



Diálogos sobre educación. Temas actuales en investigación educativa

ISSN: 2007-2171

Universidad de Guadalajara, Centro Universitario de Ciencias Sociales y Humanidades

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Formación internacional, retorno y ejercicio profesional de algunas mujeres
mexicanas en la ingeniería, física y matemáticas: motivaciones, desafíos y estrategias
Diálogos sobre educación. Temas actuales en investigación
educativa, vol. 13, no. 24, 00020, 2022, January-June
Universidad de Guadalajara, Centro Universitario de Ciencias Sociales y Humanidades

DOI: <https://doi.org/10.32870/dse.v0i24.1036>

Available in: <https://www.redalyc.org/articulo.oa?id=553474080020>

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Training abroad, return to Mexico and professional practice of Mexican women in the fields of engineering, physics and mathematics: motivations, challenges and strategies

DOI: <https://doi.org/10.32870/dse.v0i24.1036>

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Abstract

In this article we studied the academic training abroad of a group of Mexican women scientists, their return to the country, and their incorporation to and professional practice in public universities. We analyzed their motivations to take up their scientific careers, the main challenges they faced in the field of science, as well as the strategies they deployed as mechanisms of permanence and progress in those research spaces. We conducted semi-structured interviews with female scientists in the areas of engineering and physics-mathematics from three different generations, all of them members of Mexico's National Research Network. Among their strategies for advancement we identified the ability to generate opportunities for access to resources and networks for their academic and professional development.

Keywords: scientists – international training – return – professional practice.

Introduction

The last decades in Mexico have seen an increase in the incorporation of women to universities (Quintana, Blazquez, 2017). It has also been noticeable that in certain areas, despite a massive incorporation to Bachelor's degree programs (Victorino, Atriano, Rueda, 2014; Razo, 2008), women are scarcely represented when compared to men, particularly in the sciences and in engineering (García, 2005; De Garay, Del Valle, 2012; Arredondo, Vázquez, Velázquez, 2019; Izquierdo, Atristan, 2019). And once they complete their studies in science, the number of women who find positions to practice their professions is also lower (Zubieta, Marrero, 2005; Bustos, 2012; 2002).

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Authors such as García (2005), Bustos (2008), Buquet *et. al.* (2013), Izquierdo (2009), Blázquez and Fernández (2017) have identified a number of obstacles that tense and may hinder the progress of women's training and work trajectories. Sometimes their training and professional career overlaps with their biological cycles and life projects, some of which may be having a family, motherhood, child upbringing, or taking care of others (Quintana, Blázquez, 2017). Our research focused on women with a sustained academic and work career whose academic education, specifically as a Ph.D., took place in academic spaces abroad, and who then returned to Mexico to work in their areas of study. We wanted to know how these female scientists were able to get a scientific education and find employment, what or who motivated and encouraged them, what barriers they had to overcome, and which strategies of advancement they implemented for their academic and work-related development.

This study inquired into the process of entry of women into careers in the exact sciences and engineering, their international mobility to pursue graduate degrees, their return to Mexico, and their insertion in the professional sphere. We focused especially on the latter because it is there that we identified that the number of women was reduced, segregating them to spaces where their contributions and knowledge might be made invisible (Dides, Benavente, Morán, 2008; Arredondo, Vázquez, Velázquez, 2019).

Women who achieve a high academic and professional qualification with the completion of their doctorate abroad and their incorporation to the field of work, even when they become an exception to the rule as highly qualified human resources according to studies such as those we have cited, have not done so without overcoming a number of barriers that in practice make up the so-called *glass ceiling* and *sticky floor* (Bustos, 2002; Cervera, Upegui, 2018; Camarena, Saavedra 2018), which refer to practices that hinder and obstruct the advancement of women to better positions in working spaces. However, some women show distinctive features in their academic careers that allow them to advance with a motivation and effort that manage to be sustained over time under the outline of a defined horizon, managing effectively the tensions they are faced with by deploying strategies of advancement such as mechanisms of permanence and development to achieve their goals, as was the case of the female scientists who participated in this study.

