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WOMEN IN COMPUTATIONAL SCIENCE AND ENGINEERING: AN INTERSECTIONAL ANALYSIS OF SCHOOL EVASION IN A BRAZILIAN UNIVERSITY

MULHERES NA CIÊNCIA DA COMPUTAÇÃO E ENGENHARIA: UMA ANÁLISE INTERSECCIONAL DA EVASÃO ESCOLAR EM UMA UNIVERSIDADE BRASILEIRA

MUJERES EN CIENCIAS E INGENIERÍA COMPUTACIONALES: UN ANÁLISIS INTERSECCIONAL DE LA EVASIÓN ESCOLAR EN UNA UNIVERSIDAD BRASILEÑA

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ABSTRACT

This article aims to identify the profile of women students who dropped out of higher education programs in the fields of computing and engineering at a Brazilian university. The programs analyzed include Computer Science, Environmental Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Computational Engineering, and Product Engineering. The study employed a comparative analysis of data processed by computational algorithms, covering female students enrolled between 2009 and 2018. An intersectional approach was applied, considering gender, age group, participation in affirmative action policies, and ethnicity. Although higher education institutions are expected to serve predominantly younger students, the results indicate that older women face additional barriers to admission and completion. Affirmative action policies were not sufficient to offset ethnic disparities across the programs. However, as the number of women participating in such policies increased, the dropout rate decreased. Despite these advances, computing and engineering remain predominantly male domains in the university studied.

Keywords: Evasion. Intersectionality. Women. Computation. Engineering.

RESUMO

Este artigo tem como objetivo identificar o perfil de mulheres que se evadiram de cursos de ensino superior nas áreas de computação e engenharia em uma universidade brasileira. Foram analisados os cursos de Ciência da Computação, Engenharia Ambiental, Engenharia Civil, Engenharia Elétrica, Engenharia Mecânica, Engenharia Computacional e Engenharia de Produto. O estudo foi conduzido por meio de uma análise comparativa de dados processados por algoritmos computacionais, considerando alunas matriculadas entre 2009 e 2018. Adotou-se uma abordagem interseccional, levando em conta gênero, faixa etária,

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participação em políticas afirmativas e etnia. Embora se espere que as instituições de ensino superior atendam majoritariamente ao público jovem, os resultados indicam que mulheres mais velhas enfrentam barreiras adicionais de ingresso e conclusão. As políticas afirmativas não se mostraram suficientes para compensar as desigualdades étnicas entre os cursos. No entanto, à medida que cresce o número de participantes dessas políticas, a taxa de evasão diminui. Apesar desses avanços, as áreas de computação e engenharia permanecem majoritariamente masculinas na universidade analisada.

Palavras-chave: Evasão. Interseccionalidade. Mulheres. Computação. Engenharia.

RESUMEN

Este artículo tiene como objetivo identificar el perfil de las mujeres que abandonaron sus estudios superiores en las áreas de informática e ingeniería en una universidad brasileña. Los cursos analizados fueron Informática, Ingeniería Ambiental, Ingeniería Civil, Ingeniería Eléctrica, Ingeniería Mecánica, Ingeniería Computacional e Ingeniería de Producto. El estudio se realizó mediante un análisis comparativo de datos procesados con algoritmos computacionales, considerando a las estudiantes matriculadas entre 2009 y 2018. Se adoptó un enfoque interseccional, teniendo en cuenta el género, el grupo de edad, la participación en políticas de acción afirmativa y la etnia. Si bien se espera que las instituciones de educación superior atiendan principalmente a un público joven, los resultados indican que las mujeres mayores enfrentan barreras adicionales para el ingreso y la graduación. Las políticas de acción afirmativa no han demostrado ser suficientes para compensar las desigualdades étnicas entre los cursos. Sin embargo, a medida que aumenta el número de participantes en estas políticas, disminuye la tasa de abandono. A pesar de estos avances, los campos de informática e ingeniería siguen siendo predominantemente masculinos en la universidad analizada.

Palabras clave: Evasión. Interseccionalidad. Mujeres. Informática. Ingeniería.

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1 INTRODUCTION

According to the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, 2019), even when women reach the highest levels of education, their participation in the labor market remains lower than that of men, both in employment rates and income levels. Data also reveal that women who occupy positions requiring higher education are predominantly white, while those from lower-income backgrounds—mostly Black women—are concentrated in production and service sectors, especially in domestic work. This suggests that gender inequality intersects with class and race, disproportionately affecting specific groups of women.

