception UABC 2016 Tijuana Campus	Female	1	2.7	0	0.0	3	8.1	3	8.1	3	8.1
	Male	1	2.7	3	8.1	6	16.2	7	18.9	10	27.0
	Total	2	5.4%	3	8.1%	9	24.3	10	27.0	13	35.1
Perception UABC 2023 Agricultural Sciences Mexicali	Female	3	7.3	2	4.9%	4	9.8%	3	7.3	5	12.2
	Male	0	0.0	4	9.8%	7	17.1%	6	14.6	7	17.1
	Total	3	7.3	6	14.6%	11	26.8	9	22.0	12	29.3%
Total		77	8	99	12%	206	26	209	26	146	28

Table 2. Student perception of the importance of popular science books and magazines in choosing their career.
Source: Own elaboration, 2025.

Perception of the importance of science fiction or fantasy books or films in choosing a career		Not important		Not very important		Neutral		Important		Very important	
		n	%	n	%	n	%	n	%	n	%
Perception UABC 2016 Mexicali Campus	Female	37	23.0	21	13.0	49	30.4%	31	19.3	23	14.3
	Male	60	12.0	90	18.1	124	24.9	134	26.9	90	18.1
	Total	97	14.7	111	16.8	173	26.3	165	25.0	113	17.1
Perception UABC 2016 Tijuana Campus	Female	0	0.0	1	2.7	3	8.1	3	8.1	3	8.1
	Male	2	5.4	4	10.8	5	13.5%	8	21.6%	8	21.6%
	Total	2	5.4	5	13.5%	8	21.6	11	29.7	11	29.7
Perception UABC 2023 Agricultural Sciences Mexicali	Female	4	9.5	3	7.1	4	9.5	3	7.1	3	7.1
	Male	1	2.4	1	2.4	14	33.3	6	14.3	3	7.1
	Total	5	11.9%	4	9.5%	18	42.9%	9	21.4	6	14.3%
Total		104	11	120	13%	199	30	185	25	130	20

Table 3. Perception of the importance of science fiction or fantasy books or films in choosing a career.

Source: Own elaboration, 2025.

Student perception of the importance of museums or science centers in choosing their career		Not important		Not very important		Neutral		Important		Very important	
		n	%	n	%	n	%	N	%	n	%
Perception UABC 2016 Mexicali Campus	Female	29	18.0	24	14.9	41	25.5	39	24.2	28	17.4
	Male	83	16.7	103	20.7	156	31.3%	99	19.9%	57	11.4
	Total	112	17.0	127	19.3%	197	29.9	138	20.9	85	12.9
Perception UABC 2016 Tijuana Campus	Female	0	0	0	0	3	8.1	5	13.5	2	5.4
	Male	3	8.1%	5	13.5%	1	2.7%	11	29.7%	7	18.9
	Total	3	8.1%	5	13.5%	4	10.8%	16	43.2%	9	24.3
Perception UABC 2023 Agricultural Sciences Mexicali	Female	3	7.1	3	7.1	3	7.1	5	11.9%	3	7.1
	Male	2	4.8	5	11.9%	9	21.4	8	19.0	1	2.4%
	Total	5	11.9%	8	19.0%	12	28.6	13	31.0%	4	9.5%
Total		120	12	140	17%	213	23	167	32	98	16

Table 4. Student perception of the importance of museums or science centers in their choice of career.

Source: Own elaboration, 2025.

In general terms, it can be observed that men are more influenced by these methods of scientific dissemination, which, according to Kager (2015), may be related to the lack of female influences and representatives who can generate that influence and interest in girls and young women to achieve greater importance in decision-making regarding their professional careers.

The lack of female role models marks a significant difference between genders that continues to be the focus for improving opportunities offered to girls in the future, with an increasing number of women interested in these areas, alongside the development of favorable environments and opportunities for integration into classrooms and the workplace.

Conclusions

The conclusion is that the objective of analyzing the perception of engineering students at the Tijuana and Mexicali campuses in 2016 and 2023 on the importance of popular science books and magazines, science fiction or fantasy books or films, and science museums or centers during their previous school experience for their choice of professional career has been achieved.

It is recommended that periodic studies be implemented to provide knowledge about the factors that influence students' vocation and interest in science so that activities can be carried out that favor the development of these fields, mainly among girls and young women who are socially disadvantaged.

It is proposed that future studies analyze the current interests of young people, such as digital channels or websites that work to disseminate science, since the information obtained by children today is presented in different sources that were not as popular a few years ago.

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