Our research followed two axes of analysis: the access of women to higher levels of academic education and their professional work in the areas of knowledge of engineering and physics-mathematics. Our research focused on identifying and analyzing the motivations and advancement strategies of Mexican women who broke the cultural gender roles from the moment they had access to higher education in this country, going against the social imaginary that places women in the stereotype of wife/mother as social roles, and who decided to study a major in science (physics-mathematics) or engineering, traditionally dominated by men, completing their graduate studies abroad in prestigious universities with international recognition,

and then returning to the country and working as researchers in a Higher Education Institution (HEI) or a public research institution.

In regard to conceptual elements and following Naranjo (2004; 2009) we understand by motivation the deployment (activation) directed towards an objective or goal (direction). Three relevant aspects of motivation were considered in our study: the first one had to do with the expectations, that is, the ideas that the female scientists had and still have about themselves to execute an action, the value with regard to the importance of their goals, and “the affective component, which includes the affective-emotional consequences derived from performing a task, as well as the results of academic success or failure” (Naranjo, 2009: 163).

The other element linked to the academic and professional development of the women in our study refers to the strategies, understood as “an ensemble of actions coordinated to achieve victory at the interactional level, which is dynamic” (Kasterszein, 1999, p. 30). In the case of our study, the female scientists interviewed had daily interactions in the academic field in universities abroad, as well as in Higher Education Institutions in Mexico, in spaces pertaining to disciplines of knowledge in which men are a majority and have therefore constructed their own rules of social interaction closely adapted to their gender, since they are associated to physical characteristics and social skills culturally assigned to men such as physical strength, objectivity, mathematical rigor, leadership capability, among others, which are set up against the imaginary of women, constructed according to cultural standards dictated by a patriarchal system that dictates that women *do not possess*, in the same measure as men, those characteristics and skills (Buquet *et. al.*, 2013; Blazquez, 2011).

By restricting themselves to these rules, negotiating or transgressing them, women put their capacities into play, and did so through certain actions or strategies with a view to a horizon: completing their doctoral academic formation in a university abroad, and then joining an institution in Mexico as researchers. In these journeys they had to consider less distant ideas, such as joining study, work-study, or social groups, adapting to a different culture or language, interacting only with groups of men, maintaining sometimes a discrete, almost imperceptible presence in academic spaces, making alliances with men to join research groups or to be endorsed by prestigious researchers who projected them to universities abroad using their contacts and research links, or transgressing the rules, developing their own styles of work, some of them belligerent, direct or unorthodox, which finally made them “different” not because they were women but because they possessed qualities that characterized them as female scientists.

Methodology

Our research relied on a qualitative approach that allowed us to observe the experiences of female scientists through life stories (Pujadas, 1992) in semi-structured interviews (Valles, 2002) with five female researchers who responded to our e-mail invitation to participate in the study.

The selection was made based on the review of the register and announcements of Mexico's National Council of Science and Technology (CONACyT).

Table 1. Participants in the study

Code	Major studied	University where she conducted her doctorate studies	Age	Marital Status
IE1	Chemical Engineering	Université de Paris XI, France	50	Single
IE2	Chemical Engineering	University of British Columbia, Canada	48	Married
IE3	Engineering in Communications and Electronics	University of Duisburg, Germany	69	Single
IE4	Physics	Bristol University, Great Britain	52	Married
IE5	Physics	University of Tennessee, U.S.A.	44	Single

Source: own, based on field work.