Although women have gained representation in the labor market and achieved progress regarding pay equity, visibility, and access to research funding, disparities persist in science, technology, and engineering (Charlesworth & Banaji, 2019).

With respect to racial inequality in Brazilian basic education, white students still make up the majority of higher education enrollments and graduates. Despite a recent increase in Black students' participation, the average years of schooling remain uneven: eight years for Black people and ten for white people (Campos, França & Feres Junior, 2018).

To promote democratization and access to higher education, the public education system has implemented several measures since the early 2000s, including the institutionalization of affirmative action policies that reserve a percentage of seats for underrepresented demographic groups. As a result, Black and brown students comprised the majority of public higher education enrollments (50.3%) in 2018 (Instituto Brasileiro de Geografia e Estatística, 2019). Nevertheless, dropout remains a persistent challenge, especially in science and engineering programs.

After analyzing factors influencing student attrition, Saccaro, França, and Jacinto (2019) observed that Science, Mathematics, Computing, and Engineering courses present high dropout rates despite their strategic importance for technological development. Similarly, Petinelli-Souza, Corcetti, and Sartori (2021) found that women are underrepresented among both professors and students in these fields.

For this reason, an intersectional perspective is crucial in studies on women in higher education, since "intersectionality is one of the tools to fight multiple, connected oppressions and, therefore, a political instrument of resistance" (Hirata, 2014, p.69).

Accordingly, this study aims to profile women students who dropped out of higher education programs in Computational Science and Engineering at the Federal University of

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Espírito Santo, using computational data analysis based on academic records from 2009 to 2018. The analysis examines dropout determinants through an intersectional lens, considering gender, age group, ethnicity, and participation in social or racial quota programs.

The article is organized as follows: Section 2 presents the theoretical background on higher education dropout and intersectionality; Section 3 explains the research methodology; Section 4 discusses the results; and Section 5 provides concluding remarks and recommendations for future research.

2 THEORETICAL FRAMEWORK

2.1 UNIVERSITY EVASION

The Brazilian Ministry of Education and Culture defines higher education evasion as the definite egress of a student from his originally intended degree without conclusion. However, it also differentiates between three types of evasion. These are degree evasion, where the student evades from his originally intended higher education degree for a variety of reasons, institution evasion, where the student leaves the higher education institution where he was originally enrolled, and system evasion, which occurs when the student evades, definitely or temporarily, from all types of higher education.

According to the Map for Higher Education in Brazil (BRASIL, 2020), between the years 2013 and 2018 the evasion rate was stable. In 2013, the total evasion rate accounted for 24.9% of all in person and remote higher education degrees. By 2018, this rate was slightly higher, reaching 26.5% due to an increase in evasion from remote learning higher education courses.

In Brazil, there are virtually no programs set in place to fight evasion. The few initiatives in course focus on encouraging the access and permanence of low family income students who were a part of the public school system, students who come from native communities and those from quilombolas communities (communities founded centuries ago by former slaves) (Barreto, 2015).

In the early 2000s, affirmative policies were set in place as an attempt to lessen the access and permanence issues faced by some students and to promote equality. In the Brazilian context, these measures are comprised by policies related to physical disabilities, the elderly population, race and gender, amongst others governmental affirmative action policies, such as the quotas law, created by the federal government in 2012. Mendonça and Aranha (2020) state that the racial quotas policy characterizes an affirmative action since it

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aims at creating equality between black and white people in regards to their access to public higher education institutions.

According to this law, all federal higher education institutions must destine at least 50% of their new student spots for students who completed all three years of high school education within the public educational system. 50% of these spots must be destined to students whose family income is equal to or less than one and a half of the nationally established monthly minimal wage per capita. Shares of the originally reserved spots are also guaranteed for indigenous and black people, as well as people with physical disabilities, according to the proportion of the population each of these groups composes in the state where the higher education institution is located. It is important to highlight, however, that the destination of spots to these groups does not ensure the students' permanence in the institution and, therefore, other policies are necessary to provide student assistance (Mendonça; Aranha, 2020).