The female scientists interviewed are Full-Time Research Professors (FTRP) in research centers and institutes belonging to public Higher Education Institutions (HEI), and belong to Mexico's National Research Network (SNI) at Levels I and II. One of them is an Emeritus National Researcher. They come from different social strata and places of origin, two from Mexican states (Zacatecas and Puebla) and three from Mexico City. Their ages range from 44 to 69 and belong to three different generations, which allowed us to observe three processes linked to each other: career choice, access and incorporation to doctoral studies in a university abroad, and return to Mexico and incorporation to work in Higher Education Institutions or national public institutes in different moments in history, which accounted for variations in opportunities and gender biases that have been reshaped in our country in the decades studied.

The article consists of four parts. First, we approach the female scientists' career choice process, identifying their motivations and the challenges they faced. Then we present their international mobility experiences centered in their graduate studies. We take a look at their strategies of advancement in their process of insertion and permanence in their jobs when they returned to Mexico, and finally we share the conclusions of our study.

The career choice process: motivations and challenges

We identified that the motivations of the participants in our study to choose a scientific career were the product of their desires based on the image of direct positive referents in their childhood and adolescence, which made them "desire" to be like certain characters that appeared before and during their university education, in some cases, particularly reinforced by female

scientists that broke gender stereotypes in science and who have been examples to follow (García, 2016; Mendoza, 2016), as we can see in this account:

I remember that once the university hosted an Analytic Chemistry Congress. Thanks to my grades I won a scholarship to attend it, I went and Heard a lecture by a female doctor of the UNAM Chemistry School. She impressed me so! Her clarity, her self-confidence, her intelligence created a deep impression in me and I told myself "I want to be like her someday" (IE1).

There was also a component that activated their motivation and "curiosity", reinforced by the presence of a referent in science within the family. The valorization of figures who operated as positive referents oriented, according to Naranjo (2009), future actions in the young girls' academic life; that is, it provided them with direction to perform the action, studying a major in science:

My father worked as a researcher in a laboratory. We went to see him at work even on weekends. We waited for him in the gardens, and from the garden my mother or we saw him in the laboratory in his lab coat while he was working, and I was always curious. What does he do? What is he doing there? (IE2).

Another element we observed in all our interviewees' narratives, which is not always visible in studies about the training of women in science, was the self-confidence reflected in their career choice, although some of the participants in our study changed their line of work during their training according to the opportunities they found and the new interests that arose as a result of their further studies, as well as their interactions with researchers more experienced in the field. But there was no doubt about their career choice or about the area de knowledge in which they wanted to specialize. Some even had to deal with difficulties at home such as the lack of economic support to pursue a career that did not correspond to their families' expectations. In spite of all that, we identified in all the participants a certainty in their choices and the "ability to decide" by themselves (Naranjo, 2009), according to their own desires and future projections, without heeding social mandates that construct women under the permanent tutelage of others, questioning precisely their ability to decide and to act. We observed that in all our interviewees, as a central component of their trajectories and definitive for the achievement of their academic goals:

I was always inclined toward the sciences. For some reason I was always good at mathematics and physics. When the teacher asked questions and nobody wanted to answer or participate, the teacher would say: "X, come to the blackboard!" I walked to the blackboard and answered the questions, I felt capable of doing it. It was a challenge but I thought "I can do it" (IE4).

For me it was very easy. I was never in doubt: I was going to study Chemical Engineering. Without a doubt, I would be admitted to the Chemical Engineering School and that was it, I enrolled and I finished my studies. (IE1).

I wasn't interested in studying languages or psychology back then. I somehow stayed on the other side, the side of exact, harder, more logical science. In order to advance faster I enrolled in the *Poli* (Mexico's National Polytechnic Institute) and after two years at the *Poli* I decided to study electric engineering, and that's how I enrolled in the School for Higher Studies in Mechanic and Electric Engineering (IE3).

I don't think that my choice was that difficult. Perhaps it's like, your parents expect something from you, right? And my parents, for example, always wanted me to study Medicine, but fortunately my mother was always an admirable woman, she raised us in an environment in which whatever you wanted to do was fine. Then, in that sense, it was mostly not difficulty, but the fear of somehow disappointing my parents (IE5).

These stories show the ways in which the participants in our study had constructed an imaginary of their career as a scientist, as well as a projection of their professional future drawn together with a series of skills that the participants themselves described as possessing logical-mathematical reasoning, for instance, added to their socialization with positive figures and referents in science, which consolidated their projection of a future in a scientific discipline. We also recognized elements that showed their confidence in themselves and in their actions, despite adverse scenarios. In this respect we agree with Guevara and Flores (2018): those experiences and learnings of young women who were successful in science must be considered when developing public policies that have an impact on Mexico's educational system, both in the level of basic and middle-high education, to motivate and inspire female scientific vocations in little and young girls, especially in the exact sciences and engineering or other disciplines whose social imaginary generally assigns them to men.

Graduate studies: experiences of international mobility

The international mobility of higher education has been scarcely studied starting in the 1970s and has now become relevant due to the global reality we are faced with, which submerges us in a much more competitive academic market (Izquierdo, Cárdenas, 2019). However, even back then the two challenges for students who decided to study abroad were identified: the difficulty of learning the language of their target countries and the more accelerated pace of study due to a more competitive system in those countries (Lomnitz, Moran, 1976):

The level that French students had in a doctorate is far superior to the formation we had, and it was also very heavy [...]. I arrived at a very rich laboratory, one of the best in France for nuclear techniques and radio chemistry. The most difficult part was the first year (IE1).

In all the cases in our study, studying towards a doctorate in a foreign university and country was narrated retrospectively as a pleasant process, beyond the heavy academic demand and the challenges of studying in a language other than their own:

The people in the laboratory were the nicest people you can imagine, curious to know “Who are you? Why are you here? What are you doing here?” Obviously they are very educated, and for the same reason their cultural outlook is broader, not closed like they’re just American, so integration happens gradually and at some point it felt like a second home. It was a very pleasant experience for me (IE5).

It was a small group in that city of Duisburg, basically an industrial city where steel is produced and where there are many foreign migrants. German people at that time made us register in a different place. The person with whom I arrived seemed to be surprised that I wanted to study engineering and liked me very much, and really helped me with *everything* to find the best house, the professor helped me *a lot* and the work team was *very small*, we were like 15 people there at the laboratory with the professor, it was a very close group because the university had just been founded [...]. Germany was still being reformed at that time, it was the 1970s, there were many things that were the product of the war, the country was still divided, Germans tried to show their best side, even at the university, to foreigners (IE3).

All our interviewees reported having found support in their working teams, mainly in their thesis counsellors, and in groups of compatriots or other migrants who helped them make their daily life less stressing: finding a house to rent, using public transportation and dealing with the paperwork in the universities themselves, as well as joining groups and networks to socialize outside the universities. They all still have friendships and links with those people, and given the positive experience they had and how well they were treated they were open and wanted to help new generations of young female researchers so they can also have experiences of international mobility.

The administrative process required to meet the requirements to have access to a CONACyT scholarship to do their doctorate studies abroad seemed easy enough, heterogeneous for women and men, without any special complexity beyond that of meeting the deadlines established and producing the documents that supported their application for a financial scholarship. However, in some cases we did identify elements that suggested the existence of certain gender barriers, which have not always been noticed in previous research about graduate studies enrollment and dropout (Hernández, Pérez, González, 2014) and that some women faced in their scientific careers when they applied for scholarships to study a doctorate. This was identified in the selection processes, specifically in the interviews in which institutional committees evaluate and finally determine if an applicant for an international scholarship will be accepted or not:

When I took my evaluation for the doctorate, I met with a committee of five men. They did not ask me any scientific question, only personal ones. The main question, which they insisted on, was about children, if I wanted to have them, which I answered without a doubt from my conviction, and I assured them I did not, that it was not something I was interested in and that I did not intend to have children. I think that was what got me through [...] But I think that the women who hesitated or said that they did want to have children, right there, they were crossed out (IE2).