In that which pertains to the gender composition of Brazil's higher education institutions, the Anisio Teixeira National Institute for Educational Studies and Research (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2019) concluded that women have continued to compose the majority of degrees traditionally considered feminine. This was observed through an analysis of the 20 degrees with the greater number of students in 2017, which made up for 5.432.301 under graduation admissions. These include Nutrition, Pedagogy, Psychology, Nursing, Language Studies and Social Service. Meanwhile, the more prestigious scientific careers such as Physics, Mathematics, Computational Science and Engineering have remained male dominated fields.

By interviewing both male and female professors, Lima (2013) sought to understand how they perceive the insertion of women in Computational Science. Lima (2013) observed that, for the interviewed professors, the high rates of female evasion from the field are related to discrimination from their male peers and to difficulties with the calculus based classes. According to the interviewees, since this usually happens in the beginning of the course, it is a difficult hurdle to overcome, leading to evasion. The results from the interviews also show that there are many different types of subtle discrimination and segregation, which are imposed to the women who study or work in these fields, which requires additional effort so they can reach the same level of recognition as men.

The evasion of students admitted through the quotas policies imposes negative repercussions over the whole system, since the abandoned spots are offered to the general

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population. However, some studies show that the evasion rate of students admitted through the quotas policies was inferior to the evasion rate of students who entered university through the general admissions (Souza, 2019; Silva; Xavier; Costa, 2020).

2.2 THE ORIGINS OF AND CONCEPTIONS ON INTERSECTIONALITY

The origins of Intersectionality can be traced back to the end of the 1970s, to the black feminism movement, in its pursuit to meet needs that the white, middle class and heteronormative feminism movement could not meet (Hirata, 2014). According to Kyrillos (2020), intersectionality relates to the social struggles and theoretical formulations of black women, who state that it is not possible to understand gender in an isolated context, apart from the concepts of race and class.

The feminist movement, especially the strand that aims at reimaging the different categories of women (black, indigenous, Latin-American and women of color or non-white, amongst others) under the spectrum of intersectionality, restructures the foundations for the understanding of different aspects and distortions that must be taken into account (Berth, 2019).

According to Hirata (2014), Crenshaw was one of the pioneers in the critical race theory in the United States between the 1980s and 1990s, followed by British, North American and German researchers. The term is presented by Crenshaw to designate the interdependence of power relations between race, gender and class. In this manner, intersectionality is set forth as one of the ways to challenge many types of oppression that overlap.

Crenshaw (2002, p. 117) believes that intersectionality “is a conceptualization of the problem that tries to capture the structural and dynamic consequences of the interaction between two or more subordinate axles”. The same author also states that this concept deals with the ways that racism, the patriarchy, class oppression and other discriminatory devices develop inequalities and structure society according to gender, race/ethnicity and class, amongst others, In this manner, these systems overlap and cross, making up one category of structural intersectionality.

Critical analysis of the concept of gender coincide with internal claims from the feminist movement, contemplating the different claims from black women, women from developing countries and feminist lesbians. Some authors who were involved in these reformulations of the concept of gender have stated the importance of also considering class and race but, in

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their majority, have continued to emphasize the gender category (Haraway, 1991; Piscitelli, 2008).

According to Hirata (2018), while Crenshaw has emphasized the intersection of race and gender, marginally mentioning class or sexuality, the idea of articulating the social relations of gender and class was proposed in France in the late 1970s by Kergoat (1978). This author argues that intersectionality theorists think in terms of categories instead of social relations, highlighting one category or another without historically contextualizing them or taking into consideration the material dimensions of dominance. Kergoat (1978) affirms that intersectional analysis highlights gender and race to a larger extent than social class.

Intersectionality is born from the synergy between critical research and critical practices, resulting in a synthesis of social movements and critical academic knowledge. The authors aim at understanding intersectionality as an emancipatory policy, taking into consideration both its theoretical and practical aspects and highlighting the importance of the term in other spheres such as the internet, especially in that which pertains to social media (Collins;Bilge, 2016).

According to Bilge (2009), the intersectional approach goes beyond acknowledging the pluralism of the oppressive systems that operate through the sex and gender, class, race and ethnicity, age, disability and sexual orientation, defending that these determiners interact in the development and propagation of social inequalities. As a result, the greater use of intersectionality in the field of gender studies has been shown to be of great importance for the better understanding of the many kinds of inequality relations (Kyrillos, 2020).