This account shows the gender mandates that women *must fulfill* in the masculine, patriarchal and androcentric imaginaries, which see women only as caretakers, and sheds light on an idea that is recurrent and hidden in public policies about academic merits and that which constitutes the “social profile” of a female professional, which is linked to the configuration of unwritten rules or conditions that women must meet to be in the same conditions as men in the field of the exact sciences and engineering. In this case, this profile demands that women have no commitment other than that of scientific work, such as the one implied by child procreation and upbringing. That is, for the single woman, without children, constructed by the social imaginary, the idea that in order to work in science, any personal or family project must be abandoned, becomes only for women a choice between their personal and their professional desires, which from the start dismembers and splits them. All of this may operate as discouragement for younger women to enter into and have careers in exact sciences, exposing the inequality and imbalance in the organs of evaluation of scientific work, where gender may bias the result of a selection and, under certain social constructions in which women are pigeonholed, may delay or cut short any possibilities of academic development abroad.

After completing their doctorate studies, some of the participants in the study had postdoctoral stays and all of them, at some moment, decided to return to Mexico. In most cases this decision had to do with their commitment and responsibility to their country and the institution that provided them with financial support to study abroad, but there was also a constant and strong presence: “the family”. In four of the cases (two of them had joined the labor force in the target countries as postdoctoral researchers), and in spite of the difficulties and challenges they were familiar with about the social and economic reality of our country, they decided to “come back home”:

In the last year I began to work. I had a good job and everything was going wonderfully, and I said: “I have to go back, I have a commitment at the Institute and with CONACyT” and all that *stuff*, my family. My husband told me “Yes, let’s go, this is not our country, we know that we came here for that, for your doctorate, we have a plan”. It was a decision I made mainly because of my family (IE2).

For us [her partner and her] the commitment with CONACyT was very important. It was not only that we felt that moral responsibility: we also went with a scholarship credit, we signed a document where we

committed ourselves to return or pay back the money that had been invested in our education. So it was very clear to us that we had to return to the country (IE4).

They [the people in the country where she studied] are colder, it is harder for me to approach them, and that was when I decided to return, to “come back home”. Not so much because of the scientific situation, but rather because I missed feeling more integrated (IE5).

Their return was seen retrospectively by the participants in the study as part of a process, a cycle that culminated successfully with the achievement of the academic goal, by attaining the doctoral degree, but especially by having experienced “being” in another country, which provided them with a new view of academia, science, and themselves. After their experience, their decision to return was expressed as necessary. They said that they benefited from an international scholarship with the support of their country, considered themselves fortunate, and with a firm commitment to return to their country and the conviction of making a contribution with their scientific work.

Insertion and permanence in employment after their return to Mexico: strategies for advancement

The experiences that these female scientists had in finding employment after returning to Mexico were diverse. We observed that in two of the cases, considering the time in history when they joined the labor force, there was some openness of institutions to offer them opportunities to work and develop. In the 1980s the older researcher narrated the experience of a time when there were opportunities for those who returned to Mexico with a higher quality education, even for those who had finished it with a Bachelor’s degree. The reality of universities in Latin America and Mexico demanded the expansion of academic institutions and opening of new research centers, in spite of the serious economic crises of the decade (Victorino, Atriano y Rueda, 2014; Izquierdo, 2009). At that point in history there was little competition in the field of science, since there were very few researchers in Mexico, and the country needed new scientific developments and highly qualified people who wanted to do research:

It was *very easy* for me at that time, and the country was eager, there were positions, they wanted you to stay or come back here, not like now that you have to wait for five years and do a postdoctoral degree and then I don’t know... No, right away, “Do you want to come here?” and I said “Well, yes” “Do you want to teach here in the school?” “Yes, of course!” “Do you want to be a member of the Engineering Academy?” “Yes!” It was open then because we were very *few* and there was support from the government to make the number of female researchers really grow in Mexico, *now* it seems they are not interested in making it grow (IE3).