Prins (2006) and Piscitelli (2008) have pointed out different perspectives on intersectionality. The systemic or structural approach, originated in the United States, focusing on the effects of the system over the identity construction (Crenshaw, 1991; Collins, 1991, 1998). The other approach is supported by the constructionism (Mcclintock, 1995; Brah; Phoenix, 2004; Brah, 2007), especially in the United Kingdom, emphasizing the power relations and agency aspects and social identity.

In the context of the systemic or structural approach, Crenshaw (2002) argues that intersectionalities make it possible to visualize the consequences of the interaction between different forms of subordination, such as sexism, racism and patriarchy. “This notion of 'interaction' between forms of subordination would make it possible to overcome the notion of superposition of oppressions” (Piscitelli, 2008, p.267).

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While in the constructionist approach, identity markers such as gender, class or race are not considered only as modes of categorization, as they provide resources that enable the action of subjects. This approach offers distinctions between categories of differentiation and systems of discrimination, between difference and inequality, questioning the attempt to merge race and racism, considering that in this process there would be a fixed understanding of the meaning of the category race, just as racism would be. understood as a single system (Piscitelli, 2008).

The concept is also related to how actions and policies produce oppression, instituting disempowerment and constituting what Crenshaw (2002) calls political intersectionality. In this context, the researcher warns that intersectional subordination is regularly obscured because it affects those who are marginal, even in already subordinate groups, and existing models do not consistently assume this type of discrimination.

Furthermore, for Henning (2015), intersectionality should not be understood only in its effects of producing inequalities, but also from the social practices derived from the conjunctural interaction of social markers of difference.

The idea of intersectionality seeks to offer analytical tools to understand the articulation between multiple differences and inequalities. Its theoretical contributions can be organized in three aspects. The first one states that intersectionality challenges the hegemonic model that considers the category of women as a universal concept. The second aspect is that gender, race and class, within their respective classification, operate on multiple levels of life in society and, therefore, intersectionality does not regard only individual identities, such as the material relations of inequality. Lastly, the production of knowledge must consider social positions and classifications in a relational manner, not reducing the investigated individual's experiences to only one category. These aspects are observed in studies that relate the issue of the sexual division of work with aspects such as race, class and gender (Magliano, 2015; Machado, Costa;Dutra, 2018).

In Brazil, one of black feminism's main contributions was to question the universal view of women, in which the mainstream feminism was grounded (Kyrillos, 2020). Some of the pioneers in Brazilian intersectionality studies were Lélia Gonzalez, Beatriz Nascimento and Sueli Carneiro.

Since the 1980s, Gonzalez (2019) has approached the myth of racial democracy in Brazil and the fact that the place the subject is at determines its interpretation over the double

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phenomena of racism and sexism. The author states that this articulation produces violent effects, especially over black women.

Also starting the 1980s, Carneiro (2019) unveils the implications of sexism and racism in the social exclusion and marginalization processes, shining a light on the black feminist perspective and its specificities, which until then were barely contemplated in feminist studies. On the other hand, Nascimento (2019), still in the late 1970s, approaches the Brazilian societal structures and its consequences to the allocation of roles in the job market in that which pertains to women, emphasizing the roles attributed to black women. The author addresses the slavery inherited social dominance structure that continues to be socially propagated to produce inequalities, in spite of improvements in the educational sphere.

Recently, also in Brazil, Akotirene (2019) points out the erasure process of the African centered paradigm that happens when the expression intersectional feminism is addressed without mention to its original ties to black feminism, a kind of epistemicide and epistemic racism.

According to Kimberlé Crenshaw, Audre Lorde, Sueli Carneiro, amongst others, there is no hierarchy of oppressions. What does exist is a perspective from an intersectional point of view, striving to identify how they relate to each other and how their effects over a specific group can be layered, added and potencialized (Berth, 2019).

It is important to highlight that Hirata (2014), Brazilian philosopher born in Japan and researcher in France, starts from the work done by Haraway (1988), Harding (1991) and Lowy (2002) and tackles the relations between work and gender through an inseparable approach between sex, race and class.

3 METHODOLOGY

This study used a comparative analysis of data provided by computational algorithms, based on informational data of women in Computation and Engineering courses at Federal University of Espírito Santo, in Brazil, from 2009 to 2018. The analyzed courses from the referenced fields were Computational Science, Environmental Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Computational Engineering and Product Engineering. The comparative analysis was conducted alongside an intersectional analysis that took into consideration gender, age group, ethnicity and if the student had been admitted or not through the quotas system. It is important to reiterate that the quotas system aims at providing support for students who have studied though the

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entirety of high school in public schools, with university spots being preemptively secured for those who come from low-income families, for black students and others.