Later, in the 1990s, another one of our interviewees who returned to Mexico through the Program of Repatriation promoted by CONACyT also explained that she found a favorable economic reality for those who completed their doctoral studies and came back to the country. She immediately received offers of employment, and was able to choose between three options, according to her economic and personal needs:

For me it was, let's say a good time for CONACyT and for Mexico. At the same time I was offered a job at the Institute I was offered jobs at the university where I had studied [...]. I could choose even to work in Chihuahua, there were possibilities that don't exist now (IE1).

However, the female scientist who returned to Mexico ten years later, in 2000, said she needed to resort to her links in the field to find a position in a university. Despite that, the time between searching for an opportunity and finding a job was less than three months, but unlike the female researchers who returned to Mexico in the 1980s and 1990s it was not so easy. After that and until now, as told by four of our interviewees, the hiring policies of Higher Education Institutions (HEI) and public institutes in Mexico have become much more restrictive, which coincides with several studies (García, 2005; Canales, 2011; Archundia, 2020) about policies and funding in science and technology.

This, according to the narratives in this study, translates into more requirements and a longer time waiting, as well as a professional over-qualification that nevertheless does not guarantee that applicants for a full-time research position will finally find it, justifying the pertinence of their stay in Mexico and the position they are occupying or about to occupy, exposing conditions of precarious employment and few opportunities to find a permanent position (Reis, Cecílio, 2014; Basail, 2020).

Our study also revealed a lack of public follow-up policies by CONACyT and a sustained support of policies to reincorporate or, at least, identify the work and contributions of those who have received scholarships to study abroad and, due to their (lengthy) stays in universities in other countries, have lost their links with scientific work groups in Mexico. Thus, when they return, highly qualified human resources find obstacles and disadvantages in finding employment, which may lead to a loss (*brain drain*) when they emigrate definitely to other countries where their work might have more recognition than in their country of origin:

It is abroad where I find more recognition and where doors are opened more easily for collaborative work, for any kind of negotiation or technical discussion, it is *as smooth as butter* (IE2).

When I entered UNAM, a *postdoc* was enough. Now there are people who come here with two, three *postdocs*, different laboratories, different parts of the world, and there is really a lot of competition to find a full-time position (IE4).

All of this generates tensions in those who return as highly qualified human resources and find enormous challenges on their arrival to Mexico both to find employment and for promotions and permanence, since the work climate, as one of our interviewees says, has become ever more hostile due to fierce competition and a constant struggle for an opportunity of employment:

At some time I did reach a limit, interactions here were not that smooth, because the director at that time wanted me to work under another experimental researcher here. Following the advice of the people I knew, well, they told me don't, then there was a *little* confrontation, rumors, gossip, then yes, it got difficult [...]. My stay here has been a bit marked by the process of insertion I had here (IE5).

My projects were not approved for almost ten years, they didn't approve any project. I wanted to quit, but the circumstances kept me here (IE2).

According to our research findings, the challenges female scientists encountered when they returned to Mexico had to do with the lack of infrastructure and materials to work in the laboratories to which they were incorporated, in universities or in national research institutes, added to strong resistance within the institutions due to seniority policies created by labor unions or separate working teams created and grouped together in institutions (Ramos, Sieglin, Zúñiga, 2013), which forced them to struggle to obtain a position. Once they achieved it, they became the target of criticism by those who already belonged to research groups against those who had been trained abroad:

The opposition of coworkers who were already at the school was terrible. "Why did they hire her? I've been teaching here for three years, for five years, and she didn't have to take an admission exam. Why do they give her the classes? Why do they give her full-time?" [...] I can tell you that there was some difficulty and disadvantage for us who had been abroad, because unlike the ones who were already here, who had the support of *this* doctor or *that* teacher, we didn't, we only had our document, our Ph.D. (IE1).

We identified other work-related challenges having to do not only with the contexts and the problems mentioned above but with their gender, which contradicts the idea that the academic world is by its own nature a gender-neutral space and therefore ruled by conditions of equality among academic peers, and also that meritocracy is a sure road to success and professional recognition comes with it, regardless of whether one is a man or a woman:

I do believe that some environments are much more aggressive towards women [...] I don't know if it is my character or the fact that they do feel that it is not as easy for us, or at least for me, to arrive to an environment of backscratching, of corruption, I don't know, that has been hard for me here. (IE3)

The results of our study disprove the idea that being highly qualified academically, especially if this was abroad, will translate into employment advantages, in this case immediate employment in a HEI or a public institute in Mexico. Added to this, we conclude that women who have such high qualifications are not in an advantageous position against their peers, whether male or female, who have been educated in Mexican universities. Highly qualified women seeking opportunities to work in HEIs in Mexico must overcome challenges and even face hostile working environments because, even though they have the required competencies to obtain research positions like their male peers, in some cases their appointments are questioned and criticized. Thus, even if they are accepted, in daily interactions it seems that they are never legitimized:

It is very frustrating, you need to have a tight grip on reality because it's very frustrating. We spoke of what you lose when you go abroad, it is precisely that, when you come back and see a female peer, you see that she did her doctorate studies much later, she made some progress and you are still struggling because you didn't have the road opened by having done your doctorate here, staying here (IE1).

She also realized that one of the problems that makes finding a position difficult and that represents further challenges for the female scientists who returned to the country is the lack of resources in the HEIs and the loss of academic and work links. Although their return to Mexico was helped by the subprogram of Repatriation as a public policy (Izquierdo, 2009), they had to start from the ground up in the working spaces where they were incorporated, since they did not belong to any research team and when they arrived they had to look by themselves for an institution to work in. They mobilized the links they did have in Mexico, so that although their high academic qualifications opened new opportunities for work they did not always guarantee the best conditions for it or the consolidation of their research projects. On the other hand, this study identified that the stringent work demands in the academic system made these women, just like the men, more competitive. However, competition seemed to become disloyal between them, turning into a ferocious struggle to occupy a position or moving up at work, where the masculine presence is overwhelming. What men see as strange or atypical, for women becomes a transgression to the orders of their own gender:

I worked with a female colleague. We had been working together for many years. We complemented each other, and suddenly I began to notice that she began to publish things without telling me. When I confronted her, I realized that she had begun to do and copy many of the things that I did. That also happened with another colleague at UNAM (IE4).

When a very important project finally got to CONACyT, it had to be resolved by an international committee, because here in Mexico there were complaints about "misogynistic practices" in its evaluation.

When it was finally accepted in that international committee, a female colleague told me “your only merit is not having children, that’s why it was approved.” (IE2)

I have had very bad experiences with colleagues, and curiously two of them have been with women. You consider them colleagues, friends... well, not friends, but close acquaintances, but their competitiveness is so much that they steal your ideas, they steal the work that you are doing [...]. Relationships between women are not as idyllic as you would think, “Oh yes, we are women and we will support each other.” (IE4)

In working spaces, according to our research findings, gender barriers seem to be in a re-configuration process due on the one hand to the high demand for work and the great competitiveness among highly qualified human resources regardless of their gender but with more marked repercussions in the case of women, and on the other hand to the fact that competitiveness and the scarcity of positions, added to an increasing awareness of women about their social and work-related disadvantages, forces them to struggle for power not against men but against other women who also aspire to occupy work spaces or better positions, as well as positions that involve the exercise of power, seeking to *get out of the way* other women with the same qualifications and, seemingly, the same opportunities for access. This explains why some women – and also men – in highly competitive fields such as science, far from supporting their own gender, see each other as potential adversaries.