The data set used for this research was collected from the university's academic system, through the software *Orange Datamining*, which can be freely used and possesses advanced statistical resources. During the data's pre-processing stage, there were 1005 data points. To avoid duplicity and perfect the analysis quality, the data points that indicated the reason for the student's evasion was attributed to data input errors, annulled enrolment or due to the student's choice to change degrees were disconsidered, resulting in the selection of 985 data points (Table1). To classify the data points according to age group, the difference between the birth date and the date the student enrolled at university was calculated. In that which pertains to the quotas system, the different types of quotas were not considered and, therefore, each data point was simply considered as having being admitted or not through the quotas system. The same was done in regards to the egress students, who were considered simply as having evaded from the course or not.

Table 1

Type of data and annual numbers of women in exact sciences and engineering at the Federal University of Espírito Santo

Class	Value	Quantity per year of entry									
		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ethnicity	Yellow	0	1	1	2	0	0	0	0	0	1
	White	67	49	59	64	60	59	59	57	56	77
	Brown	23	26	27	26	33	34	30	24	30	43
	Black	6	4	6	4	3	6	5	4	4	7
	Not informed	2	3	2	2	1	2	2	3	4	5
Quota type	Students participating affirmative policies	18	38	34	35	37	51	45	45	44	47
	Non-participating students affirmative policies	80	45	61	63	60	50	51	43	51	87

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Age group	17-24 years	91	80	86	95	94	98	92	85	92	129
	25-34 years	6	3	8	3	2	3	4	3	2	5
	35-44 years	1	0	1	0	1	0	0	0	1	0
Egress	Evasion	25	20	17	19	16	18	9	6	13	20
	No evasion	73	63	78	79	81	83	87	82	82	114

Source: Own authorship from data extracted from the academic system of UFES.

After the data selection and initial processing, two computational analysis processes were set in place. In the first one, the goal was to profile the female evasion, according to course, in the yearly periods through percentage calculations. This information was useful to compare the different evasion rates in the computation and engineering fields, as well as other factors and classes, besides evidencing relevant phenomenon and characteristics.

The second process involved the calculation of the *information gain ratio* for ethnicity (according to the labels provided by the university), type of quota chosen and age group (Han; Pei; Kamber, 2011).

The rate is calculated by the concept of entropy, as a measure of disorder, impurity, or randomness in the data points. The information gain value is applied to quantify which feature provides maximum information about the classification, based on the notion of entropy. The logarithmic formula is applied from the product of the probabilities of each class in the tree. The information gain rate is a ratio between the information gain and the intrinsic information. This value can be used as a comparison of classes, even before the application of machine learning and classification algorithms.

4 RESULT ANALYSIS

In order to investigate the aspects that factor into the evasion rate of Computation and Engineering courses, the total number and percentages of all enrolled women by year (Table 2), as well as those belonging to specific categories, were calculated (Table 3). The data referring to women who were not a part of the quotas system as well as of the ones who were and of the ones who identified as black and the ones who identified as belonging to other ethnicities was used to analyze matters related to race and affirmative actions (Table 4). Meanwhile, to analyze the issues and youth and ageism, as well as family dynamics and job market, the total number and percentages of all enrolled women were also calculated pertaining to women who were younger than 25 years old and the ones older than 25 years old (Table 5). The information gain and order of relevance for each class of data was grouped

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by course to demonstrate the similarities and differences between both areas in regards to evasion (Table 6).

Table 2

Totals and annual percentages of dropout of women in exact sciences and engineering at the Federal University of Espírito Santo

1 - Computer science; 2 - Environmental Eng.; 3 - Civil Eng.; 4 - Electrical Eng.; 5 - Mechanical Eng.; 6 - Computer Engineer; 7 - Production Eng..												
2009		2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	
1	2/4	½	4/7	3/6	1/2	2/2	1/2	3/6	1/2	2/12	20/45	44,4%
2	1/17	3/10	4/19	2/15	2/16	1/12	3/13	0/10	2/7	3/12	21/131	16,0%
3	8/42	4/34	1/27	1/30	4/32	1/33	2/39	0/39	1/30	4/44	26/350	7,4%
4	5/14	4/12	4/19	4/17	5/19	6/23	1/15	0/7	2/13	1/14	32/153	20,9%
5	4/13	3/14	4/10	3/14	3/11	5/17	1/11	2/11	3/14	3/20	31/135	23,0%
6	2/2	5/5	0/3	4/7	1/3	3/6	1/5	1/5	1/4	1/4	19/44	43,2%
7	3/6	0/6	0/10	2/9	0/14	0/8	0/11	0/10	3/25	6/28	14/127	11,0%

Source: Own authorship from data extracted from the academic system of UFES.