We also identified narratives that show predominantly the presence of men in work spaces, especially in positions of power and higher hierarchy, as well as the advancement, “going further”, which can be seen when there is the possibility of an “alliance” with male peers:

In the professional field, let’s say that the fact of being a woman hasn’t played a definitive role, as I see it, but actually there must be something that does, because there are not many of us working in science. In the places where I have worked I’ve been the only woman and the rest just men. And it’s not like they *try to make you stumble* because you’re a woman, but I wonder why I’m the only woman. When you move up to decision-making spheres, then it’s different [...], it’s different there, it’s a men’s world entirely [...]. At the level of area directors, I’m the only woman. (IE1)

Prejudice in some is strong, I believe. Mexico unfortunately has not ceased to be a difficult place for a woman *alone* to do science. I think that, without a doubt, an alliance with a male researcher is very important so you, as a woman, can make progress. (IE5)

These experiences led female scientists to create and develop new skills that they themselves described as necessary to work in science and work environments, such as the ability to form “key” relationships, generating and cultivating positive links, the ability to speak in concrete

te terms (go to the point), negotiating, and being “charismatic” (capable of convincing others of your ideas/leadership). In their research work, we identified that all the female scientists who participated in this study work on frontier projects internationally which have an impact on their country’s development. Some of their projects are related to the automatic diagnosis of failures in dynamic systems and leaks in ducts that transport fluids such as water, oil and gas, to prevent environmental disasters and loss of life. They also develop radio-pharmaceutics for nuclear medicine, work on the management of radioactive waste using pioneering technics such as atomic analysis to ensure their final disposal and environment protection, produce and characterize thin layers of conductive molecules and design and synthesize thin film with potential applications to save energy, do research on anionic fuel cells for energy storage, as well as pioneering projects in experimental nuclear physics that might lead to important scientific and technological advancements in Mexico.

Conclusions

Our research findings show that the main challenges faced by women in their academic training and scientific work are, first, the high academic demands of the majors and graduate studies in engineering, physics, and mathematics, which require possessing certain strengths such as logic-mathematical reasoning, speaking other languages, as well as a great capacity for work and discipline to study, skills that are still not fostered well enough among students in México in basic and middle high levels of education, especially in girls. Another challenge we identified was the “cold and hostile” climate naturalized in the academic spaces pertaining to those disciplines, which leads us to inquire about the context in which the intellectual skills of the women who enter them are often put into question, reproducing discourse and practices that isolate them.

A third challenge was the lack of support from their family, due to the cultural constructions attached to the female gender, which create a gap between them and the careers they choose, whose social imaginary corresponds to the “masculine universe”, as well as the expectations that parents have about their children’s professional choices, which translates into cultural burdens for women that might influence their career choices.

In the field of work, the main challenge we identified in their return to Mexico was the lack of professional and even personal links due to the disruption that might have been caused by their mobility to study a graduate degree abroad. Once they joined work spaces, the most recurrent, though not the only, challenges were gender barriers, which are in a process of reconfiguration due in part to the high demand for work in Mexico’s Higher Education Institutions and in part to the great competitiveness among highly qualified human resources – regardless of their gender – which converges with the scarcity of positions and financial crisis, added to an increasing awareness of women about their social and work-related disadvantages. All of the above

generates tensions among female researchers and even disloyal practices to *get out of the way* potential competitors, which might result in a lack of support for their own gender.

With regard to their motivations, we identified that the main one was the image, seen retrospectively, of their positive academic referents (women and men) who were part of their childhood and adolescence experience. The future projection they built based on their academic referents was what first moved them to action in choosing a career in science. Their strategies of advancement were also diverse, but the one that emerged as fundamental was the ability to act in their favor in the professional field, which involved breaking some rules to generate their own opportunities for access and development. We also identified in all the participants the ability to make decisions by themselves without sticking to the social mandates of the female imaginary, which from this space we encourage so that this kind of experiences can be taken into account in the policies to strengthen vocations in sciences with a gender perspective.

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