Table 3

Totals and annual percentages of dropout of female quota holders in exact sciences and engineering at the Federal University of Espírito Santo

1 - Computer science; 2 - Environmental Eng.; 3 - Civil Eng.; 4 - Electrical Eng.; 5 - Mechanical Eng.; 6 - Computer Engineer; 7 - Production Eng..													
Students participating affirmative policies		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	
1	Yes	-	-	1/1	0/1	-	1/1	-	2/2	0/1	1/1	5/7	71,4%
	No	2/4	1/2	3/6	3/5	1/2	1/1	1/2	1/4	1/1	1/11	15/38	39,5%
2	Yes	0/2	2/6	1/6	0/3	0/2	1/6	2/5	0/6	0/3	1/3	7/42	16,7%
	No	1/15	1/4	3/13	2/12	2/14	0/6	1/8	0/4	2/4	2/9	14/89	15,7%
3	Yes	1/5	2/15	0/13	0/11	2/15	0/16	0/13	0/22	0/12	3/20	8/142	5,6%
	No	7/37	2/19	1/14	1/19	2/17	1/17	2/26	0/17	1/18	1/24	18/208	8,7%
4	Yes	2/5	3/7	2/4	3/10	4/11	2/10	1/11	0/4	1/6	1/5	19/73	26,0%
	No	3/9	1/5	2/15	1/7	1/8	4/13	0/4	0/3	1/7	0/9	13/80	16,3%
5	Yes	2/5	3/6	2/5	0/3	2/5	3/10	0/6	0/5	2/7	0/8	14/60	23,3%
	No	2/8	0/8	2/5	3/11	1/6	2/7	1/5	2/6	1/7	3/12	17/75	22,7%

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6	Yes	1/1	3/3	0/1	2/2	1/1	2/3	1/3	0/2	1/3	1/2	12/21	57,1%
	No	1/1	2/2	0/2	2/5	0/2	1/3	0/2	1/3	0/1	0/2	7/23	30,4%
7	Yes	-	0/1	0/4	2/5	0/3	0/5	0/7	0/4	1/12	2/8	5/49	10,2%
	No	3/6	0/5	0/6	0/4	0/11	0/3	0/4	0/6	2/13	4/20	9/78	11,5%

Source: Own authorship from data extracted from the academic system of UFES.

Table 4

Totals and annual percentages of dropout of black women in exact sciences and engineering at the Federal University of Espírito Santo

1 - Computer science; 2 - Environmental Eng.; 3 - Civil Eng.; 4 - Electrical Eng.; 5 - Mechanical Eng.; 6 - Computer Engineer; 7 - Production Eng..												
Black ethnicity		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	
1	Yes	-	-	1/1	-	-	1/1	-	-	-	1/1	3/3	100%
	No	2/4	1/2	3/6	3/6	1/2	1/1	1/2	3/6	1/2	111	17/42	40,5%
2	Yes	0/1	-	1/2	1/2	-	0/1	-	-	-	-	2/6	33,3%
	No	1/16	3/10	3/17	1/13	2/16	1/11	3/13	0/10	2/7	3/12	19/125	15,2%
3	Yes	1/3	-	0/1	0/1	0/1	-	0/1	0/3	0/2	0/4	1/16	6,3%
	No	7/39	4/34	1/26	1/29	4/31	1/33	2/38	0/36	1/28	4/40	25/334	7,5%
4	Yes	1/1	0/1	-	-	0/1	0/2	0/1	0/1	0/1	-	1/8	12,5%
	No	5/13	3/11	4/19	4/17	5/18	6/21	1/14	0/6	2/12	1/14	31/145	21,4%
5	Yes	1/1	1/1	1/2	-	-	1/1	-	-	-	0/1	4/6	66,7%
	No	3/12	2/13	3/8	3/14	3/11	4/16	1/11	2/11	3/14	3/19	27/129	20,9%
6	Yes	-	2/2	-	-	-	-	-	-	-	-	2/2	100%
	No	2/2	3/3	0/3	4/7	1/3	3/6	1/5	1/5	1/4	1/4	17/42	40,5%
7	Yes	-	-	-	1/1	0/1	0/1	0/3	-	0/1	0/1	1/8	12,5%
	No	3/6	0/6	0/10	1/8	0/13	0/7	0/8	0/10	3/24	6/27	13/119	10,9%

Source: Own authorship from data extracted from the academic system of UFES.

Table 5

Totals and annual percentages of dropout of women over 25 years of age in exact sciences and engineering at the Federal University of Espírito Santo

1 - Computer science; 2 - Environmental Eng.; 3 - Civil Eng.; 4 - Electrical Eng.; 5 - Mechanical Eng.; 6 - Computer Engineer; 7 - Production Eng..												
Over 25		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	
1	No	1/3	1/2	4/5	3/6	1/2	1/1	1/2	3/5	1/2	2/12	18/40	45,0%
	Yes	1/1	-	0/2	-	-	1/1	-	0/1	-	-	2/5	40,0%

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2	No	1/16	3/10	2/16	2/15	2/16	1/12	3/13	0/10	2/7	3/11	19/126	15,1%
	Yes	0/1	-	2/3	-	-	-	-	-	-	0/1	2/5	40,0%
3	No	7/39	4/33	0/24	1/30	3/31	1/33	1/37	0/39	0/27	4/44	21/337	6,2%
	Yes	1/3	0/1	1/3	-	1/1	-	1/2	-	1/3	-	5/13	38,5%
4	No	4/13	3/10	4/18	4/17	5/19	6/22	1/14	0/6	2/13	1/13	30/145	20,7%
	Yes	1/1	1/2	0/1	-	-	0/1	0/1	0/1	-	0/1	2/8	25,0%
5	No	4/13	3/14	4/10	1/11	1/9	4/16	1/10	2/11	3/14	3/19	26/127	20,5%
	Yes	-	-	-	2/3	2/2	1/1	0/1	-	-	0/1	5/8	62,5%
6	No	2/2	5/5	0/3	4/7	1/3	3/6	1/5	1/5	1/4	1/4	19/44	43,2%
	Yes	-	-	-	-	-	-	-	-	-	-	-	-
7	No	2/5	0/6	0/10	2/9	0/14	0/8	0/11	0/9	3/25	5/26	12/123	9,8%
	Yes	1/1	-	-	-	-	-	-	0/1	-	1/2	2/4	50,0%

Source: Own authorship from data extracted from the academic system of UFES.

Table 6

Information gain rate of ethnicity, quota and age groups regarding the dropout of women in exact sciences and engineering at the Federal University of Espírito Santo

All courses		Computer science		Environmental Eng.		Civil Eng.	
Age group	0,043	Ethnicity	0,083	Age group	0,061	Age group	0,088
Ethnicity	0,003	Students participating affirmative policies	0,063	Ethnicity	0,015	Ethnicity	0,005
Students participating affirmative policies	0,001	Age group	0,001	Students participating affirmative policies	0,000	Students participating affirmative policies	0,002
Electrical Eng.		Computer Engineer		Mechanical Eng.		Production Eng.	
Ethnicity	0,011	Ethnicity	0,073	Age group	0,107	Age group	0,111
Students participating affirmative policies	0,010	Students participating affirmative policies	0,053	Ethnicity	0,033	Ethnicity	0,061

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Age group	0,001	Age group	0,000	Students participating affirmative policies	0,000	Students participating affirmative policies	0,000

Source: Own authorship from data extracted from the academic system of UFES.

Through an analysis of the obtained results, from 2009 to 2018, it was possible to profile the women who enrolled in the Computation and Engineering courses at Federal University of Espírito Santo as predominantly identifying as white or brown. The majority was less than 24 years old at enrollment, 40% were admitted through the quotas system and 16.54% evaded from the course. Some important points must be highlighted, however, in order to list arguments and hypothesis regarding the characteristics that influence the profile of the evaded student and the respective profile for each area of study.

The age group is the data component, amongst all the studied aspects, that better discriminates in regards to female evasion. As observed, women above the age of 25 years old at enrollment have an average evasion rate of 41.86% while women who were younger than 24 at enrollment had a 15.39% chance of evasion. On the other hand, the absolute number of women over 25 years old at enrollment represents only 4.55% of the total number of enrolled students. Even though it is expected that a young adult demographic will predominantly compose an under-grad course, this data shows that women experience difficulties regarding gaining entrance to and graduating from technology courses. It is also possible to observe that these difficulties increase along with their age, probably due to conflicts with marriage and childbearing and rearing, although the difficulties they face in the job market might also influence their academic and professional lives.

A study conducted by Saccaro, França and Jacinto (2019), however, shows that women tend to be more resilient in their pursuit for higher education, taking longer to evade than men. On the other hand, gender and maternity are status related characteristics, which might be tied to different perceptions and addresses from potential employers (Muniz & Veneroso, 2019), which is when stereotypes and gender prejudice need to be taken into account.

The Computation and Engineering courses have the worst average number of enrolled women, with respective 4.5 and 4.4 yearly enrollments and 44.4% and 43.2% evasion rates. When applying this data to the ones from the Civil Engineering course, for example, it represent an average enrollment rate 7 times smaller and evasion rate 6 times greater than

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that of male students, reinforcing the results from Saccaro, França and Jacinto's (2019) study, which points out the high evasion rate in the mentioned courses.

The results observed in this study demonstrate that both the Computation and Engineering fields have continued to be predominantly male dominated (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2019). Amongst many aspects that lead to this occurrence, it can be mentioned that there very few governmental initiatives that favor women in these areas in Brasil (Barreto, 2015).

In regards to the number of female students who identify as black that have enrolled in the Computation courses, there have only been five students in the decade long period reviewed by this study, with a 100% evasion rate. Furthermore, even though the other reviewed courses have a slightly higher rate for this demographic, the numbers are still low. Therefore, it is possible to observe that the quotas system put in place in recent years has not been enough to attract these students and address the racial issues in the academic field.

Thus, it is possible to affirm that women of color, whose sum equals the number of women who identify as black, can be found in even smaller numbers in these courses, which are, often, considered prestigious. Other actions need to be taken, such as affirmative policies and actions in partnership with basic educational institutions.

These conclusions demonstrate the importance of intersectionality in the data analysis, when considering that it allows us to contemplate the consequences of different types of subordination interacting, such as racism and sexism (Crenshaw, 1991; 2002). This allows us to comprehend the many different inequality relations (Kyrillos, 2020).

In relation to indigenous women, they were not taken into account for the study.

The evasion percentage of students who are admitted through the quotas system is higher than that of students who are admitted without it in almost all the analyzed courses. The only exceptions are the Civil and Product Engineering courses, which have below average evasion rates. However, as the number of students from the quotas system in a course increases, the general evasion rate for the course decreases. Thus, we conclude that, according to this case study, the quotas policies factor towards the decrease of evasion rates at university.

Henceforth, it is arguable that, in courses that have effective policies, female students' engagement and commitment increases, presumably due to an improvement to the feeling of belonging to the course, the increased cooperation between peers and the strengthening

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of relationships as well as the adverse conditions for sexist and discriminatory practices, which are determinant factors for insufficient results and dropout.

In the same manner as Silva, Xavier and Costa (2020), it is concluded here that, beyond the limitations of a case study, the results provided by the present study have weakened the arguments against the quotas system. Arguments that are founded merely on the hypothesis that there is a decrease in the course quality or high evasion rate of students who made use of the system to enroll in university. On the other hand, in spite of the changes that have taken place over the recent decades, there are still differences in the science, technology and engineering fields (Charlesworth & Banaji, 2019).

5 CONCLUSIONS

The Conclusions section synthesizes the main findings and implications of the study on female dropout in Computing and Engineering programs at the Federal University of Espírito Santo. It highlights that intersectionality—encompassing gender, race, age, and admission type—is an essential analytical tool for understanding the structural inequalities that shape women's educational trajectories.

The study confirms that older women and those in Computing courses face the highest barriers to persistence, while effective affirmative action policies can serve as mechanisms to mitigate these disparities.

Finally, the section emphasizes the need for broader societal and institutional reforms to ensure equitable access and retention for women, especially Black, Indigenous, and other women of color, and recommends expanding future research to include additional socioeconomic and geographical dimensions.

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